Public Utility Commission of Texas

Volume 1. Statewide Energy Efficiency Portfolio Report Program Year 2018

TETRA TECH

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EM&V team primary report contributors include:

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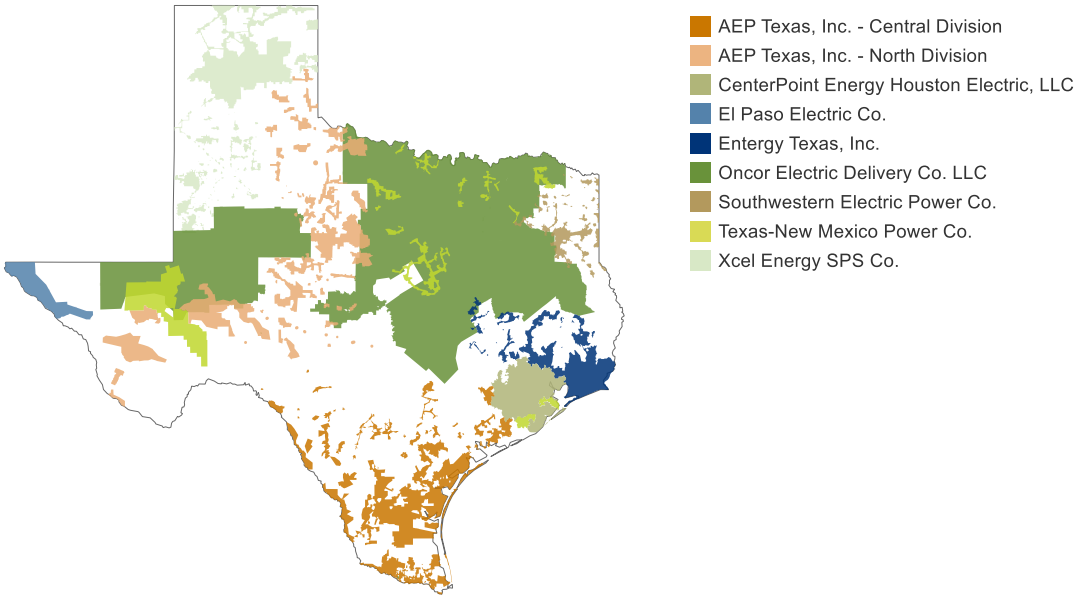
ACRONYMS AND ABBREVIATIONS

AEP TCC	American Electric Power Texas Central Division
AEP TNC	American Electric Power Texas North Division
C&I	Commercial and Industrial
CATI	Computer-assisted Telephone Interview
CNP	CenterPoint Energy Houston Electric, LLC
CSOP	Commercial Standard Offer Program
DI	Direct Install
EEIP	Energy Efficiency Implementation Project
EEPR	Energy Efficiency Plan and Report
EESP	Energy Efficiency Service Provider
EM&V	Evaluation, Measurement, and Verification
Entergy	Entergy Texas, Inc.
EPE	El Paso Electric Company
HEEP	Healthcare Energy Efficiency Program
HPwES	Home Performance with ENERGY STAR®
HTR	Hard-to-Reach
kW	Kilowatt
kWh	Kilowatt Hour
LI	Low-income
LM	Load Management
M&V	Measurement and Verification
mcf	1,000 cubic feet
MTP	Market Transformation Program
NTG	Net-to-Gross
PUCT	Public Utility Commission of Texas
PV	Photovoltaic
PY	Program Year
QA/QC	Quality Assurance/Quality Control
RFP	Request for Proposals
RSOP	Residential Standard Offer Program
SOP	Standard Offer Program
SWEPCO	Southwestern Electric Power Company
TEESI	Texas Energy Engineering Services, Inc.
TNMP	Texas New Mexico Power Company
TRM	Technical Reference Manual

1.0 EXECUTIVE SUMMARY

The Public Utility Commission of Texas (PUCT) oversees the energy efficiency programs delivered by the state's investor-owned electric utilities: AEP Texas, Inc. [1] (AEP Texas), CenterPoint Energy Houston Electric, LLC (CenterPoint), Entergy Texas, LLC (Entergy), El Paso Electric Company (El Paso Electric), Oncor Electric Delivery LLC (Oncor), Southwestern Electric Power Company (SWEPCO), Xcel Energy Southwestern Public Service Company (Xcel SPS), and Texas New Mexico Power Company (TNMP). The utilities' service territories are shown in Figure 1-1.

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



The Texas electric utilities administer a variety of programs that improve the energy efficiency of residential and commercial customers' homes and businesses. Standard offer programs (SOPs) develop the infrastructure of trade allies (e.g., contractors, distributors) and provide financial incentives to deliver higher efficiency products and services. Utilities select implementation firms to run market transformation programs (MTPs). MTPs provide additional outreach, technical assistance, and education to customers in harder-to-reach markets (e.g., small business, health care, schools, and local governments) and for select technologies (e.g., 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. The utilities that are part of the Electric Reliability Council of Texas (ERCOT) also offer targeted low-income (LI) programs that coordinate with the existing federal weatherization program. Finally, the utilities manage load management programs, which are designed to reduce peak demand when needed.

[1] The PUCT approved the application AEP Texas Central Company (AEP TCC), AEP Texas North Company (AEP TNC), and AEP Utilities Inc. to merge AEP TCC and AEP TNC into AEP Utilities, and then rename that corporate entity AEP Texas Inc. AEP Texas is reporting energy efficiency programs by the legacy AEP TCC and AEP TNC territories, which are now referred to as AEP Texas Central Division and AEP Texas North Division.

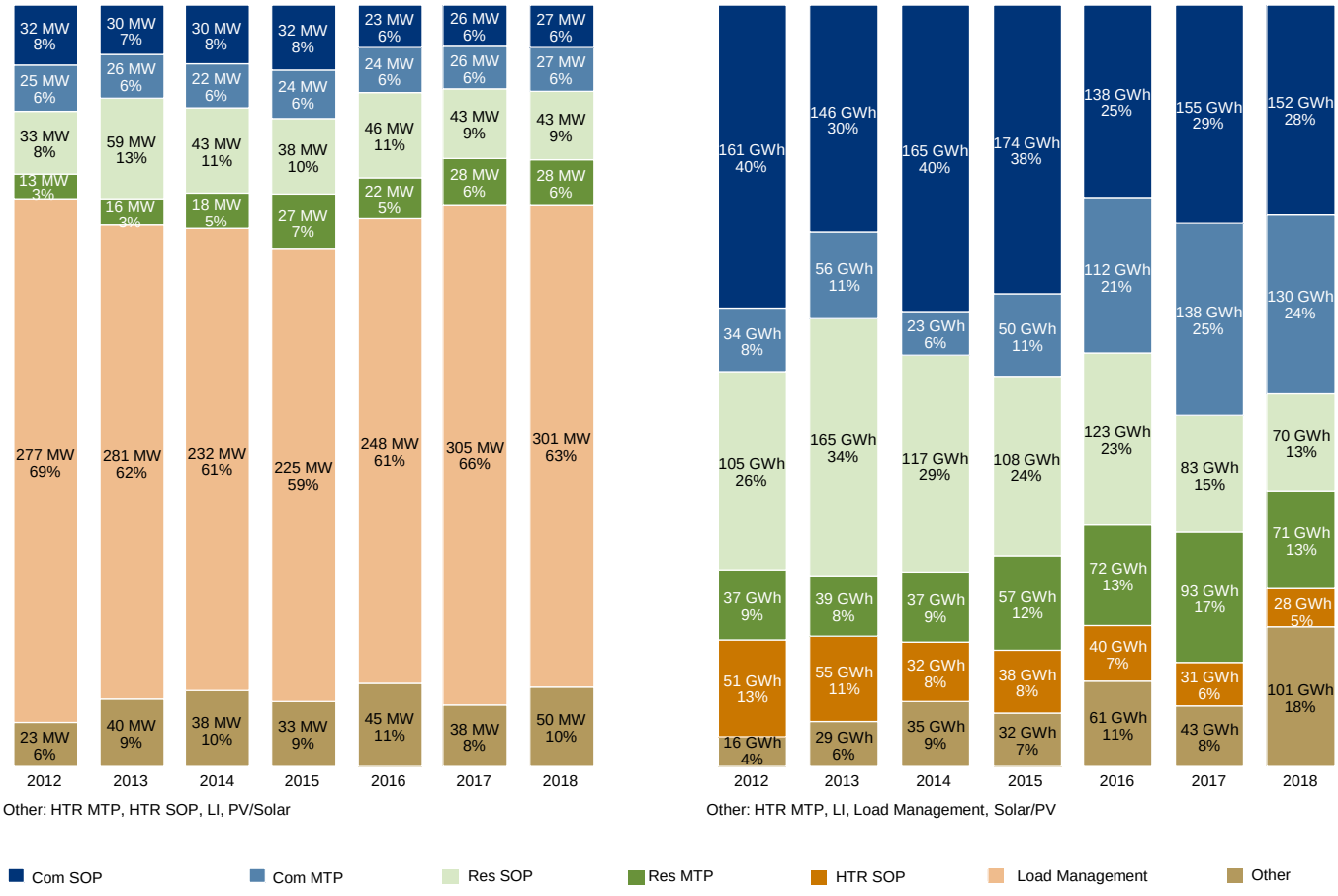
1.1 PY2018 ENERGY EFFICIENCY SUMMARY RESULTS

In program year (PY) 2018, the Texas electric utilities achieved statewide demand reductions of 475,752 kilowatts (kW) at a lifetime savings cost of $19.99 per kW[2]. The utilities achieved statewide energy savings of 577,804,709 kilowatt-hours (kWh) at a lifetime savings cost of $0.009 per kWh.

1.1.1 Savings

As shown in Figure 1-2, load management programs continue to account for more than 60 percent of the statewide gross demand reduction (MW). Commercial SOPs and MTPs continue to account for the largest percentage of statewide energy savings, 28 percent and 24 percent respectively. PY2018 has seen a larger percentage of statewide savings coming from Midstream programs (included in "other") and less from Residential SOP and MTPs.

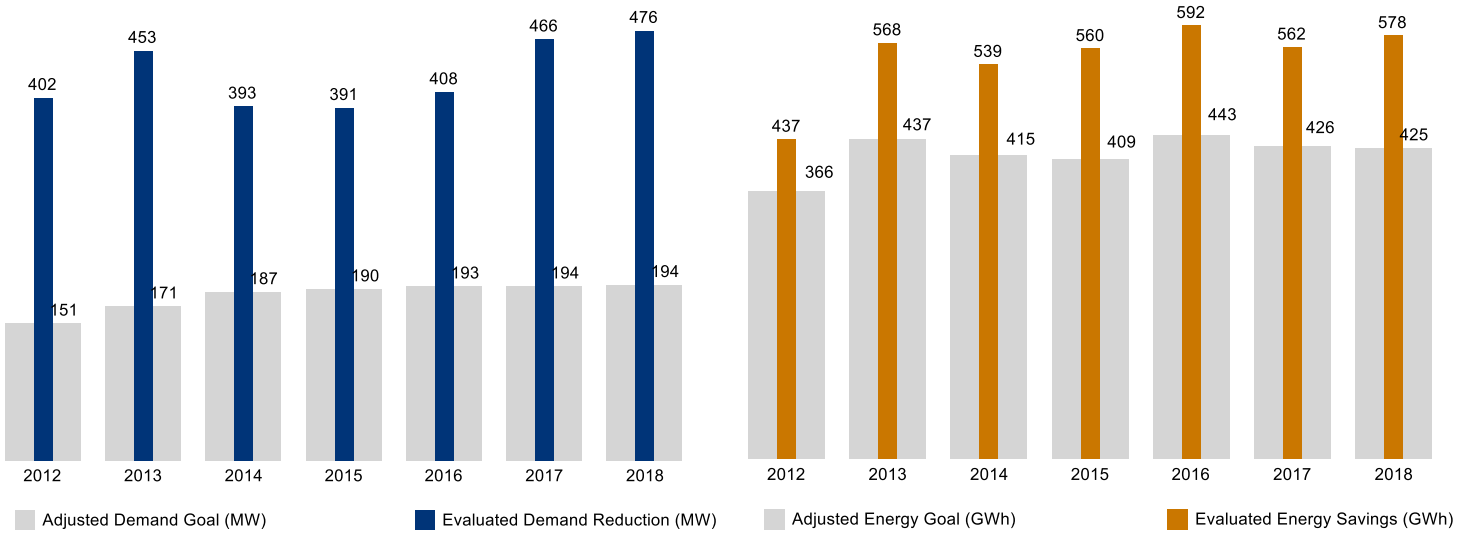
Figure 1-2. Evaluated Gross Demand Reduction and Energy Savings by Program Type (PY2012 - 2018



As shown in Figure 1-3, statewide, the utilities continue to significantly exceed demand reduction goals in large part due to the load management programs. The utilities also are consistently exceeding energy savings goals.

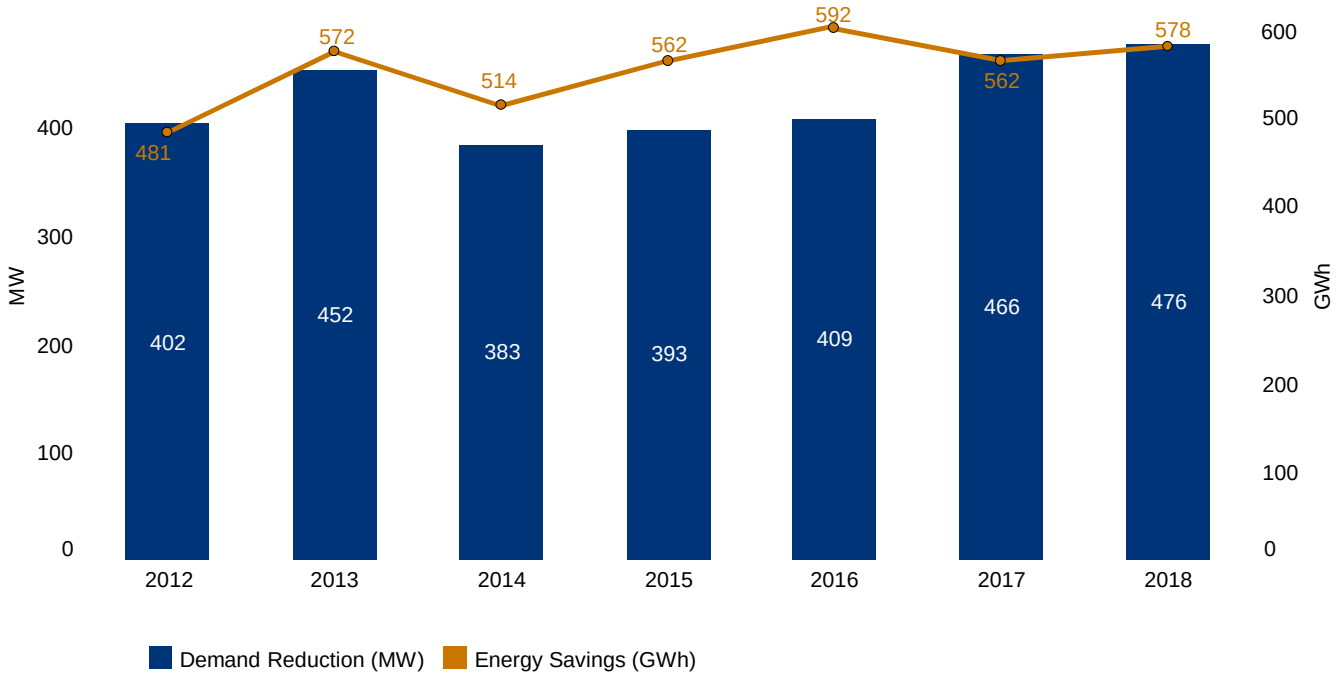
[2] Excluding load management programs, the lifetime savings cost is $18.21 per kW.

Figure 1-3. PY2012–2018 Legislated Goals and Actual Demand Reduction and Energy Savings



As indicated in Figure 1-4, PY2018 achieved the highest demand reductions to-date. Evaluated gross energy savings were 577,804,709 kWh, which was a slight increase from PY2017 but still slightly below the highest savings of 592 GWh in PY2016.

Figure 1-4. Total Statewide Portfolio: Evaluated Gross Demand Reduction and Energy Savings by Program Year



Energy savings and demand reductions from the energy efficiency programs persist beyond the program year they are installed based on the type of energy efficiency improvement made and how long it typically lasts. The cumulative savings the utilities have achieved since PY2012 are shown in Figure 1-5 (demand reduction) and Figure 1-6 (energy savings). Half of the demand reductions and energy savings achieved to-date are expected to continue through 2030.

Figure 1-5. PY2012—PY2048 Lifecycle Demand Reduction by Sector (MW)

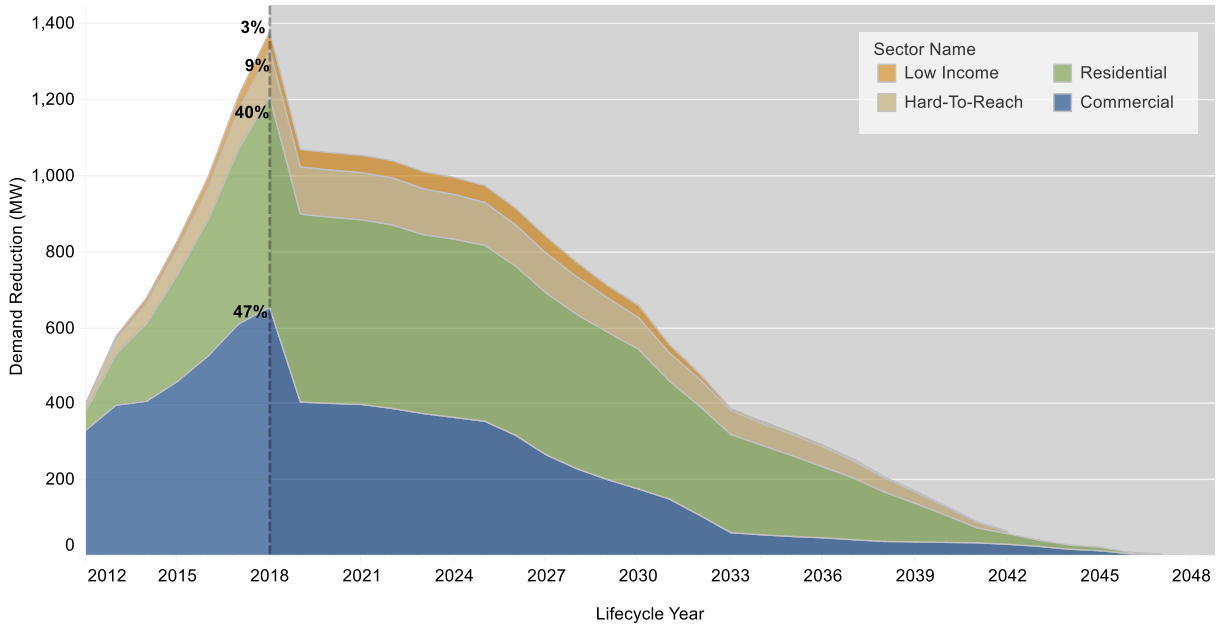


Figure 1-6. PY2012—PY2048 Lifecycle Energy Savings by Sector (GWh)

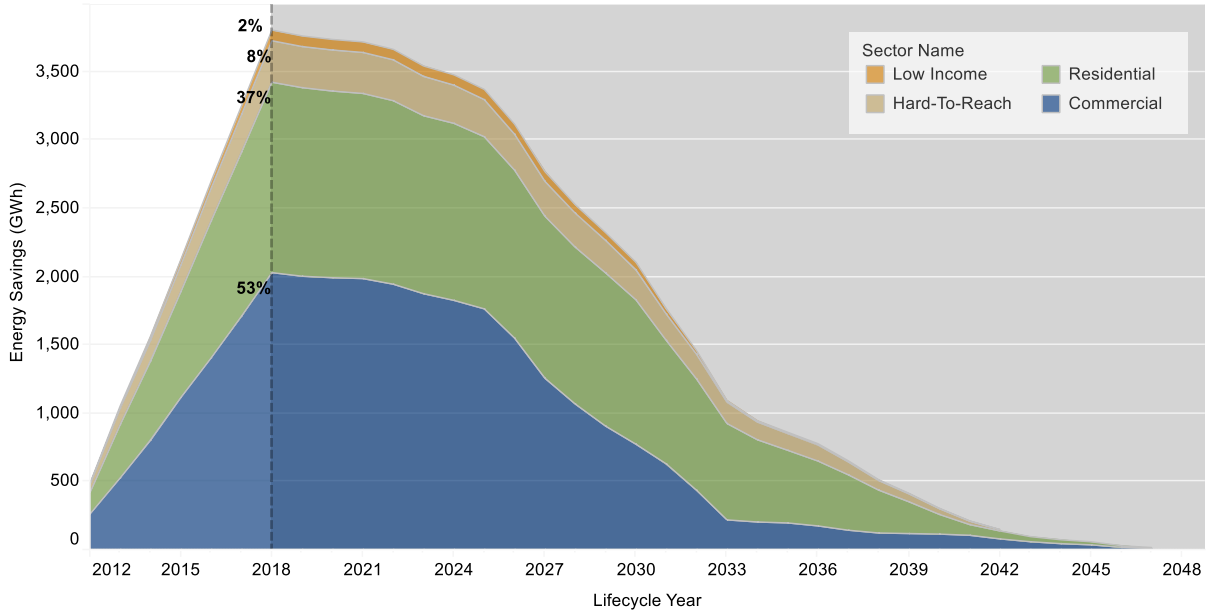
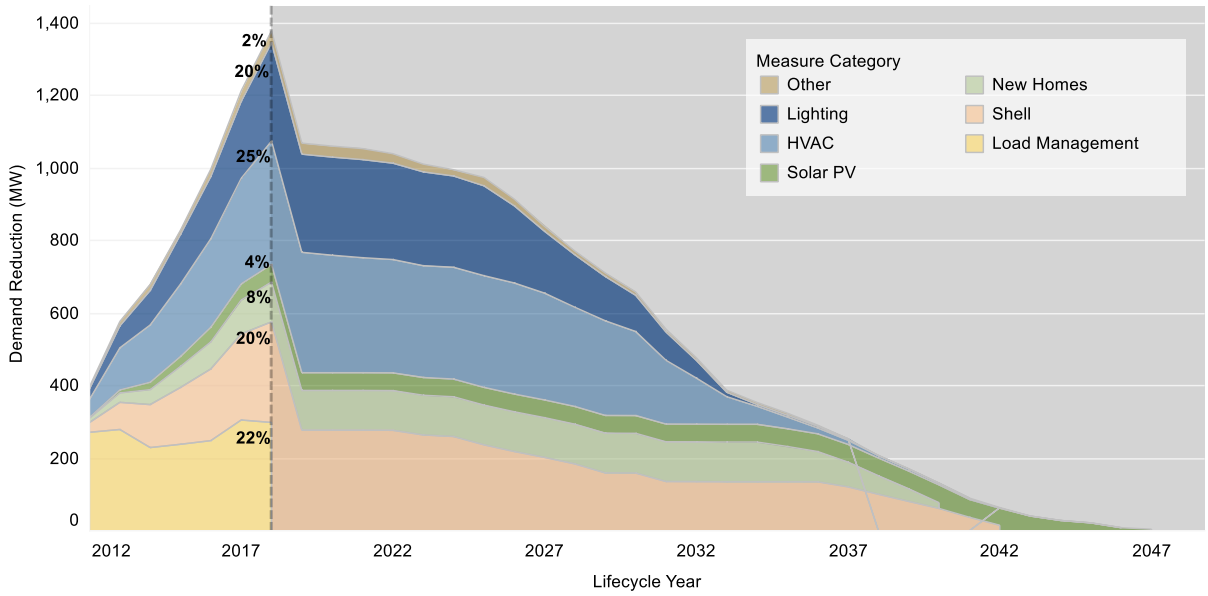


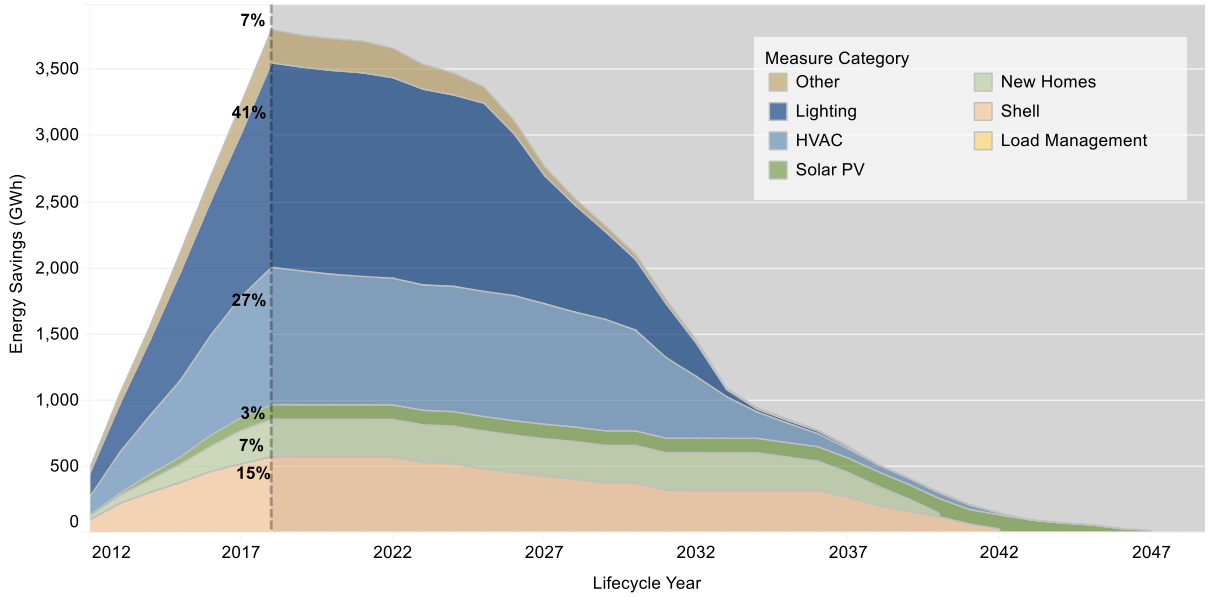
Figure 1-7 and Figure 1-8 show the types of measures the programs installed and how they contribute to lifecycle savings. Lighting, HVAC and building shell improvements are delivering the most savings over time.

Figure 1-7. PY2012–2046 Lifecycle Demand Reduction by Measure Category (MW)



Other: AC/HP Tune Up, Appliance, Behavior, Custom M&V, Food Service, Motors, Refrigeration, Roofing, Water Heat, Whole Building, Windows.

Figure 1-8. PY2012–2046 Lifecycle Energy Savings by Measure Category (GWh)



Other: AC/HP Tune Up, Appliance, Behavior, Custom M&V, Food Service, Motors, Refrigeration, Roofing, Water Heat, Whole Building, Windows.

1.2 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 an EM&V team through the Request for Proposals (RFP) 473-17-00002, Project No. 46302. This team is led by Tetra Tech and includes Texas Energy Engineering Services, Inc. (TEESI) (hereafter, "the EM&V team").

Independent EM&V was conducted for Texas electric utilities' PY2018 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[3]
- Provide feedback to the PUCT, utilities, and other stakeholders on program portfolio performance
- Prepare and maintain a statewide Technical Reference Manual (TRM).[4]

This Statewide Energy Efficiency Report presents the PY2018 EM&V findings and recommendations looking across all nine 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 updates to the TRM.

The PUCT's EM&V independently verifies claimed savings across all programs through program tracking data that is received from the utilities. Additional EM&V activities (engineering desk reviews, on-site M&V, interval meter data analysis, participant surveys and in-depth interviews) are conducted based on an evaluation prioritization of high, medium or low by program type. The PUCT and EM&V team re-visit the prioritization each year based on considerations such as magnitude and uncertainty of savings, stage of program, importance to future portfolio performance and PUCT and Texas utilities' priorities, prior EM&V results and changes in the markets in which the programs operate.

In PY2018, load management programs were designated a "high" priority due to their significant contribution to capacity (kW) savings and to provide performance feedback on these programs. Residential new construction was also designated as a "high" priority due to the new baseline change that programs were to respond to in PY2018.

Commercial standard offer programs (SOP) and the commercial market transformation programs (MTP) were "medium" priority. These programs continue to represent the largest percentage of statewide savings and have plans to explore new customer segments and technologies. While prior EM&V generally found evaluated savings to be similar to the utilities' claimed savings, it also resulted in several recommendations for changes to reported claimed savings. In addition, Small Business Programs were a "medium" priority in PY2018 as they have been "low" priority the last three years.

[3] The EM&V team conducts cost-effectiveness testing applying the program administrator cost test. For low-income programs, cost-effectiveness is calculated using the savings-to-investment ratio (SIR).

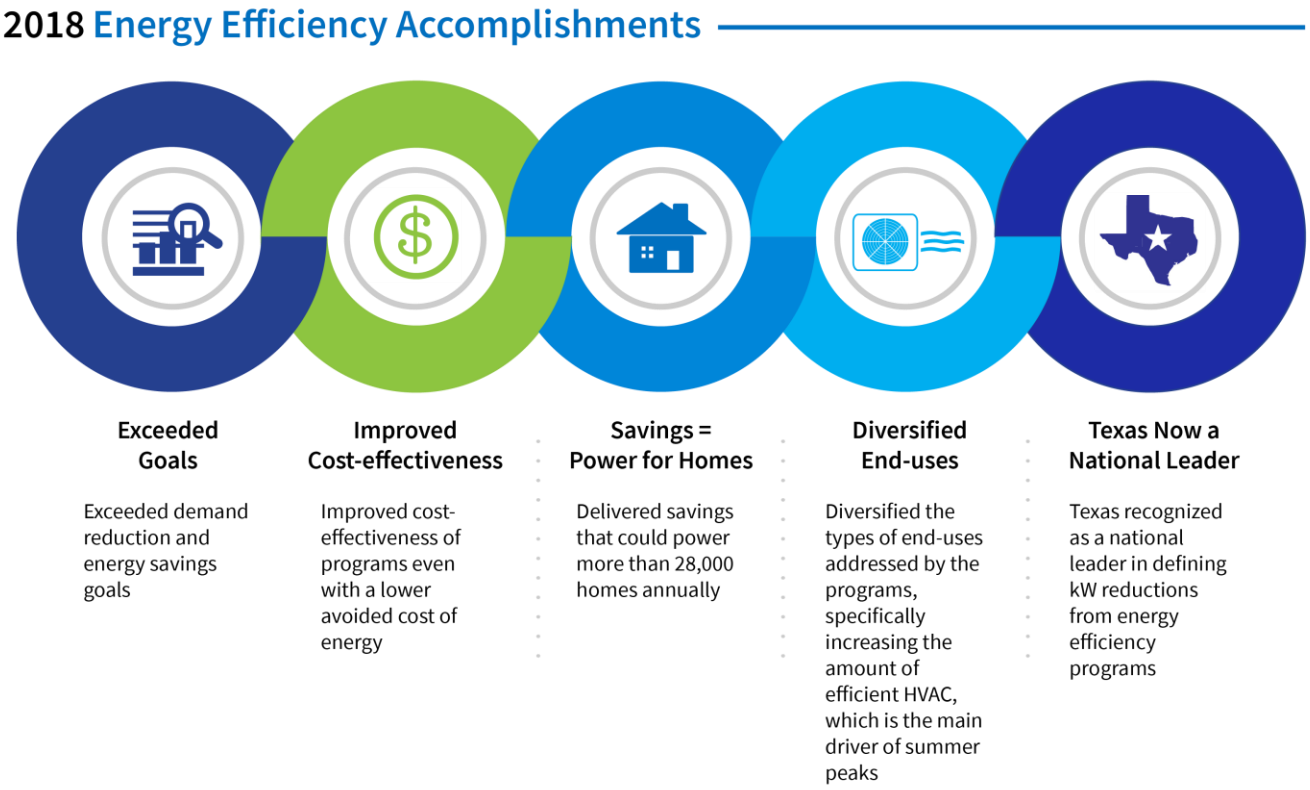
[4] The maintenance of the TRM is informed by the EM&V research and coordinated with the Electric Utilities Marketing Managers of Texas (EUMMOT) and the Energy Efficiency Implementation Project (EEIP).

Residential retrofit programs were a “medium” evaluation priority. These programs continue to comprise a substantial percentage of overall statewide portfolio savings and were still in the process of responding to substantial TRM updates to the envelope measures. Moreover, EM&V has recommended expanding the measure mix in these programs.

All other program types are “low” priorities for evaluation because they are small contributors to portfolio savings, have little uncertainty in savings, and/or have fairly homogeneous deemed savings projects that have seen healthy realization rates[5] in the prior program years’ EM&V.

1.3 EM&V KEY FINDINGS

The overall evaluation results for the utilities’ portfolios are positive with claimed savings very similar to evaluated savings. This is a result of well-established program design and delivery processes, tracking systems, documentation, and savings tools coupled with the utilities’ collaboration with and responsiveness to the EM&V effort and improvements in the TRM. One of the prior improvements in the TRM—consistently defining demand reductions—has placed Texas as a national leader in defining demand reduction savings through energy efficiency programs.[6] The programs have demonstrated marked improvement in the diversity of measures offered through the programs, in particularly increasing HVAC projects.



[5] Realization rates are claimed savings divided by evaluated savings. Realization rates of 100% demonstrate that claimed savings and evaluated savings match. As can be seen in Volume 2 of this Statewide Report, realization rates for each utility’s portfolio are very close to 100%.

[6] Collecting and Analyzing Peak Demand Impacts From Electricity Efficiency Programs, Energy Analysis and Environmental Impacts Division, Lawrence Berkeley National Laboratory, 2019

The utilities have demonstrated a willingness to work with the EM&V team when EM&V results identify an adjustment to claimed savings that is needed; to be upfront when M&V reviews or additional technical assistance or input can reduce uncertainty in savings estimates; and in implementing a number of process improvements. The EM&V recommended savings adjustments to which utilities fully responded in PY2018 are identified in Table 1-1.

Table 1-1. EM&V Claimed Savings Adjustments by Utility

Utility	EM&V Demand Claimed Savings Adjustments (kW)	EM&V Energy Claimed Savings Adjustments (kWh)
AEP TCC	31	590,434
AEP TNC	-3	-49,983
CenterPoint	-862	-2,296,203
El Paso Electric	-3	-20,082
Entergy	172	41,675
Oncor	1	-109,961
SWEPCO	-11	-66,846
TNMP	-8	6,386
Xcel Energy	0	12,112
Overall	**-683**	**-1,892,469**

1.3.1 Cost-effectiveness

The statewide cost-effectiveness remains above 2.0 (benefits divided by costs) using the program administrator cost test in PY2018. Cost-effectiveness increased to 2.3 in PY2018 from the recent low of 2.2 in PY2017, despite the avoided cost of energy decreasing slightly from $0.03989 per kWh in PY2017 to $0.03757 per kWh in PY2018. The avoided costs and overall cost-effectiveness ratios from PY2012 to PY2018 can be seen in Figure 1-9.

Figure 1-9. Statewide Evaluated Gross Cost-benefit Ratio and Avoided Cost by Program Year

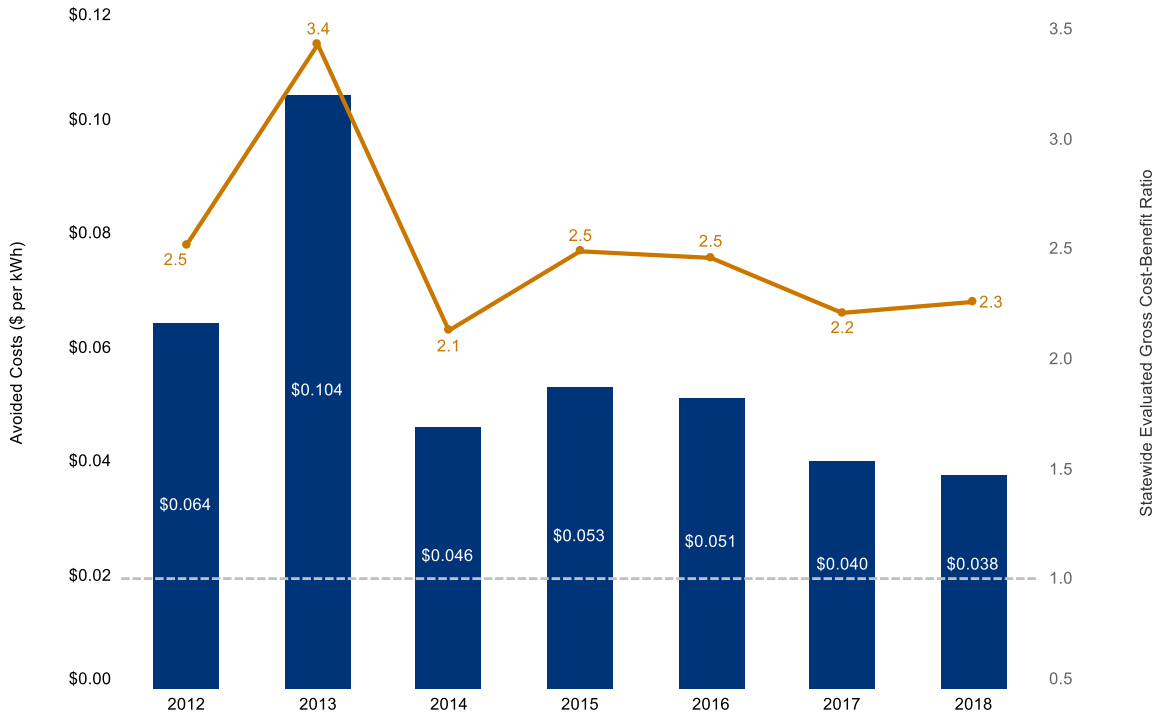
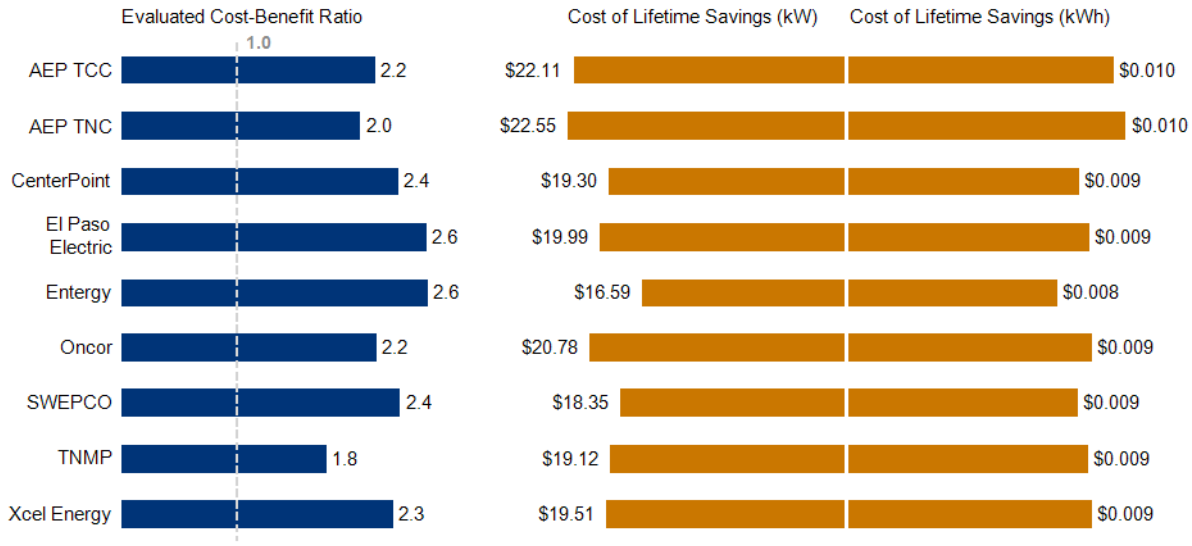


Figure 1-10 summarizes the cost-effectiveness of each utility's energy efficiency portfolio including low-income programs. All portfolios were cost-effective, ranging from 2.0 to 3.2. The cost per kW ranged from $16.59 to $22.55 and the cost per kWh ranged from $0.008 to $0.010. These costs provide an 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.

Figure 1-10. PY2018 Evaluated Savings Cost-benefit Ratio and Cost of Lifetime Savings



1.4 RECOMMENDATIONS

The PUCT's EM&V recommendations are 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.[7] The PUCT and EM&V team worked with the utilities to establish a process to document recommendations and utilities' responses, referred to as "action plans." Utilities use these action plans, which are also vetted with the Energy Efficiency Implementation Project (EEIP), to respond to program design and implementation recommendations within the next program year consistent with 16 TAC § 25.181(o)(09). Recommendations made based on PY2016 evaluation research, which was completed in 2017, were expected to be fully implemented in PY2018. Likewise, recommendations resulting from the PY2018 EM&V completed in 2019 are expected to be implemented in PY2020. First, we report on utility progress in meeting recommendations that were to be implemented in PY2018 programs, then we summarize recommendations from the PY2018 EM&V research to be implemented in PY2020.

1.4.1 Prior EM&V Recommendations

Table 1-2 summarizes the status of PY2016 EM&V recommendations that utilities were to implement in PY2018. Utilities have been responsive to recommended changes in their program implementation, savings calculations and reporting. Of the nine recommendations, six are complete and three are in progress. The three still in progress have additional recommendations from the PY2018 EM&V or planned PY2019 EM&V.

Table 1-2. PY2016 EM&V Recommendations for PY2018 Implementation[8]

Sector	Category	Recommendation	Status	Status Description
Commercial	Load Management Programs	PY2016 was the first year of a new TRM baseline methodology to calculate the impacts of the load management programs consistently. The utilities implemented the new calculation methods; however, differences in calculations for individual meters still occur. The EM&V team also recommended standardized documentation on which meters participated in specific events.	 Complete	The utilities have maintained ongoing communications with the EM&V team to resolve minor calculation differences and provide clearer and consistent participant data for load management events.

[7] The EM&V team recognizes there may be a trade-off between the objectives of the recommendations, program administration costs, and program participation barriers. The EM&V team strives to recognize these trade-offs by making feasible recommendations and working with the utilities to agree upon reasonable action plans.

[8] The PY2016 EM&V has fewer recommendations than prior and subsequent years because it was the first program year evaluated in a new four-year contract. Due to a truncated evaluation time period resulting from the new contract period, the PY2016 EM&V scope was limited.

Sector	Category	Recommendation	Status	Status Description
	HVAC Savings	Excel-based calculator tools are used to simplify the savings estimation process for prescriptive commercial HVAC energy efficiency projects. The EM&V team found multiple occurrences of misuse, which resulted in significant changes in the evaluated savings for some projects. Several issues found could be caught and corrected during application processing and savings calculation quality control reviews.	 In Progress	The number of savings adjustments declined for HVAC projects in PY2018 indicating utilities are addressing common errors and omissions found within the HVAC calculators to avoid inaccurate project savings.
	Lighting Hours of Use	The EM&V team analyzed annual operating hours (AOH) from on-site visits compared with the TRM assumptions across building types. The analysis indicated that the AOH for manufactures that operate different production shifts should be updated in the TRM.	 Complete	The EM&V team updated the "Manufacturing" building type for the PY2018 TRM version 5.0 to provide separate stipulations for annual operating hours and coincidence factors for 1, 2 and 3 shift operations and guidance on seasonal changes in manufacturing shift schedules.
	Lighting Qualification	The TRM has eligibility criteria for LED lamps and fixtures to be qualified and listed by an independent third-party that has tested savings and performance. After conducting research of TRM and utility practices across the country, it was recommended that the TRM continue to have eligibility criteria for prescriptive lighting projects with the option of custom non-qualified lighting projects.	 Complete	The EM&V team revised the PY2018 TRM 5.0 eligibility requirements to recognize the option of submitting non-qualified products as custom lighting with additional documentation.
Residential	Demand Response	The PY2016 TRM was the first year that a residential demand response M&V approach was included. The EM&V found inconsistencies on how to calculate event savings across the many residential meters that participated including how to deal with participants who	 Complete	The EM&V team revised the PY2018 TRM 5.0 M&V protocol for residential demand response programs to clarify how to sum meter level results for a given event. All utilities followed the PY2018 TRM protocol to calculate savings.

Sector	Category	Recommendation	Status	Status Description
		opt out of an event. In addition, one program implementer's calculations differed substantially from the TRM approach.		
Cross-sector	Program Tracking Data	The EM&V team identified inconsistencies with program tracking data and recommended maintaining sufficient detail so that records can be aligned with TRM entries; ensure that program plans, tracking data, and reporting maintain the same program definitions.	 In Progress	While program tracking data continues to improve, not all program tracking data fully aligns with program reporting, especially for larger umbrella programs that have distinct program components. The PY2018 EM&V reiterates program tracking data recommendations where improvement is still needed.
	Program Reporting	The EM&V team verifies all savings in EEPRs with final program tracking data. It was recommended that EEPRs report savings in kWh and kW as opposed to rounding to larger units.	 Complete	All utilities 2019 EEPRs reported savings in kWh and kW.
	HVAC Tune-ups	A number of recommendations to improve the M&V methodology for HVAC tune-ups, especially given the change in the mix of tune-ups from primarily residential to a mix of residential and commercial and changes in efficiency losses, were to be implemented fully in PY2018.	 In Progress	The utilities and implementer are using a rolling three-year average of the efficiency losses and calculating efficiency loss by Refrigerant Charge Adjustment and Sector using the rolling three-year average. While M&V samples have increased, the PY2019 EM&V will assess if at least a ten percent sample was collected for the commercial and residential populations. The recent M&V data can also inform an update to the deemed AC tune-up measure though there has been no uptake in the deemed measure to-date.
	Pool Pumps	A number of recommendations to improve the M&V methodology for commercial and residential pool pumps were made in order to inform a pool pump deemed savings.	 Complete	Project documentation and tracking data capture baseline equipment and usage schedules for the existing and new pumps make and model numbers. A new midstream delivery of pool pumps will be evaluated in PY2019.

1.4.2 PY2018 Key Findings and Recommendations

Based on findings from the evaluations conducted across all the utilities, the EM&V team provides the following key findings and recommendations for the commercial, residential, load management and demand response programs, and for issues that jointly affect both residential and commercial sector programs ("cross-sector").

1.4.2.1 Commercial Programs

Commercial key findings and recommendations are summarized in Table 1-3 in the following categories:

- Project timing
- HVAC projects
- Lighting projects
- Building type selection
- New construction projects
- Custom assumptions
- Midstream programs
- Recommissioning programs
- Small Business programs

Table 1-3. Commercial Program Recommendations and Action Plans

Category	Key Finding and Recommendation	Action Plan
Project Timing	The commercial programs' historical pattern of the timing of projects and savings across the program year sees the lowest energy savings claimed in the first quarter. The second, third and fourth quarters have increasing savings. While this pattern is typical for commercial programs, the disparity across quarters has increased in recent years for some utilities. In the past three years (2016-2018), the share of the energy savings claimed in the fourth quarter has increased to between 40 percent and 50 percent compared to 33 percent to 40 percent in the previous three years (2013-2015). The increasing disparity between the fourth quarter and the earlier part of the year could be smoothed out, which could aid the utilities in meeting program year reporting timelines.	Utilities should consider strategies to smooth participation throughout the program year, including activities and communications to support the increase in projects in the first quarter to minimize a first quarter slow down.
HVAC Projects	Evaporative cooling system projects claimed the space Conditioning Type as "Other" which follows the TRM. The "Other" category provides no interactive effects benefit associated with cooling interior space and therefore is a conservative estimate of energy savings. Consider capturing the HVAC energy interactive effects associated with evaporative cooling systems.	The EM&V team will discuss with the utilities adding an evaporative cooler space conditioning type in the TRM to capture the HVAC energy interactive effects.

Category	Key Finding and Recommendation	Action Plan
Lighting Projects	The TRM requires that the number of non-operable fixtures be limited to 10 percent of the total facility fixture count. If the non-operable fixture count is greater than 10 percent, the baseline wattage cannot be adjusted to include the non-operational fixtures. The EM&V team found that the impacted line items were adjusted correctly, but the finding was not applied to the other line items in the project. The calculation process when the total non-operable baseline lighting fixtures exceeded 10 percent of the total should be done as directed in the TRM.	Utilities will confirm lighting calculators utilize the TRM process for non-operable fixtures.
	The EM&V on-site verification found sensors installed for control of lighting fixtures in several cases. The sensors appear to be spillover, which were installed without an incentive. This indicates customer interest in this measure that could be integrated into projects more often.	Utilities should consider providing information to service providers on the benefits of sensor controls on interior and exterior lighting.
	Lighting calculations use variable baseline fixture wattages between utility territories. Calculators provide baseline fixture wattages and some calculations used the TRM listed fixture baseline wattages, while others used the marketplace available wattages. This inconsistency is especially relevant to two types of fixtures, screw-in light bulbs and fluorescent lighting fixtures. To address this, the TRM commercial lighting wattage table for linear fluorescent and screw-in lamp baselines should be updated.	The EM&V team will update the PY2020 TRM lighting wattage table.
	Manufacturer's rated lighting wattages were typically used instead of third-party rated wattages of the fixtures or lamps as recommended from the PY2017 EM&V. Many evaluated projects required that the installed watts for an individual line item to be adjusted to match DLC or ENERGY STAR® -listed wattages in their qualified listing. Although this happened in all lighting projects, it was prevalent for the Small Business programs. This recommendation was not expected to be fully implemented until PY2019 but is reiterated in PY2018 recommendations due to the number of projects found.	Utilities will check that the rated lighting wattages are used using third-party qualification agencies such as ENERGY STAR and DLC to fully respond to the PY2017 EM&V in PY2019.
Building Type Selection	Commercial lighting and HVAC project analysis require proper building type selection as guided by the TRM. In some cases, facilities can have multiple building types at the same location, but the savings calculation requires the selection of one building type per calculator. The building type should match the predominant building type based on the surface area. Like the area approach, the number of shifts for manufacturing that is most common should be used to identify this building type.	Program manuals and utilities' service provider trainings will clarify that the predominant building type for surface area and operations should be used to calculate energy savings.
New Construction Projects	New construction buildings are primarily claiming only HVAC and lighting improvements in the programs. The buildings that attempted to claim envelope, controls, or other improvements necessitated a custom calculation. The most common way for energy efficiency programs to offer additional new construction benefits is to require building energy modeling at code and the approved design or constructed building.	The EM&V team will discuss with the utilities interest in a new construction M&V approach for the 2020 TRM.

Category	Key Finding and Recommendation	Action Plan
	The lighting new construction limit of 10 percent non-qualifying fixtures or total watts is augmenting energy savings. The PY2018 TRM 5.0 process to claim lighting savings for a new construction project has a process to handle lighting equipment that is not qualified for the program to be incorporated into the design. It is a three-stage process. The first stage removes areas and the associated lighting fixtures that are known to be unique. The second stage assesses whether the non-qualified percentage is below 10 percent. If above 10 percent, then areas and associated lighting are removed from the project until both metrics are below 10 percent. The third stage applies a multiplier of five times to the wattage of the non-qualified lighting for use when calculating the energy savings against the qualified area lighting power density.	The EM&V team will eliminate the 10 percent non-qualifying limit for quantity of fixtures and adjust the non-qualified wattage multiplier to 2.0 for New Construction projects in the 2020 TRM.
	The date of new construction projects varies from standard retrofit projects. It is allowable to use all energy efficiency calculators that were in use on the date of the building permit for new construction projects. For example, if a project started in PY2017 (building permit was approved in 2017) and was completed in PY2018, PY2017 lighting and HVAC calculators should be used to determine PY2018 post-install energy savings.	Utilities should use the date of the building permit for New Construction to select the correct version of energy efficiency savings calculation tools.
Custom Assumptions	There were a small number of custom assumptions made regarding commercial and industrial building operation, which is acceptable. The assumptions, however, lacked documentation to confirm custom assumptions, and therefore the evaluation team generally found that the project should have used a TRM standard assumption.	Utilities will check that service providers using custom assumptions have the required documentation of the operation profile if it varies from the Texas TRM standard assumptions.
Midstream Programs	The Midstream lighting programs are given limited guidance. These projects provided an incentive at the distribution point to the installing contractor with the intention of installing the equipment for a commercial or industrial eligible customer. Within the midstream program, the post-install wattage for the projects is known, but the pre-install equipment and the building type are unknown.	The EM&V team will update the Texas TRM to include a method for developing the savings calculation for Commercial Midstream lighting programs.
Retro-commissioning Programs	The Retro-commissioning (RCx) TRM M&V protocol follows Option C of the International Performance Measurement and Verification Protocol (IPMVP) framework, which requires significant effort. RCx projects range in size and scope. Small projects are unduly burdened by the rigorous IPMVP Option C method. A simpler process for small projects would increase the opportunity to improve existing building operations with low cost measures. A simplified method for smaller projects is recommended to provide a conservative savings value and a shorter expected useful life.	The EM&V team will revise the TRM RCx M&V Protocol to include a simplified process for projects falling within a limited scope, size and energy savings.
Small Business Programs	The date to determine eligibility for specifications was not consistent across Small Business projects. This was noted when evaluating lighting qualifications. The EM&V team understands the streamlined process for the Small Business	The EM&V team will update the 2020 TRM to provide guidance that the date of the customer acceptance of

Category	Key Finding and Recommendation	Action Plan
	programs, which requires installation trade allies to pre-purchase standard lighting equipment. Therefore, it is acceptable that the date to measure against third-party certification for equipment is the customer acceptance signature date on the project scope.	the Small Business projects can be used for lighting qualification equipment eligibility.
	The EM&V found that the building type for small business customers was less accurate than other commercial projects. The implementation teams should provide additional training or quality control inspections to confirm building type and provide continuous education to the installation trade allies.	Utilities should update QA/QC processes to ensure the building type is verified prior to final energy savings calculation.

1.4.2.2 Residential Programs

Residential key findings and recommendations are summarized in Table 1-4 in the following categories:

- Ceiling insulation projects
- Attic encapsulation projects
- HVAC capacity bins
- Duct sealing education
- HVAC project participation
- New homes
- AC Distributor program

Table 1-4. Residential Program Recommendations and Action Plans

Category	Key Finding and Recommendation	Action Plan
Ceiling Insulation Projects	Determining the effective R-value of ceiling insulation takes into account several factors, including square footage. However, the TRM lacks guidance on how to accurately and consistently determine the effective R-value in attics where varying levels of existing insulation can be found across multiple areas. The most accurate way to estimate savings is to use an area-weighted U-factor and convert to find the effective R-value, because U-factor is the actual energy loss per square footage.	The EM&V team will include an additional option in the PY2020 TRM to estimate savings using the area-weighted U-factor methodology. Using one conservative value for varying levels will continue as an option.
Attic Encapsulation Projects	There is very low usage of the attic encapsulation measure across residential programs, as the TRM savings resulted in substantially lower savings than should be expected from this measure. Given the multifaceted nature of this measure, savings should be greater than the ceiling insulation measure of the same R-value. Instead, the TRM-modeled savings were lower than the ceiling insulation measure savings.	The EM&V team provided a guidance memo with revised insulation and air infiltration savings for the attic encapsulation measure for PY2019 and will update the PY2020 TRM.
HVAC Capacity Bins	Historically, the central air conditioner and heat pump measures had reported capacity based on nominal tonnage. The PY2019 TRM updated the reported capacities to rated British Thermal Units per Hour (BTUh), which is industry best practice. The updated rated capacity ranges in the PY2019 TRM were specified with a 5 percent tolerance in accordance with the Air Conditioning, Heating, and Refrigeration Institute	The EM&V team provided a guidance memo with updated capacity ranges for PY2019 and will update the PY2020 TRM.

Category	Key Finding and Recommendation	Action Plan
	(AHRI) Standard 210/240 to account for systems that are rated slightly below the applicable nominal capacity.	
Duct Sealing Education	During on-site M&V, the EM&V team found several completed duct sealing projects where the measures had been undone by maintenance staff. In some cases, the mastic tape used to seal joints was removed or damaged and not replaced resulting in an increase in duct leakage. In one case, gaps were left between the wall and air handler unit resulting in a loss in pressure and increasing air infiltration as well as duct leakage.	Utilities should consider developing education materials to leave with homeowners on upkeep of duct sealing improvements.
HVAC Project Participation	In response to a PY2016 EM&V recommendation, utilities have successfully increased residential HVAC projects. The PY2018 net-to-gross (NTG) research with HVAC contractors found the majority of these projects were completed due to the programs.	Utilities should continue to encourage efficient HVAC adoption as a component of their portfolios.
New Homes	Energy models estimate energy usage for the program homes, and the utilities provided either the energy model configuration or pre-configured reports that showed energy model inputs. In some cases, the EM&V team had to make follow-up requests to receive sufficient detail.	Utilities should review the documentation section of the new homes measure characterization in the TRM and ensure that they continue to collect the required documentation.
	Required tracking fields for new homes include the date the home was permitted and the energy code version under which it was permitted. While most homes were constructed under IECC 2015, a few were still permitted under IECC 2009. Although the TRM specifies a statewide code based on IECC 2015, local jurisdictions may decide not to adopt and enforce that code under home rule.	Utilities should continue to work with builders to improve the efficiency of homes even in jurisdictions that have not adopted the latest state energy code.
AC Distributor Program	The EM&V team found several discrepancies in the baselines for projects, which reduced savings. One was a discrepancy in the age of equipment reported in the tracking data compared to what was found in the documentation. The second was in the type of baseline equipment reported. In both cases the desk review identified these discrepancies through a review of the photo documentation provided.	Utilities offering AC Distributor Programs should review documentation to ensure that all necessary information input into tracking data align with both the photo documentation and field checklist.
	Interviews with A/C Distributors identified program paperwork and processes as well as delay in receiving incentives as an area for program improvement.	Utilities may want to review participation and incentive processes to respond to participating distributor feedback.

1.4.3 Load Management Programs

Key findings and recommendations are presented in Table 1-5 in the following categories:

- Overarching
- Commercial

- Residential

Table 1-5. Load Management Program Recommendations and Action Plans

Category	Key Finding and Recommendation	Action Plan
Overarching	The percentage of total kW that was met from load management in 2018 averaged 63%. This ranged from a low of 30% of kW reductions for one non-ERCOT utility to a high of 74% of kW reductions for an ERCOT utility. While there is not a cap on kW reductions achieved through load management programs as part of energy efficiency portfolios in Texas, other jurisdictions have caps. For example, one large Midwestern utility has capped load management demand reductions at 60% of their total portfolio kW reductions. Some utilities in regions served by system operators long on capacity have decreased load management savings in their energy efficiency portfolios to less than half of kW reductions. The ERCOT market is not long on capacity.	A cap on the percentage of kW that can be met from load management should be considered.
	All ERCOT utilities report the primary objective of the programs is to serve as an ERCOT Tier 2 emergency resource before controlled outages. All ERCOT utilities' program participation requirements do also reserve the right for the utility to call curtailment events for its own system needs. Only one ERCOT utility is currently using the program for its own system reliability. The non-ERCOT utilities report using the program as an emergency capacity resource in their integrated resource planning, but also saw value of the programs to meet their system needs in the future. One non-ERCOT utility has recently used the program for its own system reliability.	More diversified uses of the load management program should be considered.

Category	Key Finding and Recommendation	Action Plan
	Several utilities reported that the clarity introduced by having consistent TRM methodologies is a positive support. In addition, several utilities reported their territories frequently experience storms during the control season that can result in outages. The flexibility of the TRM baseline can still allow customers to participate even if they experience an outage. One utility felt the interval meter data analysis needed for the TRM calculation was data intensive.	Utilities interested in developing a residential demand response deemed savings value should work with the EM&V team to pursue this option.
	The transmission and distribution (T&D) utilities coordinate with ERCOT on their programs but differ in the levels of communication.	Utilities, PUCT Staff, the EM&V team, and ERCOT will discuss consistent guidelines on timing and frequency of utility and ERCOT communications as well as protocols for verifying there is no duplicate participation between utility and ERCOT programs.
	Commercial direct load control and residential smart thermostats are an increasing resource for load management.	Utilities interested in developing a small commercial thermostat measure should work with the EM&V team to pursue this option.
	Utilities demonstrated strong capabilities to apply the TRM calculation method to savings.	Utilities should actively communicate with the EM&V team to resolve calculation differences.
Commercial Load Management	Programs are generally working well with high participant satisfaction. While fairly stable, there have been some modifications in incentive levels and the participant mix. Programs are generally retaining commercial load participants effectively, with about 600 commercial participants over the past few years.	Utilities should collect information from customers or aggregators annually on how they curtail load if they do not already do so.
	All Texas utilities have program websites with clear directions on how to enroll. Program manuals are available for download on their respective websites as well. However, some of them are not up to date with the current program year.	Utilities should update program manuals annually even if program requirements and overall documentation do not change.
Residential Load Management	While residential programs with smart thermostats are very popular with customers, utilities are seeing a need to modify incentive levels, program administration and participation limits.	For utilities offering or considering offering residential load management, the percentage of kW that met from load management should be considered comprehensively across residential and commercial offerings.
	PY2018 was the first year in which one utility could calculate savings using a deemed saving approach. There was confusion regarding what qualifies as a “participant” since customers can opt out of events.	The EM&V team will work with the utility to update the PY2020 TRM to quantify savings for a clearly defined participant.

Category	Key Finding and Recommendation	Action Plan
	Utilities offering residential programs, refer to them as demand response in program filings. Load management is the term defined in the Energy Efficiency Rule 16 TAC § 25.181.	Utilities will refer to applicable residential programs as “load management” instead of “demand response” starting with 2020 filings.

1.4.3.1 Cross-sector

Cross-sector key findings and recommendations are summarized in Table 1-6 for:

- Program tracking data
- Project documentation

Table 1-6. Cross Sector Measure Recommendations and Action Plans

Category	Key Finding and Recommendation	Action Plan
Program Tracking Data	The EM&V team previously recommended that utilities should clearly associate tracking data and records with sub-programs. They are also to track savings and budgets for distinct sub-programs.	Utilities combining sub-programs into one umbrella program should ensure that program tracking transparently allocates and tracks sub-program budgets separately to the best of the utility’s ability.
	Utilities’ methodology for rounding data was unclear and differed between tracking data provided to the EM&V team and in utility reporting.	Utilities should round energy savings in final program tracking data consistently with regulatory reporting and document how rounding occurs.
	Many measure lines in the tracking data for several small business programs included zero savings and no additional information.	Utilities with small business programs will eliminate unnecessary measure lines in the tracking data.
	Participant information for the load management and demand response programs was not always available when a utility uses a third-party service provider.	Utilities will require third-party service providers to collect and provide participant information for load management and demand response programs that include participant name, address, ESIID or other unique identifier and contact information (email or telephone).
Project Documentation	Small Business projects included a simplified calculator and documentation of baseline equipment, building type, location of installation, and proposed equipment. However, what was not always included were post-install verifications, photos of baseline or installed equipment, invoices, or spec sheets and certifications.	The utilities offering small business programs will discuss with the EM&V team the information that could be collected in the current process to better align the documentation needed to verify savings and a more streamlined program delivery for this sector.
	The EM&V team recommended in PY2017 that when sampling for site inspections from a large group of similar commercial projects, utilities should verify the projects’ business type and size for a more	Utilities should clearly indicate for sampled projects which documents are specific the project(s) to be evaluated and which documents are relevant to all projects.

Category	Key Finding and Recommendation	Action Plan
	representative sample. In PY2018 savings calculations were done properly for the sampled projects. However, it was difficult to identify the project documentation to review.	
	In PY2017, there was limited documentation available for residential direct install measures. During the PY2018 evaluation, some utilities had already started to respond to the PY2017 recommendation with improvements, such as including photos in the documentation collected for direct install measures.	Utilities will continue to improve documentation for residential direct install measures to fully comply with the PY2017 recommendation in PY2019.

2.0 INTRODUCTION AND PORTFOLIO FINDINGS

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 2018 (PY2018). Statewide program-level results are presented in Sections 3 through 5 for the commercial, residential and load management programs respectively. Volume 2 is a separate document in this statewide report and contains the detailed impact evaluation results for each utility portfolio.

2.1 EM&V OVERVIEW

The PY2018 scope targeted impact evaluations for the savings areas of the highest uncertainty identified in the prior EM&V results or changes in programs, baselines or technologies as well as programs with the highest contribution toward savings. The targeted impact evaluations are concentrated on particular commercial and residential programs and end-uses. At the same time, program tracking system reviews provide due-diligence verification of claimed savings for each utility portfolio. There was also a high priority placed on process evaluation for the commercial load management and residential demand response programs to provide performance feedback for these programs.

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

The PY2018 EM&V plans[9] were based on the prioritization of the EM&V effort. To briefly summarize, the EM&V team identified program types across utilities that have similar program design, delivery, and target markets. The PUCT and EM&V team reviewed each program type and prioritized (high, medium, low) based on the following considerations:

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

[9] Tetra Tech. Public Utility Commission of Texas Evaluation, Measurement, and Verification (EM&V) Plans for Texas Utilities' Energy Efficiency and Load Management Portfolios—Program Year 2018, July 2018.

2.1.1 EM&V Activities

The EM&V activities:

- Confirm that the measures installed are consistent with those listed in the tracking system
- Verify that the claimed savings estimates in the tracking system are consistent with the savings calculated in the deemed calculation tools or tables in accordance with the PY2018 TRM 5.0 or measurement and verification (M&V) methods used to estimate project savings
- Review 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
- Recommend updates to project-level claimed savings if EM&V results indicate variation in savings of at least ± 5 percent.
- Inform updates for the PY2020 TRM 7.0.

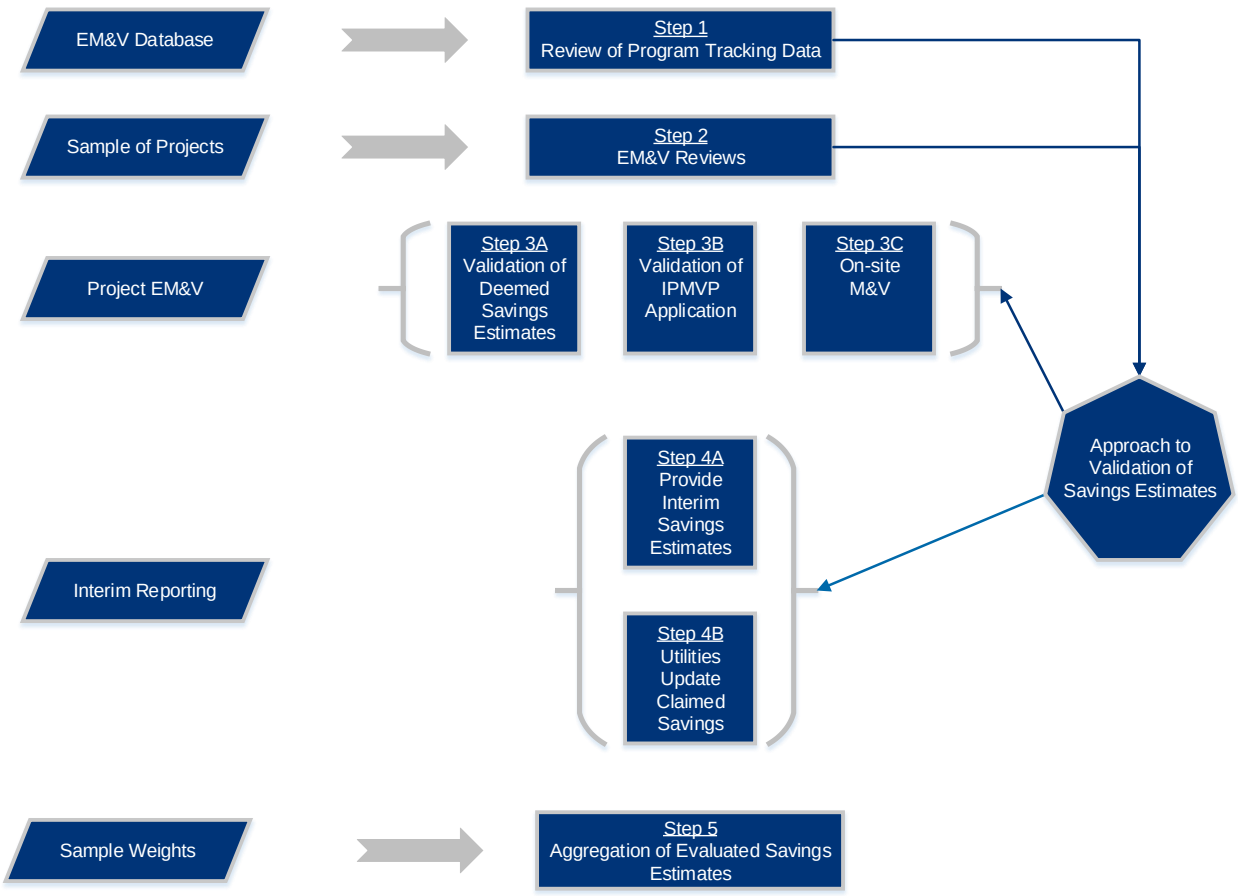
Table 2-1 shows the EM&V activities completed by program type and evaluation priority.

Table 2-1. PY2018 EM&V Priorities and Activities

Program Type	Evaluation Priority	Tracking Data Verification of Claimed Savings	Verification of TRM Savings Calculations	Participant/ Distributor Surveys	Project Desk Reviews	On-site M&V	Interval Meter Data Analysis
Commercial SOPs and Largest Commercial MTPs	Medium	Census	Sampled (see desk reviews)	N/A	141	70	N/A
Small Business Programs	Medium	Census	Sampled (see desk reviews)	N/A	60	30	N/A
Commercial Load Management	High	Census	Census	77	N/A	N/A	Census
Residential Load Management	High	Census	Census	N/A	N/A	N/A	Census
Residential SOPs and Hard-to-Reach	Medium	Census	Census	N/A	143	73	N/A
A/C Distributor MTPs	Medium	Census	Census	3	8	N/A	N/A
Residential New Homes MTPs	High	Census	Census	N/A	55	N/A	N/A
All Other Programs	Low	Census	N/S	N/A	N/A	N/A	N/A

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 for 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 illustrated in Figure 2-1.

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 program with a medium or high evaluation priority in a utility's portfolio.

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

2.2 PORTFOLIO KEY FINDINGS AND RECOMMENDATIONS

The overall evaluation results for the utilities' portfolios are positive with claimed savings very similar to evaluated savings. In other words, all realization rates are very close to 100 percent as can be seen in Volume 2 of this statewide report. This is a result of well-established program design and delivery processes, tracking systems, documentation, and savings tools coupled with the utilities' collaboration with and responsiveness to the EM&V effort and improvements in the TRM.

While recognizing the accomplishments of the programs, the PY2018 EM&V research identified some opportunities for improvements. This portfolio section discusses program tracking data and project documentation key findings and recommendations. Additional key findings and recommendations for the commercial, residential and load management programs are discussed in those specific report sections.

2.2.1 Program Tracking Data

Key Finding #1: Utilities that combine several sub-programs into one larger program do not always provide a clear way to associate records with the sub-program.

Key Finding #2: Utilities did not report budgets for sub-programs even when those sub-programs were very distinct from each other.

The EM&V team previously recommended that utilities should clearly associate tracking data and records with sub-programs. They are also to report savings and budgets for distinct sub-programs to provide stakeholders with transparency into the sub-programs' cost-effectiveness. These key findings and recommendations are repeated here as the number of sub-programs has increased, but the lack of clarity in these areas is still in need of improvement.

Recommendation #1: Ensure that program tracking is transparent when programs include multiple sub-programs.

Recommendation #2: Allocate, track, and report sub-program budgets separately to the best of the utility's ability.

Key Finding #3: Utilities' methodology for rounding data was unclear and differed between tracking data provided to the EM&V team and in utility reporting.

All utilities have not established a clear methodology for rounding tracked savings for reporting. Generally, this has not produced noticeable discrepancies, but in 2018 this resulted in slightly more sizeable differences. One utility rounded individual records prior to aggregating.

Recommendation #3: Round energy savings in provided tracking data consistently with regulatory reporting (energy efficiency plan and reports and cost recovery filings) and document how rounding occurs.

Key Finding #4: Several Small Business programs included blank measure lines in the tracking data.

Many measure lines in the tracking data for several small business programs included zero savings and no additional information. It is unclear why the blank measures are being generated in some programs, but efforts should be made to eliminate the measures with no information, no incentive, and no energy savings associated.

Recommendation #4: Improve the QA/QC process to eliminate unnecessary measure lines in the tracking data.

2.2.2 Project Documentation

Key Finding #1: Documentation was limited for many Small Business projects.

The implementation of the Small Business or Open MTP Programs is slightly different from the large commercial programs. The implementation includes an on-site scoping audit and immediate development of a project scope and associated incentive for the customer, whereas the process for large commercial programs adds additional steps to develop the application, specific calculations, and associated equipment documentation for the lighting improvements. The streamlined process for small businesses eliminated the steps to develop the details in the project prior to installation and focuses instead on installing similar equipment for all small business program participants.

The documentation for Small Business projects included a simplified calculator and documentation of baseline equipment, building type, location of installation, and proposed equipment. What was not always included in all project documentations was a savings calculator that incorporated all the components of the TRM (especially Open MTP projects), post-install verifications, photos of baseline or installed equipment, invoices, or spec sheets, certifications, and site QC documentation/ pre and post reports. The EM&V team determined that much of this information appears to be collected or could be collected in the current process, but the documentation received by the EM&V team and the utility's program documentation are not easily aligned.

Recommendation #1: The EM&V team and utility should coordinate an alternate documentation request system for Open MTP and other Small Business programs.

Key Finding #2: Savings calculations for "grouped" projects were done properly in response to previous EM&V recommendations but project documentation was difficult to locate.

In some cases, multiple store franchises or branches of the same business had completed the same energy efficiency upgrades such as installing energy efficient lighting. In many of these cases, the projects were very similar in size across multiple business locations and the lighting or other energy efficient measures that were installed were nearly identical. In these cases, the implementer or utility selected on-site inspections for a sample across the large family of identical businesses that were "grouped" for this purpose. The small sample of on-sites was then used to inform and estimate the savings for the rest of the businesses that did not receive on-site inspections. This estimation was done with the expectation that all identical business or store locations that participated in the program were nearly identical in square footage, building use type, and completed the same measures and thus would claim the same energy and demand savings.

The EM&V team recommended in PY2017 that when sampling for site inspections from a large group of similar projects such as multiple stores with the same name or business type, utilities should verify the projects business type and size for a more representative sample. In PY2018, the EM&V team completed on-site visits as part of the impact evaluation process. Like the utility or implementers sampling strategy, when many businesses of the same name were identified in a program, a sample of the businesses were selected for on-site visits. The EM&V team found that savings calculations were done properly for the sampled projects following PY2017 recommendations. However, the EM&V team encountered difficulties identifying the project documentation to review from the documentation provided by some utilities.

The documentation provided included information for different business locations or branches, which caused confusion about which was relevant to the evaluated project. This confusion generally required additional EM&V team time and communication with the utility to determine the proper components of the documentation that were relevant to each project site.

Recommendation #2: Documentation provided by the utilities on sampled projects should provide direction as to which documents are specific to the project(s) to be evaluated and which documents are relevant to all projects.

Key Finding #3: Project documentation for residential direct install measures was limited in most cases.

In PY2017, the EM&V team found that there was limited documentation available for direct install measures such as LEDs, low flow showerheads, and low flow faucet aerators. The EM&V team recommended that documentation for these measures be collected for each project. During the PY2018 evaluation, the EM&V team found that some utilities had already started to respond to this recommendation with improvements, such as including photos, in the documentation collected for direct install measures. Proper documentation for all measures mitigates risk to the utility and allows for a thorough third-party verification of key parameters, eligibility, and installation rate. The EM&V team would expect the utilities to respond fully in PY2019.

Recommendation #3: Continue to improve documentation for residential direct install measures.

3.0 COMMERCIAL ENERGY EFFICIENCY PROGRAMS

The EM&V team evaluated the commercial energy efficiency programs described below. There are two types of programs: Standard Offer Programs (SOP) and Market Transformation Programs (MTP). An SOP is a program under which a utility administers standard offer contracts between the utility and energy efficiency service providers specifying standard payments based upon the amount of energy and peak demand savings achieved through energy efficiency measures, the measurement and verification protocols, and other terms and conditions. An MTP is a strategic program intended to induce lasting structural or behavioral changes in the market that result in increased adoption of energy efficient technologies, services, and practices.[10] SOP and MTP programs continue to represent the largest percentage of statewide savings.

Commercial SOP provides incentives for new construction and retrofit installation for a wide range of measures that reduce demand and save energy in nonresidential facilities. Incentives are paid to EESPs (project sponsors) based on deemed savings or verified demand and energy savings at eligible commercial customers' facilities. The utility has a limited group of participating project sponsors determined through a selection process based on meeting minimum eligibility criteria, complying with all program rules and procedures, submitting documentation describing their projects, and entering into a standard agreement with the IOU.

Commercial Solutions MTP targets commercial customers that do not have the in-house expertise to: (1) identify, evaluate, and undertake energy efficiency improvements; (2) properly evaluate energy efficiency proposals from vendors; and/or (3) understand how to leverage their energy savings to finance projects. Assistance from the program includes communications support and technical assistance to identify/assess/implement energy efficiency measures. Financial incentives are provided for eligible energy efficiency measures that are installed in new or retrofit applications and result in verifiable demand and energy savings. This type of programs can include midstream programs that provide incentives at the distribution point to installing contractors with the intention of installing the equipment for eligible commercial or industrial customers.

SCORE MTP helps educational facilities (public and private schools K-12 and higher education) and local government institutions to lower their energy use by educating and assisting in integrating energy efficiency into their short- and long-term planning, budgeting, and operational practices. This is completed through assistance in areas such as energy master planning workshops, energy performance benchmarking, and identifying/assessing/implementing energy efficiency measures. Energy efficiency improvements include capital-intensive projects and implementing operational and maintenance practices and procedures. Financial incentives are provided to energy efficiency measures that reduce peak electricity demand.

Recommissioning MTP offers commercial customers the opportunity to make operational performance improvements in their facilities based on low cost/no cost measures identified by an engineering analysis. Financial incentives are provided to facility owners and Retro-commissioning Agents for the implementation of energy efficiency measures and projects completed by approved project deadlines.

Small Business MTP is designed to assist small business customers with identifying and implementing cost-effective energy efficiency solutions for their workplace. Small business customers are defined as business customers that do not have the in-house capacity or expertise to: (1) identify, evaluate, and

[10] PUCT Order, Chapter 25: Substantive Rules Applicable to Electric Service Providers.

undertake energy efficiency improvements; (2) properly evaluate energy efficiency proposals from vendors; and/or (3) understand how to leverage their energy savings to finance projects.

CoolSaver A/C Tune-Up MTP is designed to overcome market barriers that prevent residential and commercial customers from receiving high performance A/C system tune-ups. The program works through local A/C distributor networks to offer key program components, including (1) training and certifying A/C technicians on the tune-up and air flow correction services and protocols and (2) paying incentives to A/C contactors for the successful implementation of A/C tune-up and air flow correction services. Contractors that wish to participate enter into a contractor partnering agreement that specifies the program requirements. Contractors are trained on the A/C tune-up process and given incentives and discounts for the cost of field equipment designed to diagnose and quantify energy savings opportunities. Energy savings are captured through the correction of A/C system inefficiencies identified during the tune-up activities.

Solar Photovoltaic MTP offers financial incentives for the installation of eligible distributed solar energy generating equipment on the premises of customers served by the utilities. These programs are available to utility customers, including residential customers, businesses, and schools. The utility has a limited group of EESPs determined through a selection process based on meeting minimum eligibility criteria, complying with all program rules and procedures, and submitting documentation describing their projects.

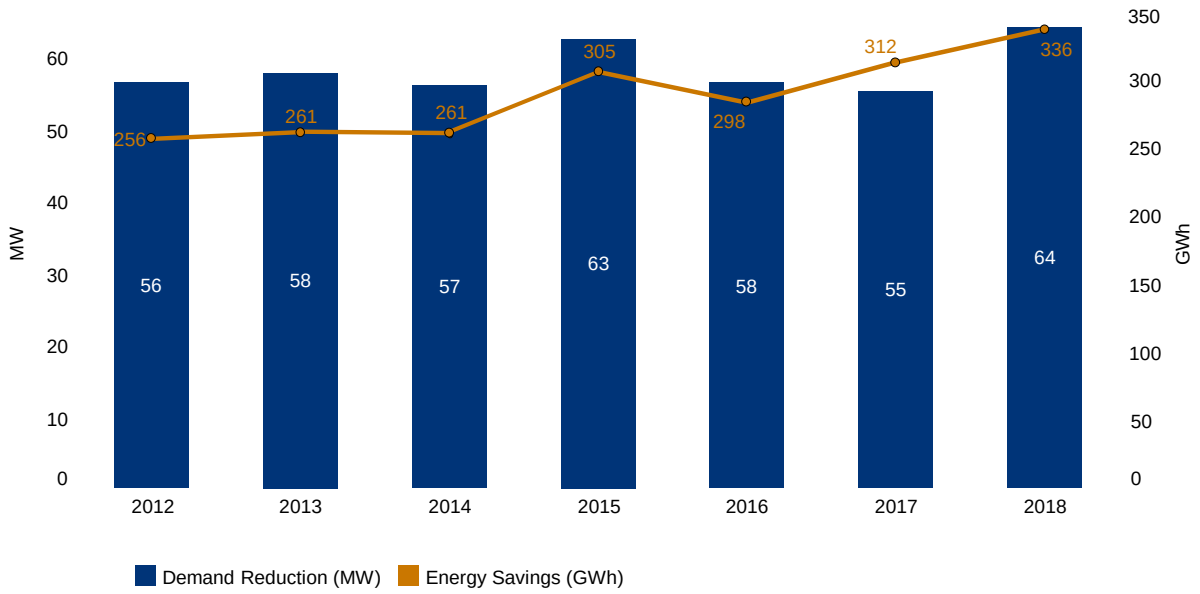
The EM&V team conducted a streamlined EM&V effort that couples broad due diligence verification of savings for the first five programs described above with targeted in-depth activities including engineering desk reviews, on-site M&V and interval meter data analysis based on the prioritization of the programs.

3.1 SUMMARY RESULTS

This section presents statewide summary results, followed by key findings and recommendations from the impact evaluations of SOPs and MTPs.

The statewide evaluated gross savings from commercial sector programs were demand reduction of 64,169 kW and energy savings of 335,943,608 kWh. Both of these results reflect an increase from PY2017 and are the highest commercial sector results since EM&V started in PY2012, as shown in Figure 3-1.

Figure 3-1. Total Statewide Evaluated Demand Reduction and Energy Savings by Program Year—Commercial Programs



As indicated in Figure 3-2, lighting measures still account for the majority of the energy savings (64 percent) and demand reduction (77 percent), which is consistent with commercial programs throughout the country. PY2018 saw HVAC and lighting measures making up approximately 85 percent and 84 percent of demand reduction and energy savings respectively.

Figure 3-2. Distribution of Statewide Evaluated Gross Demand Reduction and Evaluated Gross Energy Savings by Measure Category—Commercial Programs PY2018 Excluding Load Management

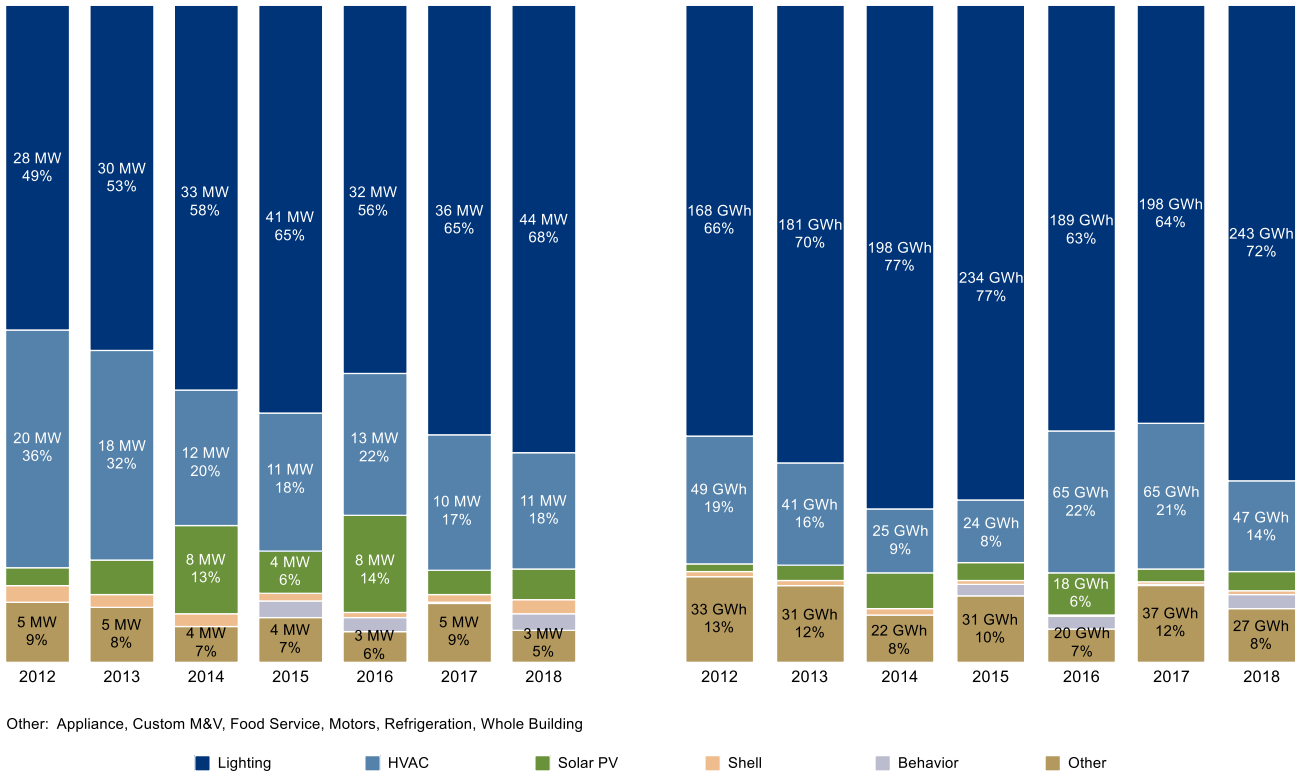
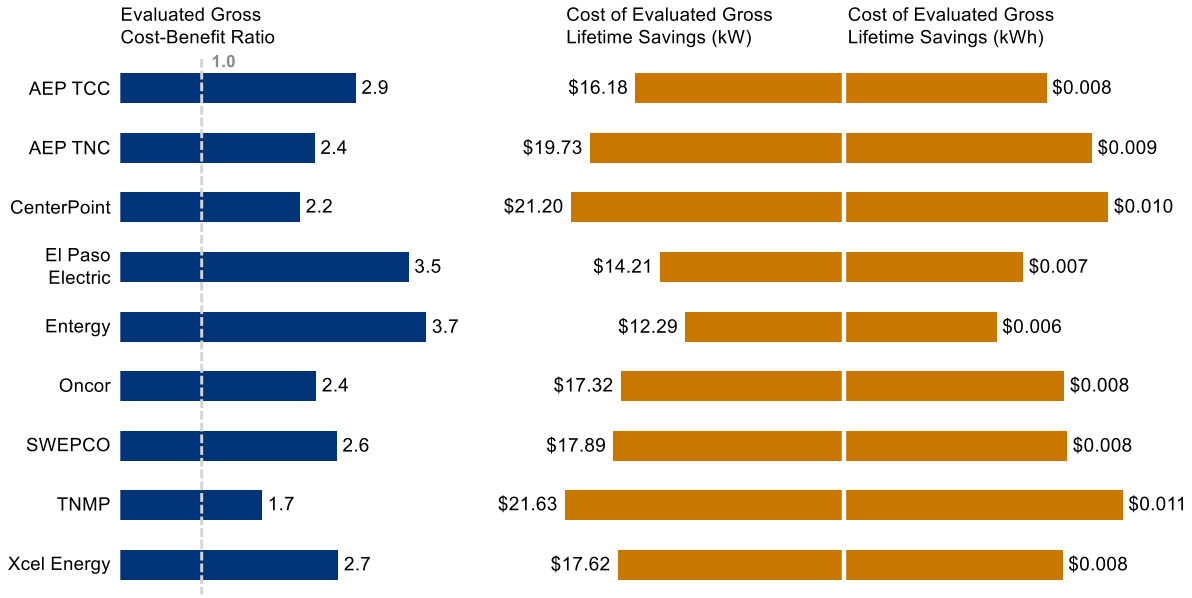


Figure 3-3 summarizes the cost-effectiveness of each utility's commercial energy efficiency portfolio. Commercial sector programs were the most cost-effective programs with an overall cost-effectiveness of 2.5 statewide based on evaluated savings and 2.3 based on net savings. Utilities' results ranged from 1.7 to 3.7 based on evaluated gross savings and 1.6 to 3.3 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.

Figure 3-3 also summarizes the cost of lifetime kWh and kW for each utility's commercial sector programs. The cost per kWh ranges from $0.006 to $0.011, and the cost per kW ranges from $12.29 to $21.63. These costs provide an alternate way of describing the cost-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.

Figure 3-3. Evaluated Cost-benefit Ratio and Cost of Lifetime Savings—Commercial Programs PY2018

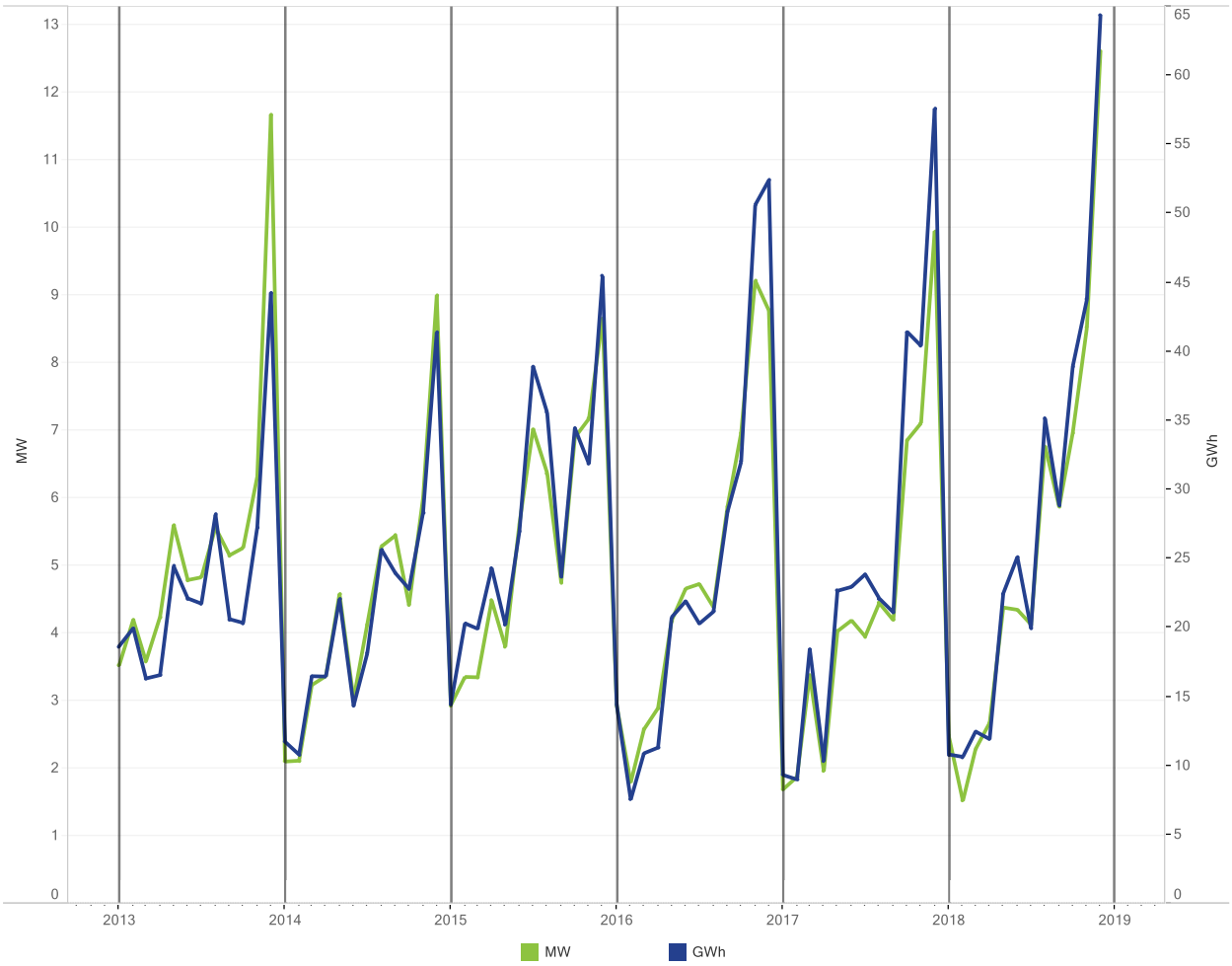


3.2 TIMING OF PROJECT COMPLETION

The commercial program has a historical pattern that the kW and kWh savings are closely linked, and that the savings increase per month as the year progresses, as shown in Figure 3-4. Each year, the first quarter has lower energy savings claimed as the programs launch the new initiatives. The second and third quarter have increasing savings as the programs gain momentum. The fourth quarter increases momentum further and accounts for more than one third of the energy savings for the year.

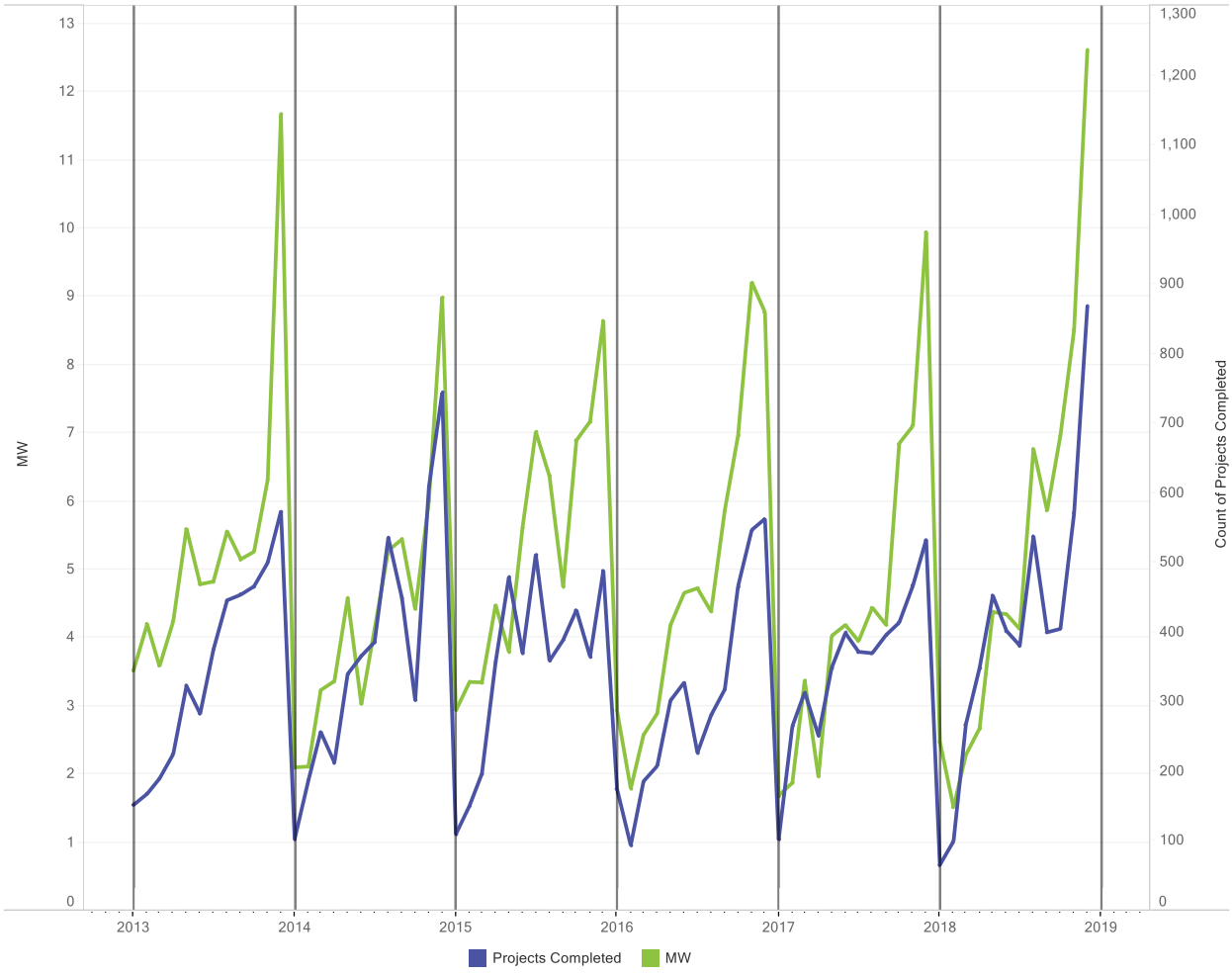
This pattern is typical for commercial programs on an annual cycle, although the increasing disparity between the fourth quarter and the earlier part of the year could be smoothed out. In the past three years (2016-2018), the share of the energy savings claimed in the fourth quarter is between 40 percent and 50 percent, which is an increase from 33 percent to 40 percent in the previous three years (2013-2015). This indicates an increased reliance on the fourth quarter results, which may result in a slower start at the beginning of the next year.

Figure 3-4. Monthly Evaluated Gross Demand and Energy Savings Over Time — Commercial Programs PY2013-2018



One reason for the increased savings in the fourth quarter is the increased project size. In Figure 3-5, this is represented by the size of the gap between the “kW” and “Project Completed” lines in the graph. Larger projects tend to take longer to implement and tend to be finalized near the end of calendar years to coordinate with their budgeting cycle. Smaller projects can be completed more quickly at the beginning of the year once incentives are announced. Ideally, the number of projects per month will remain relatively consistent between quarters two, three, and four similar to 2015 and the increase in savings at the end of the year is a result of the large projects being completed. Over time, programs can adjust their activities and communications to support the increase in projects in the first quarter and decrease the impact of the first quarter slow down.

Figure 3-5. Monthly Number of Projects and Evaluated Gross Demand Savings Over Time — Commercial Programs PY2013-2018



If the programs can effectively raise participation in the first quarter, this will alleviate pressure to accelerate programs later in the year and allow for a more even delivery. Savings claimed in the first quarter will alleviate pressure for high performance in the fourth quarter and allow for better preparation for the January launch and increased early participation.

3.3 COMMERCIAL STANDARD OFFER PROGRAMS

3.3.1 EM&V Overview

Commercial standard offer programs were “medium” evaluation priority in PY2018. These programs continue to comprise a substantial percentage of overall statewide portfolio savings. The EM&V team conducted desk reviews and on-site M&V for a sample of projects from these programs.

For the desk reviews and on-sites, the EM&V team applied the method prescribed in the PY2018 TRM 5.0 to verify energy savings and demand reduction for each project sampled. Comparing the evaluated savings to the utility claimed savings showed agreement in most cases. The average realization rates across all SOP programs were 100.3 percent and 100.4 percent for demand and

energy savings respectively.[11] Based on the results of the evaluation, the EM&V team has outlined key findings and corresponding recommendations, described below.

3.3.2 Key Findings and Recommendations

Key Finding #1: Projects with multiple building types should use the predominant building type for the energy savings calculation.

Commercial lighting and HVAC project analysis requires proper building type selection as guided by tables within the TRM. For lighting, these tables provide guidance for operating hours and summer peak coincidence factor for a variety of building types. The HVAC building type tables provide guidance for heating and cooling estimated full load hours (EFLH), demand factor (DF) based on the building type and HVAC system type. In some cases, facilities can have multiple building types at the same location, but the savings calculation requires the selection of one building type per calculator. In this case, the building type should match the predominant building type based on the surface area. This situation was typically found in projects where there was an office attached to a warehouse or manufacturing area or projects where a parking garage was incorporated into an office building or a medical facility.

This year, the building types for manufacturing was split into 1-shift, 2-shift, and 3-shift variants and it was noted that several facilities adjusted the number of shift operations frequently. Like the area approach, the number of shifts that is most common should be used to identify the buildings type. For example, if the manufacturer operates at 1-shift for 60 percent of the time and the remainder is split between 2-shifts and 3-shifts, the facility type should be “Manufacturing 1-Shift.”

Recommendation #1: Use the predominant building type for surface area and operations to calculate energy savings.

Key Finding #2: Lighting calculations use variable baseline fixture wattages between utility territories.

There are several calculators used in the implementation of the Texas energy efficiency programs. Each calculator provides baseline fixture wattages that are consistent with or lower than the TRM. The TRM does not require that the baseline fixture wattages comply with Energy Independence and Security Act (EISA) standards nor another marketplace guidance that is typical. Therefore, some calculations used the TRM listed fixture baseline wattages, while others used the marketplace available wattages.

This inconsistency is especially relevant to two types of fixtures: screw in light bulbs and fluorescent lighting fixtures.

The evaluation team sampled the projects that did not use EISA-compliant standard baselines for screw-in lamps, like the residential TRM entry. Most projects used the EISA-compliant baselines, although as it was not required, there were some projects where the overall savings were 1 percent to 7 percent higher than a project that chose to use EISA-compliant baselines. The EM&V recommends including the EISA-compliant baselines for commercial projects in Volume 3 of the TRM similarly to Volume 2 for residential projects[12].

Fluorescent lighting fixtures can use several different baseline equipment variations to determine the baseline wattages. The most typical lighting fixture currently installed is one to our fluorescent tubes

[11] These are realization rates prior to utilities adjusting savings based on evaluation results.
[12] With continued uncertainty around EISA, the 2020 TRM will not include EISA-compliant baselines at this time.

with an instant start ballast and a normal ballast factor, fixture code F4_ILL (the blank is for the number of 4' tubes in the fixture). The baseline wattage fixtures allow for the ballast to be rapid start, F4_LL, or to be undefined/magnetic ballast, F4_LE. All fixtures use the 32-watt T8 lamp (F32T8) as the baseline fluorescent tube. The instant start ballast is the lowest baseline wattage, therefore using the other baseline fixture codes increases the baseline wattage and therefore increase savings. Table 3-1 shows the comparison between the different baseline wattages that can be used in calculations.

Table 3-1: Baseline Fixture Wattage Comparison for 4-foot Tubes

2018.5 Fixture Code	Description	Lamps per Fixture	Watts per Fixture	Increased Baseline from F4_ILL
F41ILL	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (0.85 < BF < 0.95)	1	31	
F42ILL	Fluorescent, (2) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	2	58	
F43ILL	Fluorescent, (3) 48" T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	3	85	
F44ILL	Fluorescent, (4) 48", T-8 lamps, Instant Start Ballast, NLO (0.85 < BF < 0.95)	4	112	
F41LL	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	1	32	3.2%
F42LL	Fluorescent, (2) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	2	60	3.4%
F43LL	Fluorescent, (3) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	3	93	9.4%
F44LL	Fluorescent, (4) 48", T-8 lamps, Rapid Start Ballast, NLO (0.85 < BF < 0.95)	4	118	5.4%
F41LE	Fluorescent, (1) 48", T-8 lamp	1	35	12.9%
F42LE	Fluorescent, (2) 48", T-8 lamp	2	71	22.4%
F43LE	Fluorescent, (3) 48", T-8 lamp	3	110	29.4%
F44LE	Fluorescent, (4) 48", T-8 lamps	4	142	26.8%

Although it is possible that the F4_LL or F4_LE type fixtures are encountered in the field, they will be much less common that the F4_ILL fixtures. Documentation of the baseline lighting fixture ballast type is minimal and sometimes unavailable, so a picture is not always feasible and there is no opportunity during the post-install on-site inspection to determine the baseline ballast type and factor.

Recommendation #2: Update the Texas TRM commercial lighting wattage table for linear fluorescent and screw-in lamp baselines.

Key Finding #3: When the total non-operable baseline lighting fixtures exceeded 10 percent of the total, the calculation process varied.

The Texas TRM 5.0 requires that the number of non-operable fixtures be limited to 10 percent of the total facility fixture count. If the non-operable fixture count is greater than 10 percent, the baseline wattage cannot be adjusted to include the non-operational fixtures. This it to be applied for all line items in the project. Although this requirement was rarely exceeded, the EM&V team found that the impacted line items were adjusted correctly, but the finding was not applied to the other line items in the project.

Recommendation #3: Confirm lighting calculators in use utilize the Texas TRM process for non-operable fixtures.

Key Finding #4: Onsite verification found projects with sensor controls installed as spillover.

The EM&V on-site verification noted that sensors were installed for control of lighting fixtures that were not claimed in the project. It is uncertain if the sensors were claimed in a different project, but they appear to be spillover that were installed without an incentive. This spillover indicated customer interest in this measure and that may be an opportunity to increase sensor controls in lighting projects.

Recommendation #4: Consider supplying additional information to service providers regarding the benefits of sensor controls on interior and exterior lighting to include these measures in lighting projects.

Key Finding #5: Evaporative cooling systems claim interactive effects as "Other."

Projects that had evaporative cooling systems claimed the space conditioning type as "Other," which follows the Texas TRM 5.0 direction because the system is not an "Air Conditioned" type. The "Other" category provides no interactive effects benefit associated with cooling interior space and therefore is a conservative estimate of energy savings.

Recommendation #5: Consider adding an evaporative cooler space conditioning type in the Texas TRM to capture the HVAC energy interactive effects associated with this type of space cooling system.

3.4 COMMERCIAL MARKET TRANSFORMATION PROGRAMS

3.4.1 EM&V Overview

Commercial Solutions MTP, SCORE MTP, Retro-commissioning MTP and Small Business Programs were "medium" evaluation priority in PY2018.[13] The EM&V team conducted desk reviews and on-site M&V for a sample of projects from these programs.

For the desk reviews and on-sites, the EM&V team applied the method prescribed in the Texas TRM 5.0 to verify energy savings and demand reduction for each project sampled. Comparing the evaluated savings to the utility-claimed savings showed agreement in most cases. The average realization rates across MTP programs that received desk reviews and on-site M&V are outlined in Table 3-2.[14] The statewide realization rates for the different MTPs are shown below to provide additional context to the key findings and recommendations.

Based on the results of the evaluation, the EM&V team has outlined key findings and corresponding recommendations, described below. It is important to note that all key findings and recommendations outlined for the SOP programs above are equally relevant to the Large Commercial MTP programs (Commercial Solutions MTP and SCORE MTP).

[13] CoolSaver A/C Tune-Up and Solar Photovoltaic programs were "low" evaluation priority and only received a tracking system review in PY2018.

[14] These are realization rates prior to utilities adjusting savings based on evaluation results.

Table 3-2: Average Realization Rates for MTP Programs

Program	kW Realization Rate	kWh Realization Rate
Commercial Solutions MTP	100.3%	99.9%
SCORE MTP	99.4%	99.6%
Retro-commissioning MTP	54.1%	82.6%
Small Business MTP	99.6%	99.4%

3.4.2 Key Findings and Recommendations

3.4.2.1 Large Commercial MTP (Commercial Solutions MTP and SCORE MTP)

Key Finding #1: Claimed savings for New Construction projects generally only included HVAC and lighting measures.

New construction buildings are primarily claiming only HVAC and lighting improvements in the programs. The buildings that attempted to claim envelope, controls, or other improvements required a custom calculation because the Texas TRM 5.0 did not have a process to claim these savings type and new construction projects cannot be monitored like standard M&V retrofit projects. Claiming the energy savings associated with the whole building is most accurate.

The lighting and HVAC new construction measures are a variation on the retrofit measures, which uses the applicable code as the baseline. The work necessary to claim these measures in a new construction project is like a standard retrofit measure. Other measures, even if allowed as a retrofit, are not allowed as a new construction measure. This requires a custom calculation and significantly increases the amount of effort and time associated with claiming the energy savings. Without further study, it is not possible to know if the new construction projects that claim lighting and HVAC improvements also include other improvements that reduce the energy consumption of the new building. This leaves two potential scenarios. One, the upgrades include only HVAC and lighting and other energy efficiency options are not installed. Two, the whole building is constructed as an energy-efficient building creating spillover energy savings from the project.

The most common way for energy efficiency programs to offer additional new construction benefits is to require building energy modeling at code and the approved design or constructed building. This creates a holistic building savings that incorporates lighting and HVAC as well as any other improvements of the energy consumption over code.

Recommendation #1: Consider updating the Texas TRM to include a simpler way to claim additional new construction measures.

Key Finding #2: The lighting new construction limit of 10 percent non-qualifying fixtures or total watts is augmenting energy savings.

The Texas TRM 5.0 process to claim lighting savings for a new construction project has a process to handle lighting equipment that is not qualified for the program to be incorporated into the design. It is a three-stage process; the first stage removes areas and the associated lighting fixtures that are known to be unique, such as auditoriums or surgery rooms; the second stage assesses whether the percentage of non-qualified fixtures or associated wattages is below 10 percent (if one of these metrics

is above 10 percent, then areas and associated lighting is removed from the project until both metrics are below 10 percent; and the third stage applies a multiplier of five times to the wattage of the non-qualified lighting for use when calculating the energy savings against the qualified area lighting power density.

Recommendation #2: Eliminate the 10 percent non-qualifying limit for new construction projects, although keep the multiplier in place.

Key Finding #3: The date of new construction projects varies from standard retrofit projects.

It is allowable to use all energy efficiency calculators that were in use on the date of the building permit for new construction projects. For example, if a project started in PY2017 (building permit was approved in 2017) and was completed in PY2018, PY2017 lighting and HVAC calculators can be used to determine PY2018 post-install energy savings.

Recommendation #3: The date of the building permit for new construction set the grandfathered energy efficiency calculation tools.

Key Finding #4: The Midstream Lighting programs have limited guidance for commercial and industrial midstream lighting projects.

Commercial midstream projects were evaluated as part of the PY2018 Commercial Solutions MTP programs. These projects provided an incentive at the distribution point to the installing contractor with the intention of installing the equipment for a commercial or industrial eligible customer. The Texas TRM 5.0 provides guidance for residential up-stream and midstream programs and the amount of program benefits allocated to commercial customers from those sales.

The TRM does not provide guidance on the savings for purchasing from a distributor to specifically install in a commercial or industrial facility. Within the midstream program, the post-install wattage for the projects is known, but the pre-install equipment and the building type are unknown. The documentation submitted for the PY2018 projects was acceptable, although a process that provides more rigor in the data collection is recommended as the commercial midstream programs expand.

Recommendation #4: Consider updating the Texas TRM to include a method for developing the savings calculation for Commercial and Industrial Midstream Lighting programs.

Key Finding #5: There were limited custom assumptions in prescriptive projects, but the custom assumptions used in the standard calculators lacked documentation.

PY2018 projects had limited custom assumptions and generally defaulted to a TRM prescribed standard assumptions. The multi-year effort to both improve the Texas TRM and utilize standard conditions for buildings based upon type and operation worked well and limited the evaluated adjustments for standard projects. There were a small number of custom assumptions made regarding commercial and industrial building operation, which is acceptable. The assumptions, however, lacked documentation to confirm custom assumptions, and therefore the evaluation team generally found that the project should have used a TRM standard assumption.

Recommendation #5: Custom assumptions require documentation of the operation profile if it varies from the Texas TRM standard assumptions.

3.4.3 Retro-commissioning MTP

Key Finding #1: Retro-commissioning projects range in size and scope.

The PY2018 Retro-commissioning TRM entry[15] details a method to claim Retro-commissioning energy savings that generally follows Option C of the International Performance Measurement and Verification Protocol (IPMVP) framework, which requires significant pre-install and post-install monitoring and use of a regression modeling software. This process provides a high-quality estimate of the energy savings achieved through the project and assigns a 5-year estimated life to the energy savings.

The EM&V team found that the Retro-commissioning projects ranged greatly in size and scope: claimed energy savings varied from 8 kW to 400 kW and the project scope varied from a single system focus, like refrigerated storage, to a comprehensive whole building analysis and upgrade. Small projects that provide a limited amount of energy savings and improvement are unduly burdened by the rigorous IPMVP Option C method. A simpler process for small energy savings for Retro-commissioning projects would increase the opportunity to provide incentives to improve existing building operations with low cost measures. It is expected that a simplified calculator-based method will provide a conservative savings value and a shorter expected useful life from the current Commercial Retro-commissioning TRM entry. The simplified process may only allow certain building types, measures, or conditioned building areas to participate.

Recommendation #5: Consider developing simplified Retro-commissioning processes that are allowable within a limited scope, size, and energy savings of a project.

3.4.4 Small Business MTP (including Open MTP)

Key Finding #1: Manufacturer's rated lighting wattages were typically used instead of third-party rated wattages of the fixtures or lamps.

This finding is similar to Key Finding #1 under commercial lighting in the PY2017 EMV statewide report Volume I. Many small business projects evaluated required the installed watts for an individual line item to be adjusted to match DLC or ENERGY STAR listed wattages in their qualified listing. Although this happened in all lighting projects, it was more prevalent in the streamlined delivery process for the Small Business programs.

Recommendation #1: Ensure that the rated lighting wattages are using third-party qualification agencies such as ENERGY STAR and DLC.

Key Finding #2: The date of Small Business projects does not follow standard post-install application date assumption.

It was noted that the date to determine eligibility for specifications was not consistent across Small Business projects. This was noted when evaluating DLC lighting qualifications, which delisted a large quantity of lamps in April 2017. This meant that in April 2018 many of the delisted equipment could no longer be installed for an incentive per the Texas TRM 5.0.

The EM&V team understands the streamlined process for the Small Business programs requires installation trade allies to pre-purchase standard lighting equipment. Therefore, it is acceptable that the date to measure against third-party certification for equipment is the customer acceptance signature date on the project scope.

Recommendation #2: Use the date of the customer acceptance of the Small Business Program's project scope as the date of record to use for third-party equipment eligibility.

[15] Section 2.4.3 in TRM 5.0 Volume 4.

Key Finding #3: Building type entries from Small Business programs were not as accurate as other program delivery methods.

The EM&V team noticed that the building type for small business customers was less reliable than for standard lighting projects. The implementation teams should provide additional training or quality control inspections to confirm building type and provide continuous education to the installation trade allies.

Recommendation #3: Update QA/QC processes to ensure the building type is verified prior to final energy savings calculation.

3.5 DIVERSIFICATION IN COMMERCIAL END USE

The American Consortium for an Energy Efficient Economy (ACEEE) selected Tetra Tech and its co-authors CenterPoint Energy and Oncor to publish and present a conference paper on how Texas has successfully diversified end uses in the commercial programs. This section summarizes key take-aways; the complete paper is available publicly for interested readers.[16]

3.5.1 Overview

Texas, similar to many jurisdictions, heavily relies on efficient lighting to meet commercial program savings goals. The nine investor-owned electric utilities (IOUs) in Texas are effectively working to diversify the commercial program mix. Just over half of commercial savings are now coming from lighting compared to three quarters in previous program years. The programs have had particular success in increasing savings from heating, ventilation and air conditioning (HVAC), which now accounts for approximately a quarter of energy savings.

Notable achievements that combine the diversification of the measure mix with program implementation ease include standardized measurement and verification (M&V) approaches and the development of a number of new deemed savings measures. The ACEEE paper synthesized 2012 through 2017 savings information across the IOUs coupled with program design and implementation strategies employed by the two largest utilities, CenterPoint Energy and Oncor.

CenterPoint and Oncor employ different approaches to not only meet, but exceed, their commercial savings goals. Oncor's commercial portfolio has largely focused on expanding the reach of its CSOP in terms of types of customers served, participating contractors and both the technical assistance and measures offered. At the time of publication, Oncor has only one MTP targeted to the hard-to-reach small business sector with specific emphasis on the rural small business customer. However, Oncor has tried other sector-specific MTPs and plans are currently underway to include more. CenterPoint, in contrast, has a large MTP umbrella program that includes programs both targeted to specific sectors and programs targeted to specific technologies (e.g., pool pumps, recommissioning).

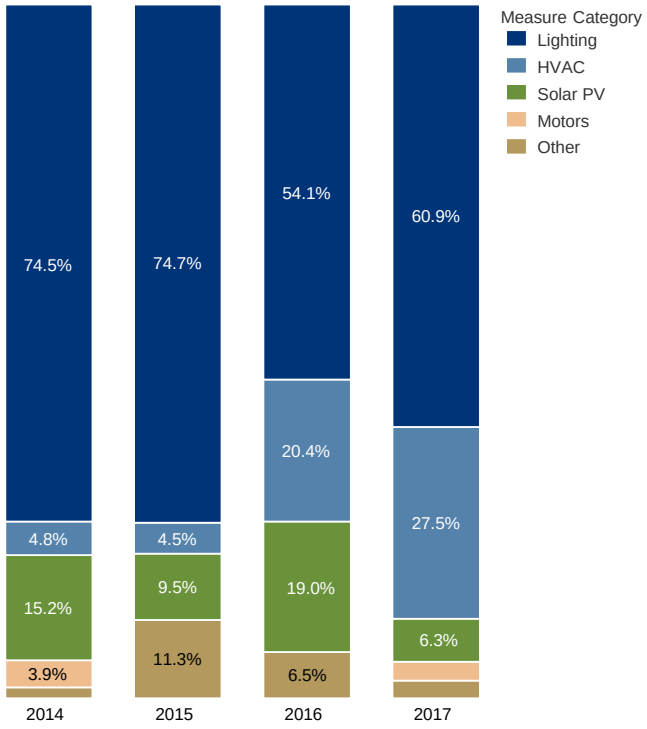
3.5.2 Oncor Successful Strategies

Historically, Oncor's energy efficiency programs have realized growth in savings, with traditional programs relying heavily on lighting equipment installations and upgrades. But as stringent building codes and standards raise the baselines and transform the energy efficiency market in Oncor's

[16] Lee, Lark, et. all, *Easing Away From Lighting: Effectively Diversifying the Commercial Measure Mix,* American Consortium for an Energy Efficient Economy, August 2018

territory, Oncor has found that achieving higher level of savings and high participation rates has become increasingly difficult. Oncor has been dedicated to pursuing less traditional program strategies to continue to produce savings and meet goals primarily with its traditional trade ally-based CSOP. One of Oncor's strategies to respond to the changing environment and market has been to provide additional resources to support diversifying the commercial measures implemented by their customers. Oncor has seen success with this strategy in 2016 and 2017. Non-lighting measures have reduced from approximately three-quarters of Oncor's commercial portfolio to just over half of Oncor's total Commercial portfolio energy savings. (See Figure 3-6.)

Figure 3-6. Oncor Commercial Evaluated Gross Energy Savings and Demand Reduction by Measure Category, Program Years 2012 - 2017. Source: Tetra Tech EM&V Database



Measures with less than 1% share in annual savings are grouped in the 'Other' category.

To move beyond the traditional lighting projects and attain the next level of energy efficiency savings, Oncor has focused on several key initiatives, including to:

- Expand outreach to increase program awareness and drive additional participation in targeted measures
- Identify and implement new program strategies and measures to diversify the portfolio
- Encourage renewable energy through incentives for commercial solar PV systems.

By leveraging these strategies, Oncor is increasing the reach of existing programs, and achieving deeper energy savings in new projects. Each of these strategies is discussed below.

3.5.2.1 Expanded Outreach

In addition to lighting, Oncor offers a variety of commercial measures including refrigeration measures, motors, thermal storage, cooling systems (variable refrigerant flow, geothermal and ground source heat pumps, chillers, air cooled and water cooled DX units) for new construction, early retirement and replace-on-burnout projects.

Starting in PY2016, Oncor decided to focus on increasing HVAC measures as the end-use most falling short of its full potential. Oncor's objective was to increase savings and participation in this end-use. To gain more traction in HVAC area, Oncor expanded its marketing scope by targeting trade allies in addition to customers. Oncor successfully recruited and provided training to 85 HVAC contactors. Utility staff engaged industry organizations like American Air Conditioning Contractors of America (ACCA) to recruit trade allies to participate in Oncor programs. In addition, Oncor created direct mail marketing materials that were sent to potential contractors identified in their service territory. Once trade ally awareness and interest were sparked, Oncor found that further support of trade allies through marketing collateral and program participation assistance was essential for HVAC trade allies to increase their participation and the sale and installation of efficient equipment. Oncor also provides technical assistance support to trade allies when M&V options are needed, engaging the PUCT's EM&V contractor as needed. This support also encourages trade allies to dig deeper for savings opportunities with larger commercial customers. Finally, Oncor provides program-eligible HVAC contractor information to customers, further promoting HVAC projects by facilitating customers search for eligible trade allies. These combined strategies have been successful in growing HVAC as part of Oncor's measure mix. Figure 3-6 above demonstrates this success, as HVAC has grown from about 5 percent of savings to over a quarter of energy savings.

Oncor's expanded outreach strategies also include additional customer segments, which again have helped bring in more diverse projects. Until recently, Oncor achieved efficiency goals through only a few participating market segments in its CSOP. Recognizing the need to expand programs into other segments, Oncor developed targeted marketing initiatives that addressed specific segment needs. Oncor tailored marketing materials for individual segments, such as automobile dealerships, apartment complexes, restaurants, and the hospitality industry. Oncor's marketing collateral demonstrates how energy efficiency can produce operational improvements and bottom-line savings for participating customers with examples from the relevant segment. Additionally, Oncor began outreach with the targeted sectors through customer meetings and industry organizations that serve these customer segments, such as the Building Owners and Managers Association (BOMA), Texas Energy Managers Association (TEMA), Fort Worth Better Buildings Challenge, and Dallas 2030. From 2016 to 2017, these targeted outreach initiatives produced an additional 51 projects in the commercial portfolio with more than half of savings from non-lighting measures.

3.5.2.2 Expanded Measures

As a result of the additional customer segments participating in Oncor's CSOP through its expanded outreach, Oncor has also been working to expand measure offerings. For example, for the health care sector, Oncor has found the majority of project opportunities in retro-commissioning and HVAC. Oncor is working the PUCT's EM&V contractor to establish a consistent retro-commissioning M&V approach to capture additional operations and maintenance improvements beyond those captured through deemed measures. Oncor also worked with the PUCT EM&V contractor to establish new deemed savings or savings approaches for variable refrigerant flow (VRF), water sourced heat pumps, air compressors and refrigeration measures. As discussed above, these measures are now added to the TRM, which will further facilitate the implementation of these measures by Oncor and other Texas IOUs.

While the small business sector has seen only lighting projects to-date, Oncor is also working to diversify the small business measure mix. Oncor launched the Small Business Direct Install MTP program to address the unique needs of small non-residential customers (<200 kW). Equally important, this program is key to reaching commercial customers in the rural counties served by Oncor that have traditionally under-participated. The Small Business Program is designed to provide convenient, turn-key energy-efficient solutions to the small business market. Oncor has long considered small commercial customers difficult to reach because of participation barriers such as lack of staff, time, money, and awareness of program offerings. The Oncor Small Business Direct Install MTP program addresses these barriers through contractor and customer education, high incentives paying up to 90 percent of projects, financing of the project balance, and direct in-person sales. In 2017, installed measures resulted in savings of 1.190 MW and 7.129MWh. This is a substantial increase over 2016 savings of 0.392 MW and 2.225 MWh. The program has been achieving its primary purpose—to reach the underserved small business community in rural areas. However, Oncor is making plans to use the customers' positive experiences in the program to open the door to new measures as they become available in the market. Oncor is currently reviewing HVAC change-out and tune-ups as additional measures. Oncor also worked with the PUCT's EM&V contractor to add two new deemed measures to the TRM that are well-suited to some small business customers: door air filtration and door gaskets for walk-in and reach-in coolers and freezers.

Looking ahead, as new technologies are essential to help move the adoption needle, Oncor will start focusing on additional non-traditional programs and measures. These will include behavioral programs, electric vehicles, advanced lighting controls, and battery storage.

3.5.2.3 Commitment to Solar

Oncor complements its traditional energy efficiency programs with a robust solar program. The Commercial Solar program provides incentives for the installation of solar photovoltaic (PV) systems to reduce upfront costs. The goal of the program is to reduce customer energy costs, reduce peak demand and save energy in existing commercial customer structures. Over the last decade, Oncor has encouraged the solar PV market by developing a program structure that responds to changing solar market conditions and meets consumer demand. Oncor provides performance assistance in addition to incentives for the small commercial segment. In 2017, Oncor successfully delivered PV accounting for 1,524 kW (2 percent of the Commercial portfolio) and 5,042,611 kWh (5 percent of the Commercial portfolio). Solar PV continues to be an important measure in both the Commercial and Residential portfolios.

3.5.3 CenterPoint Successful Strategies

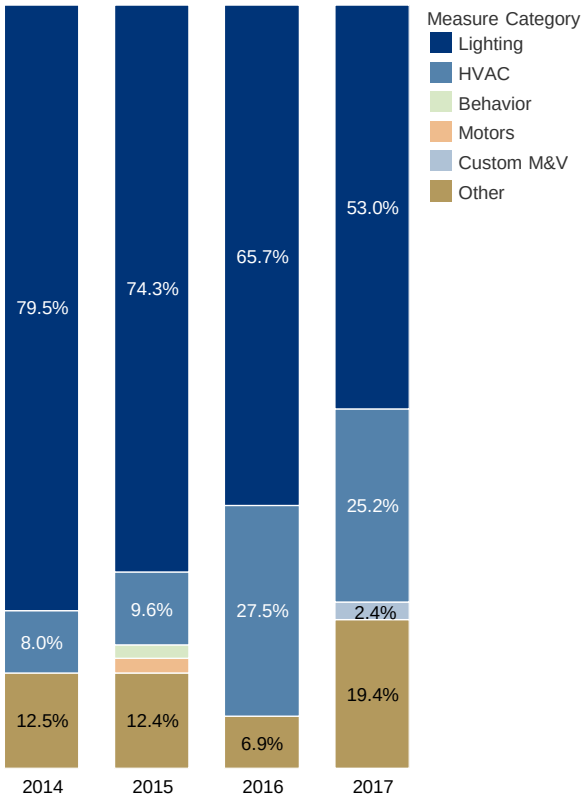
CenterPoint's strategy to engage and grow the commercial sector's participation in energy efficiency programs has evolved over the years due to several factors. Historically, the commercial market segment has been targeted through the CSOP since 2001. In the beginning, the CSOP was fully subscribed within minutes of opening for applications. However, now participation has been harder to motivate and program funds remain available throughout the year. Is this because the low-lying fruit has already been retrofitted? Are program incentives not keeping up with inflation? Are standards increasing? The answer to all three questions is yes!

What once was the only program needed to achieve CenterPoint's commercial demand and energy mandated goals has become a program that is no longer able to spend the budgeted funds. To continue to meet commercial savings goals, CenterPoint Energy expanded its commercial portfolio to include several:

- Targeted programs to specific sectors
- Specialized measure offerings.

These strategies have proven effective. CenterPoint's diversification of the commercial measure mix has increased consistently from 2014 to 2017, as shown in Figure 3-7. Savings from lighting are now just over a half of total commercial savings compared to around three-quarters in 2014 and 2015.

Figure 3-7. CenterPoint Commercial Evaluated Gross Energy Savings and Demand Reduction by Measure Category, Program Years 2012 - 2017. Source: Tetra Tech EM&V Database



Measures with less than 1% share in annual savings are grouped in the 'Other' category.

3.5.3.1 Targeted Market Sector Program Offerings

Six years into offering the CSOP broadly across the commercial sector, CenterPoint identified that schools and municipalities were not engaging in the program. To address the barriers for this sector—lack of energy efficiency knowledge, skill set, and time for its employees to implement energy efficiency projects—CenterPoint launched its first targeted program offering for public and private schools, cities, municipalities and government customers. Recently, CenterPoint added faith-based and non-profits to the mix as these entities also have similar barriers and need technical assistance to identify efficiency opportunities such as benchmarking and assistance with obtaining incentives. Having established relationships with schools has allowed the program to reach beyond lighting retrofits to more in-depth measures. In 2016 and 2017, the program focused on chillers and energy management systems, which are now resulting in half of the program's energy savings from these other measures.

With the success of the targeted program offering for schools, CenterPoint identified additional customer segments it would like to serve through market transformation programs. In 2012, CenterPoint decided to focus on smaller healthcare facilities with no dedicated energy manager looking at efficiency, but with medical equipment cooling requirements. The healthcare sector is steadily growing in opportunities. CenterPoint is educating healthcare facility staff on how cooling HVAC control strategies (scheduling, sequencing, temperature/pressure resets, etc.), demand control ventilation (DCV), HVAC/compressed air repairs, and HVAC balancing allow the facility to maintain equipment requirements while also achieving reductions in demand and energy. Additions to the TRM such as refrigeration and kitchen equipment will provide additional measures for healthcare facilities. In the last two years, the healthcare program's mix of non-lighting measures increased to 95 percent from 60 percent. CenterPoint is working with the PUCT's EM&V contractor to add demand-controlled kitchen ventilation to the TRM as another measure of interest for this sector.

In 2014, CenterPoint started targeting data centers through a Data Center market transformation program, which is now gaining traction in the market segment. Through this program, CenterPoint works with owners of facilities that have dedicated data centers, server room or closets for specialized IT-related equipment such as data storage, web hosting and telecommunications. CenterPoint has found that facility staff for data centers focus more on service reliability rather than energy efficiency. By having a third-party implementer that can speak specifically to their reliability concerns when identifying energy saving opportunities, the program has succeeded in engaging key data center customers such as CyrusOne, Level 3, Hewlett Packard and Comcast. This program is largely focused on improvements beyond lighting, with only 2 percent of savings from lighting in the last two program years.

Combined, these three programs resulted in a demand and energy reduction of 4,9711 kW and 13,114,077 kWh for PY 2017 with over three-quarters of the savings from non-lighting measures.

3.5.3.2 Specialized Measure Offerings

Identifying and promoting new measures that can be integrated into existing programs or offered as a new program is another strategy that CenterPoint uses to meet savings goals and diversify its measure mix. CenterPoint found that some types of measures were not easily implemented in its trade ally-based CSOP. To encourage greater implementation of retro-commissioning projects, CenterPoint offers a Retro-commissioning program. The focus of this optimization program is to work with existing buildings (50,000 square foot and larger) to identify no-cost or low-cost measures (up to a 3-year simple payback) which the customer can implement to reduce the demand and energy usage in commercial facilities. The program is designed to provide end-users with a free engineering analysis to improve the performance within their facilities that will reduce electric demand. Facility owners are required to implement all of the identified measures with simple payback of less than 1.5 years or pay towards the cost of the analysis. Customers do not receive capital improvement incentives in this program but can participate in other programs that do incentivize capital measures. CenterPoint continues to look for ways to engage the commercial customers and worked with the City of Houston in 2016 to support an initiative to require existing buildings to conduct ASHRAE Level 2 audit. Unfortunately, the city was not successful in getting this ordinance approved. In 2017, the program delivered 0.2 MW and 2,111 MWh. To increase participation, the program implementer hired a dedicated individual to market the program and 2018 is already in a strong position to spend the filed budget and meet projected savings goals.

CenterPoint also offers an air conditioning tune-up program. While air conditioning tune-ups first took hold in the residential sector, their reach has increased to commercial customers. Air conditioning tune-ups promoted through CenterPoint's Retail Electric Provider Program (REP) identify small to medium

commercial customers for participation and delivered 0.1 MW and 223 MWh in PY 2017. The REP program is unique to Texas's deregulated ERCOT market as the IOUs works with REPs to promote energy efficiency. The REPs have a relationship with customers as their chosen generation source of electricity. CenterPoint is looking for additional ways to promote air conditioner tune-ups, such as engaging directly with the customer and promoting the measure through other programs.

CenterPoint worked with the EM&V contractor to establish deemed savings for both residential and commercial pool pumps that are now in the TRM. CenterPoint first offered this measure as a pool pump market transformation program. However, the commercial variable speed pool pump measure had little participation as a stand-alone market transformation program due to health code concerns. Moving into 2018 CenterPoint plans to switch to a midstream delivery mechanism. CenterPoint is engaging with the pool pump distributors who can assist with identifying firms that service commercial facilities and help them address health code concerns. CenterPoint is pursuing other midstream delivery mechanisms for non-lighting measures such as an A/C distributor program.

In addition to the targeted customer segment and measure offerings, CenterPoint will continue to look for opportunities to increase awareness of program offerings across all large and small commercial customers through its Key Accounts and Service Area Consultants that have front line communications with these customers on a daily basis.

3.5.4 Conclusion

CenterPoint and Oncor utilize a variety of means to meet their commercial savings goals and diversify their measure mix. Oncor's commercial portfolio has largely focused on expanding the reach of its trade ally-based CSOP with particular success in engaging and expanding its HVAC contractor relationships and solar PV offerings. Oncor's expanded outreach to trade allies and customers has been strengthened by working with various professional and commercial associations and organizations and includes targeted marketing collateral. The end result is more diverse customer segments with more diverse energy efficiency needs. Oncor's small business market transformation program complements its CSOP and Oncor is currently considering other segment focused programs. CenterPoint has achieved success in diversifying its measure mix largely through targeted market transformation program offerings for either specific customer segments or for specific efficiency improvements. CenterPoint is considering additional opportunities, including midstream programs, to continue to cast a wide net across commercial offerings. Both utilities have successfully worked to introduce new measures to their customers with adequate technical support. These new measures are then codified in the TRM, which promotes streamlined application of more commercial measures for all nine of the Texas IOUs as well as other users of the TRM such as other municipal and cooperatives utilities in Texas that also use the TRM.

Both Oncor and CenterPoint have found that energy efficiency has entered a new era and are diversifying their portfolio to be part of the new era. They have been able to achieve high levels of savings from targeted sector outreach and program offerings, targeting rural areas, trade ally engagement, and expanding measures. They will continue to leverage the existing strategies to improve existing programs and continue to address barriers to participation, optimize incentive levels and increase customer and service provider satisfaction.

4.0 RESIDENTIAL ENERGY EFFICIENCY PROGRAMS

The EM&V team evaluated the residential energy efficiency programs described below. Like the Commercial Energy Efficiency Programs, there are Residential SOPs and MTPs. The Residential SOPs provided by the Texas utilities offer standard incentives for a wide range of measures that are bundled together as a project to reduce system peak demand, energy consumption, and energy costs. The Residential MTPs offered in Texas are designed as a strategic effort to make lasting changes in the market that result in increased adoption of energy efficient technologies, services, and practices. The MTPs are designed to overcome specific market barriers that prevent energy-efficient technologies from being accepted. On the residential side, Hard-to-Reach (HTRs) are also offered. The HTR programs were developed to provide comprehensive energy efficiency retrofits for single-and multi-family customers who meet the income guidelines of the program. Next, we describe the programs evaluated in PY2018.[17]

Residential SOP provides incentives to project sponsors for a wide range of retrofit measures that reduce demand and save energy in single-family and multi-family buildings. Residential SOPs target retrofit measures for residential customers, with incentives paid to project sponsors for qualifying measures that provide verifiable demand and energy savings. The program is open to all qualifying energy efficiency measures, including, but not limited to: air conditioning, duct sealing, weatherization, ceiling insulation, water saving measures, and ENERGY STAR windows.

Hard-to-Reach SOP provides incentives to project sponsors for a wide range of retrofit measures that reduce demand and save energy in residential buildings for customers whose annual total household income is at or below 200 percent of current federal poverty guidelines. Incentives are paid to project sponsors for qualifying measures installed such as air conditioning, air conditioner tune-ups, duct sealing, weatherization, ceiling insulation, water saving measures, and ENERGY STAR windows.

Residential Solutions MTP provides incentives to customers through participating contractors for a wide range of retrofit and new construction measures that reduce demand and save energy in residential buildings. The program also provides technical assistance and education on energy efficiency measures.

Hard-to-Reach Solutions provides incentives to customers whose annual total household income is at or below 200 percent of current federal poverty guidelines through participating contractors for a wide range of retrofit and new construction measures that reduce demand and save energy in residential buildings. The program also provides technical assistance and education on energy efficiency measures.

Residential Midstream MTP (e.g., A/C Distributor) provides incentives to the regional HVAC and pool pump distributors to reduce the cost and facilitate the installation of more efficient equipment, such as high-efficiency air conditioners, pool pumps, and heat pumps.

New Homes MTP targets several market participants, primarily homebuilders and consumers. The program's goal is to create conditions in which consumers demand energy-efficient homes and homebuilders supply them. Incentives are paid to homebuilders who construct homes to strict energy-efficient building guidelines. For PY2018, the programs used a combination of mandatory, additional

[17] Additional programs implemented by the utilities in PY2018 were given low priority for this evaluation and thus were not evaluated.

elective, and innovative measures to promote market transformation and drive deep energy savings. ENERGY STAR and complete foam encapsulated homes were offered as alternative pathways. Each home results in verifiable demand and energy savings. In addition to homebuilder and consumer outreach, the New Homes MTP targets key market actors in the homebuilding production and sales cycle: home energy raters, homebuilder sales agents, real estate agents, HVAC contractors, mortgage lenders, product manufacturers, homebuilder associations, and media outlets.

CoolSaver A/C Tune-Up MTP is designed to overcome market barriers that prevent residential and commercial customers from receiving high performance A/C system tune-ups. The program works through local A/C distributor networks to offer key program components, including (1) training and certifying A/C technicians on the tune-up and air flow correction services and protocols and (2) paying incentives to A/C contactors for the successful implementation of A/C tune-up and air flow correction services. Contractors who wish to participate enter into a contractor partnering agreement that specifies the program requirements. Contractors are trained on the A/C tune-up process and offered incentives and discounts for the cost of field equipment designed to diagnose and quantify energy savings opportunities. Energy savings are captured through the correction of A/C system inefficiencies identified during the tune-up activities.

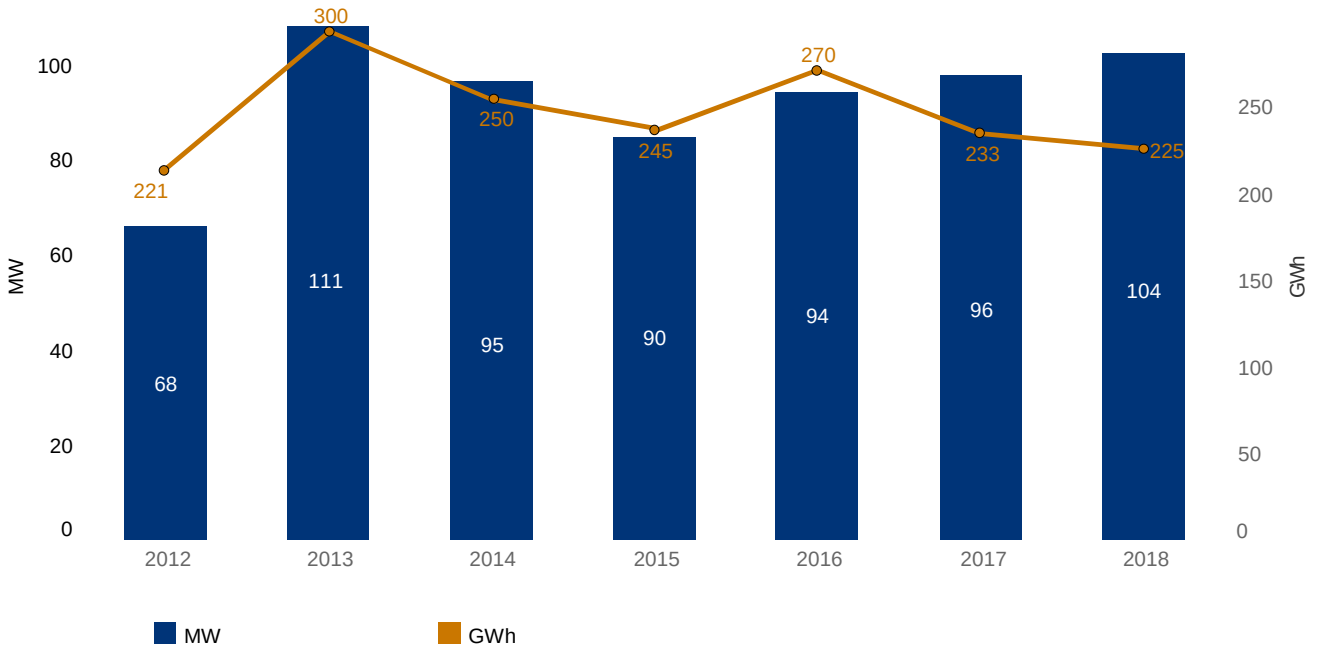
The EM&V team conducted a streamlined EM&V effort that coupled broad due diligence verification of savings with targeted in-depth activities including engineering desk reviews and on-site M&V based on the prioritization of the programs.

4.1 SUMMARY RESULTS

This section first presents a synopsis of the residential sector results, followed by a summary for each program type (SOP, HTR, and MTP), including key findings and recommendations from all relevant EM&V activities and details from the process evaluations and net-to-gross research (where applicable).

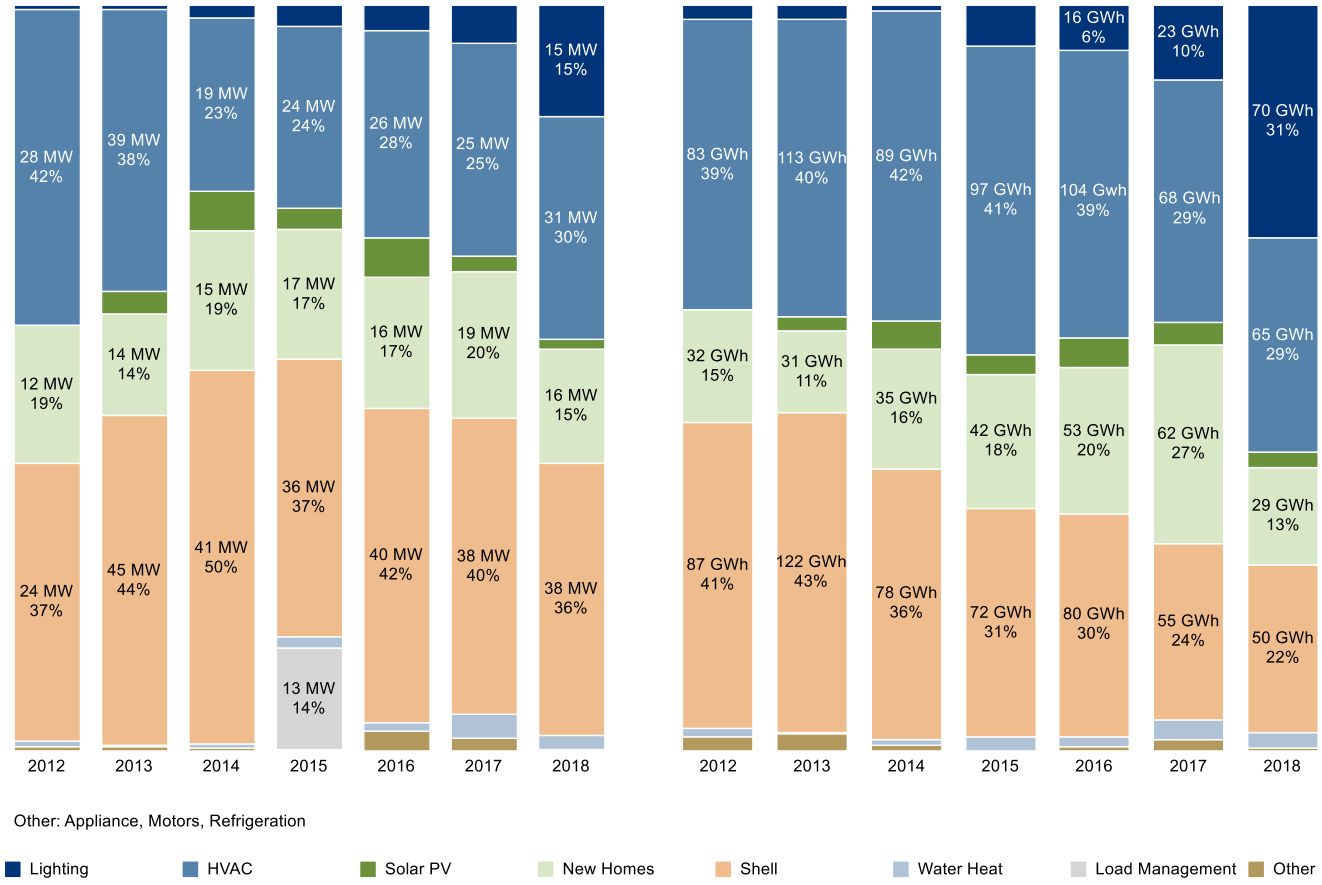
Statewide PY2018 evaluated demand reduction from residential sector programs was 104,200 kW and the evaluated energy savings was 224,788,063 kWh. As seen in Figure 4-1, the demand reduction achieved in PY2018 increased slightly from PY2017 and is the highest amount saved at a statewide level since PY2013. Conversely, PY2018 saw a decrease in energy savings compared to previous program years, with the amount saved in PY2018 being the lowest achieved since PY2012.

Figure 4-1. Total Statewide Evaluated Gross Demand Reduction and Energy Savings by Program Year – Residential Programs



For PY2018, the majority of residential demand reduction was derived from new homes (32 percent), followed closely by lighting and shell measures (29 percent each). The majority of energy savings was from lighting measures (52 percent), with new homes and shell measures making up a majority of the remainder of savings (23 percent and 16 percent, respectively). Figure 4-2 presents the breakdown of savings by measure category and demonstrates that the utilities have been successful in diversifying their measure mix for residential savings.

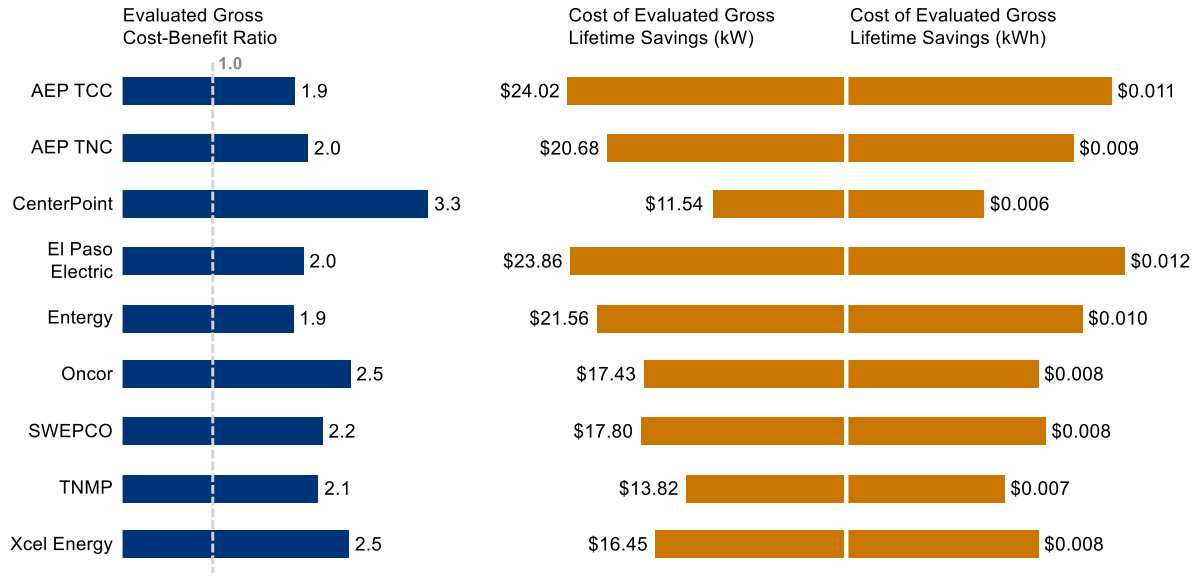
Figure 4-2. Distribution of Statewide Evaluated Gross Demand Reduction and Gross Energy Savings by Measure Category – Residential Programs PY2018



Residential sector programs' cost-effectiveness statewide is 2.2 based on evaluated gross savings and 1.9 based on evaluated net savings. Like the commercial sector, the residential sector cost-effectiveness varied among utilities, with evaluated gross savings results ranging from 2.2 to 4.3 and evaluated net savings results ranging from 2.0 to 2.5. As with the commercial sector, this is in part due to the differences in the types of programs offered by different utilities.

Figure 4-3 summarizes the cost-effectiveness of each utility's residential energy efficiency portfolio and the cost of lifetime kWh and kW for each utility's residential sector programs. The cost per kWh ranges from $0.004 to $0.010, and the cost per kW ranges from $9.01 to $20.68. These costs provide an alternative 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.

Figure 4-3. Evaluated Cost-benefit Ratio and Cost of Lifetime Savings—Residential Programs PY2018

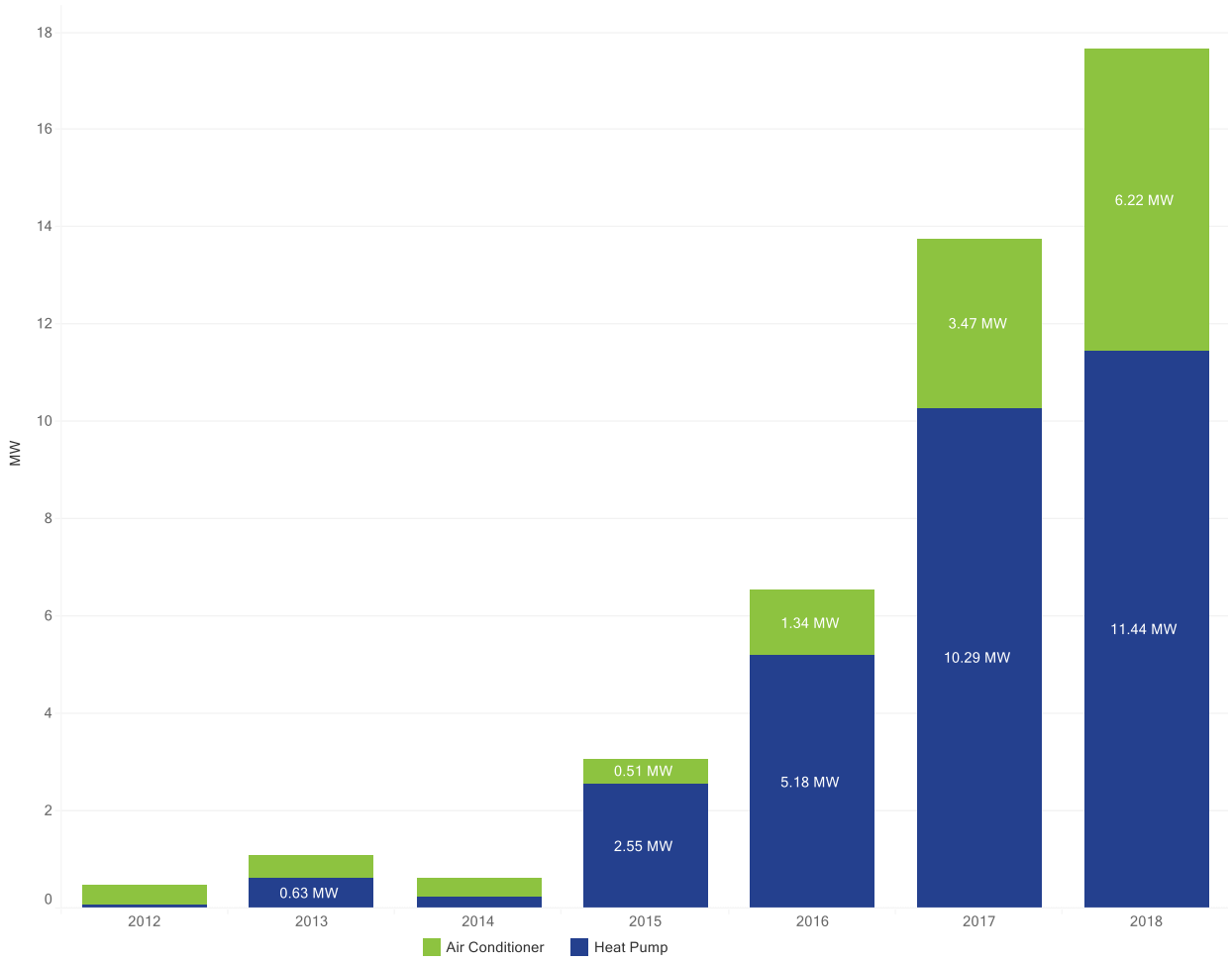


4.1.1 Increase in HVAC

In PY2015, the EM&V team performed a consumption analysis, which showed an opportunity for substantial savings by increasing the mix of measures implemented within the programs. That is, the EM&V team recommended utilities integrate delivery to optimize installations within a household and avoid lost opportunities. Due to the contractor-driven design of programs, individual households may be served by a contractor who only recommends the equipment with which he or she is familiar, rather than diagnosing other energy efficiency opportunities at the time of participation. The EM&V team also recommended that the number of contractors offering program incentives be increased.

The utilities have deployed various methods to increase participation in HVAC equipment measures including increased outreach within their SOPs and introducing midstream distributor MTP programs. Additionally, the central air conditioner and heat pump measures updates in the TRM have made these measures more user-friendly in an effort to encourage more participation among EESPs. The EM&V team found that there has been a steady uptick in HVAC measures installed across the utility programs since 2015, as shown in the Figure 4-4. This figure shows summed evaluated kW (expressed as MW) for Residential SOP and MTP programs from 2012-2018, broken out by two key measures categories—air conditioners and heat pumps. The EM&V team encourages utilities to continue to recruit additional EESPs to offer program incentives and to promote a mix of measures in residential programs.

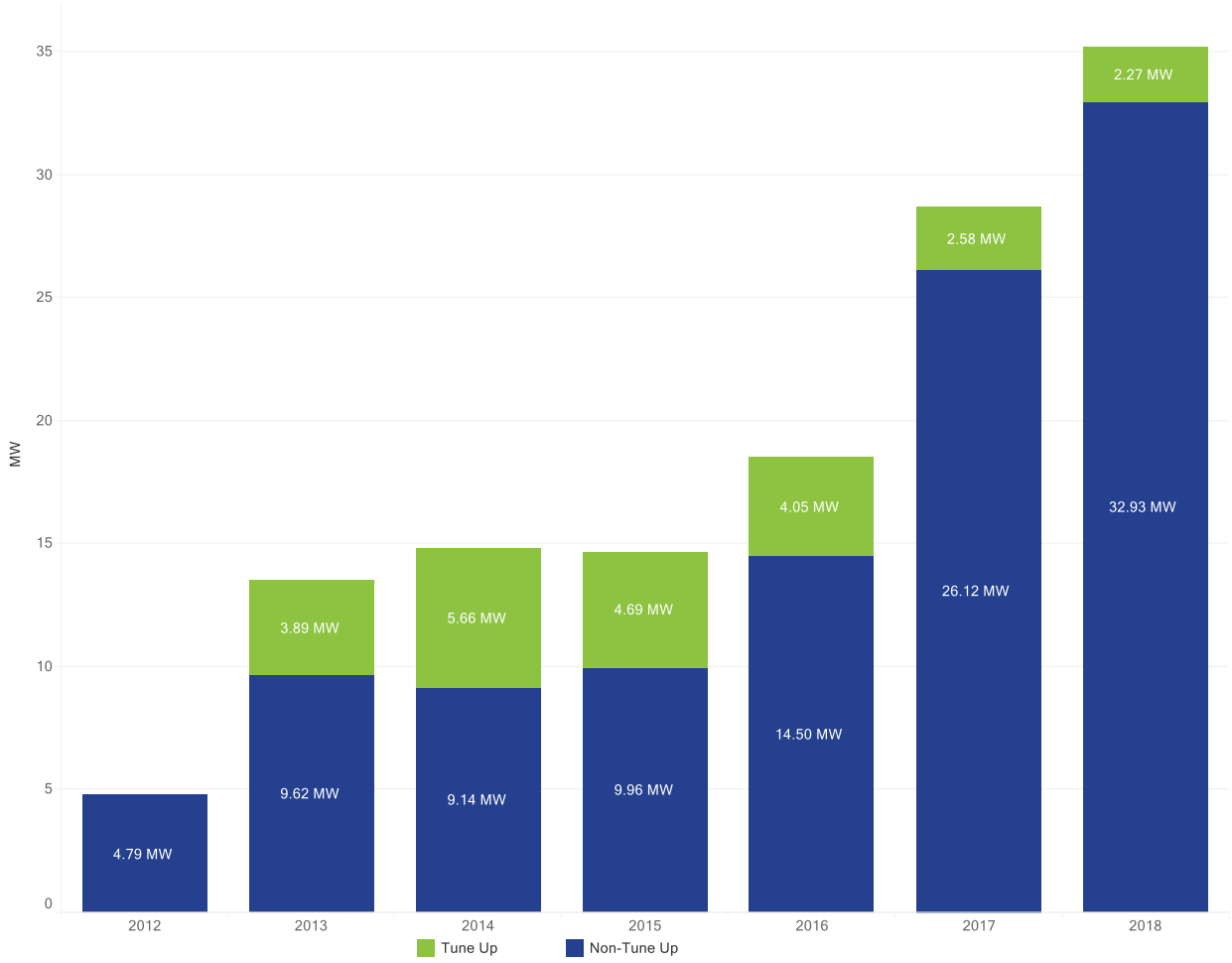
Figure 4-4. Evaluated Savings of Air Conditioner and Heat Pump Measures in Residential SOP and MTP Programs by Program Year



4.1.2 Tune-ups Versus Equipment

Cross-sector CoolSaver A/C tune-up programs were designated as a “low” evaluation priority in PY2018 and as a result received only a tracking system review in PY2018. While a low evaluation priority, there was still a fair amount of interest in the performance of this program. Figure 4-5 shows summed kW (expressed as MW) for all HVAC measure categories across the residential programs from 2012-2018. To show the effect of the tune-up measure category, the figure is comparing the tune-up measure to all other HVAC measures (e.g., air conditioner, heat pump, etc.). In comparison to all HVAC measures, residential air conditioner tune-ups have been a smaller contributor to the overall mix of measures the past two years.

Figure 4-5. Evaluated Savings of Tune-up Measures Compared to All Other HVAC Measures in Residential Programs by Program Year



4.2 RESIDENTIAL STANDARD OFFER AND HARD-TO-REACH PROGRAMS

4.2.1 EM&V Overview

Residential SOPs were designated as “medium” evaluation priority for PY2018. These programs continue to comprise a considerable percentage of overall statewide portfolio savings and have been responding to substantial TRM updates to the envelope measures. Moreover, the EM&V team has recommended expanding the measure mix in these programs. As part of the impact evaluation, the EM&V team conducted desk reviews and on-site M&V for a sample of projects and conducted telephone surveys to inform HVAC net-to-gross from the Residential SOPs and HTR programs.

For the desk reviews and on-sites, the EM&V team applied the method prescribed in the PY2018 TRM 5.0 to verify energy savings and demand reduction for each project sampled. Comparing the evaluated savings to the utility claimed savings showed agreement in most cases. The aggregated desk review realization rates across all Residential SOP and HTR programs were 100.3 percent and 98.9 percent

for demand and energy savings respectively.[18] The main driver of these realization rates was M&V on-site results that differed from reported results. Based on the results of the evaluation, the EM&V team has formulated key findings and corresponding recommendations, described below.

4.2.2 Key Findings and Recommendations

Key Finding #1: Determining the baseline for ceiling insulation projects where varying levels of existing insulation are present is handled differently across utilities due to a lack of guidance in the TRM.

The EM&V team recognizes that determining the effective R-value of ceiling insulation takes into account several factors, including square footage. However, the TRM lacks guidance on how to accurately and consistently determine the effective R-value in attics where varying levels of existing insulation can be found across multiple areas. The savings in these cases are currently calculated one of three ways: 1) using a weighted average R-value applied across the total floor area; 2) using an area-weighted U-factor converted to R-value and applied across the total floor area; or 3) treating each area as a separate measure and summing the savings to find the total for that project. The EM&V team finds the most accurate way to estimate savings is to use an area-weighted U-factor and convert to find the effective R-value, because U-factor is the actual energy loss per square footage.

Recommendation #1: Utilities should implement the U-factor methodology by working closely with the implementers and EESPs.

Key Finding #2: From on-sites that were conducted, the EM&V team found that in some cases, completed duct sealing measures had been undone by HVAC maintenance staff.

During on-site M&V, the EM&V team found that for several completed duct sealing measures, the measures had been undone by maintenance staff and not reinstalled. In some cases, the mastic tape used to seal joints was removed or damaged and not replaced resulting in an increase in duct leakage. In one case, gaps were left between the wall and air handler unit resulting in a loss in pressure and increasing air infiltration as well as duct leakage. For all affected projects, this resulted in a substantial increase in air infiltration and duct leakage from what was claimed by the utility and the EM&V adjusted savings accordingly.

Recommendation #2: Utilities should consider developing education materials to leave with homeowners about upkeep of the improvements completed by the contractor and perhaps include information on what happens if these energy efficiency improvements are changed in some way.

Key Finding #3: The deemed savings from the attic encapsulation measure (TRM v5.0 2.3.3) were lower than what the EM&V team would expect for this type of measure.

The EM&V team found very low usage of the attic encapsulation measure across residential programs. Through investigation of this measure, the EM&V team found the savings to be substantially lower than expected. The attic encapsulation measure has two savings components, 1) an air sealing component and 2) a roof deck insulation component. Given the multifaceted nature of this measure, the EM&V team would have expected the savings to be greater than the ceiling insulation measure (TRM v5.0 2.3.2) of the same R-value. Instead, the EM&V team found the modeled savings of the roof deck component were lower than the ceiling insulation measure savings. This discrepancy likely led to the low usage of this measure. In an attempt to increase usage, the EM&V team issued a guidance memo allowing for the utilities and their service providers to use the ceiling insulation measure savings from TRM v6.0 2.3.2 for the insulation component in lieu of the attic encapsulation measure savings.

[18] These are realization rates prior to utilities adjusting savings based on evaluation results.

Recommendation #3: Utilities should consider implementing the recommendations for attic encapsulation from the EM&V team's guidance memo[19] starting in PY2019.

Key Finding #4: HVAC capacity bins were not aligned with what is being sold on the market.

Historically, the central air conditioner and heat pump measures had reported capacity based on nominal tonnage, but during the PY2019 TRM update process the reported capacities were updated to rated British Thermal Units per Hour (BTUh), which is industry best practice. The updated rated capacity ranges in TRM v6.0 were specified with a 5 percent tolerance in accordance with the Air Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 210/240[20] to account for systems that are rated slightly below the applicable nominal capacity. Based on distributor feedback provided to the Texas electric utilities, the EM&V team worked with the Electric Utilities Marketing Managers of Texas (EUMMOT) to update the ranges to be more aligned with how the deemed savings are calculated and how central air conditioner and heat pump systems are manufactured and sold in Texas. The EM&V team issued a guidance memo with updated capacity ranges for PY2019 and will update the PY2020 TRM.

Recommendation #4: Utilities should consider implementing the recommendations for HVAC capacities from the EM&V team's guidance memo[21] starting in PY2019.

Key Finding #5: HVAC contractor net-to-Gross estimates support utilities continuing to encourage efficient HVAC equipment adoption.

During PY2017 evaluation, the EM&V team researched net-to-gross for residential SOPs and learned that participants who received HVAC were not able to report on their experience. The EM&V team spoke with contractors during PY2018 evaluation. The contractor survey analysis estimates net-to-gross for HVAC equipment at around 95 percent, which is slightly higher than the estimates for other measures and confirms that the utilities programs have a significant influence on customers' and contractors' decisions.

Recommendation #5: Utilities should continue to encourage efficient HVAC adoption as a component of their portfolios.

4.2.3 Impact

For the residential program impact evaluation, measures evaluated were prioritized based on the largest portion of contribution to the savings across program types. Stratum sample sizes for each utility reflected the proportion of savings derived from the prioritized measures. Thus, the sample for each utility represented the savings from that utility and the combined sample reflected the distribution of savings across utilities.

Both desk reviews and on-sites were completed for each utility's Residential SOP programs. For the desk reviews, the EM&V team drew a stratified sample of prioritized measures for evaluation—air infiltration, ceiling insulation, duct efficiency, and central air conditioners and heat pumps. For the HTR programs from each utility, both desk reviews and on-sites were also completed. For the desk reviews, the EM&V team drew a stratified sample of the three prioritized measures for evaluation—air infiltration, ceiling insulation, and duct efficiency. For these two residential program types, the on-site sample was nested within the desk review sample, meaning that desk reviews were conducted for each of the

[19] Residential Attic Encapsulation Guidance Memo, issued May 20, 2019.
[20] http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf
[21] Residential HVAC Capacity Guidance Memo, issued March 28, 2019.

completed site visits. The EM&V team also collected data for other rebated measures while on site beyond the prioritized measures to provide an additional check on installation rates.

4.2.4 HVAC Net-to-Gross

The EM&V team researched net-to-gross with residential SOP participants during the PY2017 evaluation and discovered that these participants were not able to speak reliably about all aspects of their HVAC purchases. The team followed up with participating energy efficiency service providers (EESPs) in PY2018 to gather additional information about the effect of the programs on the residential HVAC market in Texas. This section presents a summary of the methodology and key findings from the residential HVAC net-to-gross (NTG) research.

4.2.4.1 Free-ridership

Free-ridership analysis attempts to estimate the proportion of savings that stem from customer actions that would have happened in the absence of the program. Customers who would have completed the same project at the same time without the program's intervention are considered free-riders. The EM&V team spoke with 63 EESPs who participated in one or more utilities' residential SOPs in PY2018. The EESP responses were weighted by the kWh and kW contributions from measures installed by that EESP to account for different levels of participation by different EESPs. The PY2018 EESP survey resulted in free-ridership of 24 percent weighted by kW and 25 percent weighted by kWh.

4.2.4.2 Spillover

Spillover refers to additional energy-saving equipment that was installed in the utilities' service areas without receiving an incentive or direct intervention from the utility. Of the 63 EESPs that completed an interview, 34 reported they did not install any efficient HVAC in the utilities' service areas without a utility incentive. There were two EESPs for which the spillover results were capped at 200 percent; originally, they were calculated at 574 percent and 1500 percent. EESP spillover results also were weighted by the tracked kW and kWh associated with projects they completed; the weighting did not result in different spillover estimates by savings type and the analysis resulted in a spillover rate of 19 percent.

The spillover result is reasonable for two reasons. First, EESPs are in a better position to understand the influence of the utilities' programs on the overall HVAC market and can speak to the programs' effect on overall efficient HVAC sales. Second, the spillover result reflects that EESPs have changed their sales practices due to program influence even in cases where the utility does not directly incentivize a project. The EM&V team recommended in PY2016[22] that utilities should not claim gross savings for projects where there is not a direct incentive or utility intervention, such as when an EESP has reached their incentive cap. However, this spillover analysis recognizes that the programs influence EESPs and customers to install efficient HVAC even when EESPs have reached their incentive cap.

4.2.4.3 Net-to-Gross Results

Table 4-1 shows the results from the EESP net-to-gross analysis. The net-to-gross ratio for residential SOP HVAC equipment is 95 percent weighted by kW and 94 percent weighted by kWh.

[22] Incentive and Claimed Savings Guidance Memo, January 5, 2016.

Table 4-1. PY2018 Residential SOP HVAC EESP Net-to-Gross Results

Savings Type	Free-ridership	Spillover	NTG Ratio
kW	24%	19%	95%
kWh	25%	19%	94%

For reference, Table 4-2 shows the NTG estimates from PY2017 based on participant survey responses for non-HVAC measures. The results from the PY2017 customer survey and the PY2018 EESP survey are similar, although EESPs reported slightly higher free-ridership and spillover.

Table 4-2. PY2017 Residential SOP Non-HVAC Participant Net-to-Gross Results

Savings Type	Free-ridership	Spillover	NTG Ratio
kW	17%	2%	86%
kWh	16%	8%	92%

The EM&V team combined the two results by applying the PY2017 customer results to all non-HVAC measures and applying the PY2018 EESP results to all HVAC measures. This produces a weighted NTG result that incorporates the two research efforts. The combined NTG results are shown in Table 4-3.

Table 4-3. Combined Residential SOP Net-to-Gross Results

Savings Type	Free-ridership	Spillover	NTG Ratio
kW	20%	9%	89%
kWh	21%	14%	93%

4.3 RESIDENTIAL MARKET TRANSFORMATION PROGRAMS—A/C DISTRIBUTOR AND NEW HOMES

4.3.1 A/C Distributor

4.3.1.1 EM&V Overview

The A/C Distributor programs were medium priority in PY2018. EM&V activities included conducting desk reviews, gathering process information, and updating net-to-gross through benchmarking research triangulated with market actor interviews.

4.3.1.2 Key Findings and Recommendations - Impact

Key Finding #1: An incorrect baseline was identified for two of the eight projects sampled among programs.

The EM&V team found discrepancies in the baselines for two projects. The first project had discrepancies in the age of equipment reported in the tracking data compared to what was found in the documentation. The second project had a discrepancy in the type of baseline equipment reported. In both cases the desk review identified these discrepancies through a review of the photo documentation provided.

Recommendation #1: Utilities should be cognizant when reviewing documentation that all necessary information input into their tracking database aligns with both the photo documentation and field checklist.

Key Finding #4: HVAC capacity bins were not aligned with what is being sold on the market.

Historically, the central air conditioner and heat pump measures had reported capacity based on nominal tonnage, but during the PY2019 TRM update process the reported capacities were updated to rated British Thermal Units per Hour (BTUh), which is industry best practice. The updated rated capacity ranges in TRM v6.0 were specified with a 5 percent tolerance in accordance with the Air Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 210/240[23] to account for systems that are rated slightly below the applicable nominal capacity. Based on distributor feedback provided to the Texas electric utilities, the EM&V team and Frontier Energy agreed that the ranges should be updated to be more aligned with how the deemed savings are calculated and how central air conditioner and heat pump systems are manufactured and sold in Texas. The EM&V team issued a guidance memo with updated capacity ranges for PY2019.

Recommendation #4: Utilities should consider implementing the recommendations for HVAC capacities from the EM&V team's guidance memo[24] starting in PY2019.

4.3.1.3 Key Findings and Recommendations - Process

Key Finding #1: Interviews with A/C Distributors consistently identified program paperwork and processes as a barrier to program participation.

Recommendation #1: Examine the program paperwork and processes to streamline the process and remove possible barriers for contractors and end-use customers.

Key Finding #2: Respondents indicated that a wait time of 60 days (or more) was common for program incentive payments and a source of program dissatisfaction.

Recommendation #2: Evaluate the processes of processing program paperwork.

4.3.1.4 Impact

As part of the impact evaluation, the EM&V team conducted desk reviews for a sample of projects from the A/C Distributor programs. The EM&V team applied the method prescribed in the PY2018 TRM 5.0 for central air conditioners and heat pumps to verify energy savings and demand reduction for each measure sampled. Comparing the evaluated savings to the utility claimed savings showed agreement in most cases. The aggregated desk review realization rates prior to utility adjustments across the A/C Distributor programs were 68.5 percent and 74.7 percent for demand and energy savings respectively.[25] The main drivers of these realization rates were two projects where the incorrect baseline information was reported based on the documentation provided.

[23] http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_210-240_2017.pdf
[24] Residential HVAC Capacity Guidance Memo, issued March 28, 2019.
[25] These are realization rates prior to utilities adjusting savings based on evaluation results.

4.3.1.5 Process Evaluation

This section summarizes findings from the process interviews completed with PY2018 distributor participants.

Study methodology

The EM&V team designed the interview guide around key researchable topics aimed at assessing distributors' program experiences and their opinions about market transformation of the HVAC market. The distributor participants interviewed sold both HVAC and pool pump equipment. Summary interview results are presented in the following subsections. Specifically, the evaluation aimed to characterize the customer experience in the following areas:

- Program awareness
- Program interactions and involvement
- Program influence
- Satisfaction with the program

The EM&V team completed telephone surveys with three A/C Distributor program participants in June 2019.

Program awareness

Distributors were asked how they first learned about the Texas A/C Distributor programs. All three respondents said they heard about the program through utility outreach (n=2) or contact from an implementation contractor representative (n=1). One respondent had just started working with the program within the past year; the other two indicated they had been working with energy efficiency programs of this type for many years and could not recall exactly when their program involvement began. Respondents' reasons for deciding to participate in the program were attributed to a key theme: program incentives helped them sell energy efficiency equipment more effectively.

Program interactions and involvement

Handling of the program incentive varied across the three distributors interviewed. One respondent indicated she never linked the incentive to the actual utility when promoting the program, while another respondent indicated this did not apply to his scenario because he was not personally promoting the program incentive due to his lack of interaction with end-use customers. The third respondent reported he always promoted the available incentive as a utility incentive. When this distributor was asked if customers were aware of the A/C Distributor program before he mentioned it to them, he indicated that some customers knew, while others did not. The difference in how distributors promote the program and its available incentives presents an opportunity to link the program incentive to utility involvement and sponsorship.

All three distributors interviewed have handled the payment of the program incentive the same way. Contractors or installers that the distributors partner with pass the incentive through to the end customer via a price mark down (i.e., an account credit on final project bill). Once the project is processed by the program, the incentives are paid to the distributors, who then distribute the incentive payment to the contractor or installer who worked on the project. Two of the three distributors volunteered information about keeping a portion of the incentive; one respondent indicated he keeps 3 percent to cover administrative processes and to settle any contractor disputes (if any) about incentive payment coverage; the second respondent indicated his company retains 30 percent of the incentive

payment, with the other 70 percent being distributed to the contractor or installer who completed the project installation.

Respondents had comments about the incentive payment process. First, two of three respondents mentioned the incentive payment processing time—regularly 60 days or more—was too long and caused strain among their contractor base. One respondent did note that this year the program had gone to batching incentive payments twice per month, instead of once per month, and that had slightly improved payment timelines thus far. However, he felt strongly that more could be done to pay incentives in a timelier manner, processing rebates within one to two weeks' time. Another respondent said that while he and his company were grateful for the program and the incentive it provided his customers, he recommended "removing the middleman" and eliminating the A/C Distributor program completely. While he acknowledged it would create an initial revenue loss for his company, he went on to explain that if the program budgets and incentives flooded into the downstream customers instead, he was confident he could make up equipment sales and activities in direct-to-customer options.

A/C Distributor survey respondents were asked to detail program barriers to participation. First, distributors were asked to identify barriers to customer investments in installing energy efficiency equipment; multiple answers were allowed. Two of three respondents reported a key customer barrier was the actual product or equipment price. Another barrier was named twice among respondents—the lack of sales training among contractors. One respondent explained that while contractors may be very good at technically installing equipment, they often lack training or interest in explaining how equipment with greater efficiency can save on energy costs (and provide other benefits) down the line over the equipment life. Another respondent noted that particularly in distribution of pool pumps within new home construction projects, builders can lack knowledge on energy-efficient equipment options and tend to not make it part of their final package pitch or bid.

Distributor respondents were further asked to list primary barriers to actual customer participation in the program. One respondent reported that the front-end money and paperwork were too onerous for many end-use customers. Two other respondents indicated that they felt the program has occasionally been deemed too much of a hassle to participate; when probed, both respondents pinpointed the program paperwork as the key participation hurdle. They went on to detail items like the physical customer signature and load calculations as being particularly burdensome. Requests for program paperwork to be streamlined were reiterated when respondents were asked for suggestions on how the Texas utilities could improve the A/C Distributor program.

Program influence

Distributor respondents were asked to rate the importance of the A/C Distributor program overall in influencing their decision to recommend the energy- efficient HVAC upgrades to customers, using a 10-point scale, where 0 was "not at all important" and 10 was "very important." Two respondents rated the program a 10 and the third respondent rated the program a 4. When asked to use a likelihood scale to assess the likelihood of selling program-qualifying energy-efficient equipment to customers if the program had not been available, where 0 was "not at all likely" and 10 was "very likely," ratings varied. One respondent rated the likelihood a 10, another respondent said 8, and the third respondent rated the likelihood a 5. All three respondents said that the equipment they sell—whether it qualifies for a program incentive or not—does not differ.

Distributors were asked to rate the importance of A/C Distributor program components when recommending energy efficiency equipment using a 10-point scale, where 0 was "not at all important" and 10 was "very important." Their answers are compiled in Table 4-4. The "program incentive" was rated as the most important program component across all three respondents, while information and/or technical support from the utilities was of least importance to the program participants interviewed.

Table 4-4. A/C Distributor Program Component Importance Ratings

Importance of Program Component	Respondent 1	Respondent 2	Respondent 3
The program incentive	10	10	10
Your company's past participation in a rebate or audit program sponsored by utility	10	8	9
Information provided by the utility websites	NA	5	8
Training seminars provided by the utilities	9	5	5
Information provided by reps of the utilities	8	5	7
Technical support provided by the utilities	NA	NA	3

Program satisfaction

The three distributors interviewed were also asked to report their satisfaction with specific program components. They were asked to assess their satisfaction on a 4-point scale, where 1 was “not at all satisfied” and 4 was “very satisfied.” Table 4-5 shows that respondents were consistently “very satisfied” with utility support and information. Respondents reported consistently lower satisfaction scores around program paperwork.

Table 4-5. A/C Distributor Program Component Satisfaction Ratings

Satisfaction with Program Component	Respondent 1	Respondent 2	Respondent 3
The support you received from utility	4	4	4
The clarity of the program eligibility requirements	3	4	4
The utility on-line systems for completing program applications	DK	4	4
The clarity of program participation instructions	4	2	4
The clarity of program manual or documentation outlining program procedures and equipment eligibility	4	2	4
Responses to any questions or concerns you raised to utility	4	3	4
Training you received through the program	4	4	4
The amount of incentive offered through the program for participation	4	3	3
The amount of paperwork that must be completed for each project	2	1	2

4.3.2 New Homes

4.3.2.1 EM&V Overview

Residential new construction programs were designated as a “high” priority due to the new baseline change that came into effect in PY2017, which programs were to respond to in PY2018. Residential new construction evaluation activities consisted of engineering desk reviews and process interviews of builders and program design staff in anticipation of a consumption analysis in 2019 to more fully assess how estimated savings compare to realized savings.

4.3.2.2 Key Findings and Recommendations - Impact

Key Finding #1: Utilities provided documentation that supported claimed energy savings.

The EM&V team requested documentation that supported the utilities' claimed energy savings. New Homes programs rely on energy models to estimate energy usage for the homes and the utilities provided either the energy model configuration or pre-configured reports that showed energy model inputs. In some cases, the EM&V team had to make follow-up requests to receive sufficient detail, but in all cases the utilities were able to provide documentation that aligned with claimed savings.

Recommendation #1: Utilities should review the documentation section of the new homes measure characterization in the TRM and ensure that they continue to collect the required documentation.

Key Finding #2: Local jurisdictions are still in the process of adopting the new energy code (IECC 2015).

Tracking fields required for new homes include the date the home was permitted and the energy code version under which it was permitted. While most homes were constructed under IECC 2015, three homes were still permitted under IECC 2009. Although the TRM specifies a statewide code based on IECC 2015 because the State Energy Code Office adopted that version, local jurisdictions may decide not to adopt and enforce that code under home rule.

Recommendation #2: Utilities should continue to work with builders to improve the efficiency of homes even in jurisdictions that have not adopted the latest state energy code.

4.3.2.3 Impact

As part of the impact evaluation, the EM&V team conducted desk reviews for a sample of projects from the new homes programs. The EM&V team reviewed the energy model specifications for homes and the energy savings compared to TRM Version 5. Utilities provided documentation that supported claimed energy savings for all sampled projects, so realization rates for these programs were 100 percent. The new baseline resulted in overall less energy savings from new homes programs, as seen in Figure 4-2.

Utilities provided several different energy model files because the industry uses certain established software models for ease of use in the field, but the utilities want to use other software to calculate savings. This is evident in comparing the outputs of the multiple models where they were provided. The utilities established the use of energy models that meet TRM requirements at the beginning of the program year. In PY2019, the EM&V team plans to compare these energy model estimates to metered energy usage over 12 months to give the utilities feedback on the accuracy of these models.

5.0 LOAD MANAGEMENT PROGRAMS

The PY2018 EM&V effort placed a high priority on load management and demand response programs. These programs are designated a "high" priority due to their significant contribution to capacity (kW) savings and to support a process evaluation. Residential demand response programs, a fairly new offering have not previously had a process evaluation and the commercial load management programs have not had a process evaluation since PY2014. In addition to census reviews of participants' interval meter data, the EM&V team conducted process surveys with commercial and residential participants and benchmarking research of other load management and demand response offerings. The final process evaluation activity was interviewing utility managers.

This section documents key findings and recommendations from the EM&V team's impact and process evaluation for both commercial and residential load management programs and overall key findings and recommendations that apply to both sectors.

Commercial Load Management Programs are designed to manage kW use during summer peak demand periods. These periods are defined in most utility programs as 1:00 p.m. to 7:00 p.m., weekdays, June through September. These programs are based on performance and offer incentive payments to participating customers for voluntarily curtailing electric load on notice.

While each utility operates a unique load management program, there are many similarities among them. In general, a dispatch event may be called at the utility's discretion 30 to 60 minutes in advance of a curtailment event, which generally lasts one to four hours. In most cases, the utility reserves the right to call a certain number of curtailment events per season, ranging from five to 15 based on utility. Customers must meet several eligibility requirements, including but not limited to: (1) taking service at the distribution level; (2) meeting minimum demand requirements; and (3) being equipped with interval data recorder metering. Customers are not permitted to participate in other load management programs using the same curtailable loads at the same time period (i.e., "double-dipping").

Participants can either curtail their contracted load during a load control event or opt-out if they wish to not participate. If the participant participates, then they will receive an incentive based on the kW that they curtail during the event. Savings for kW and kWh are calculated by following the methodology described in TRM 5.0 and an incentive is given to a participant based on the amount of kW saved. This incentive amount is specified in an agreement with the utility when enrolling into the program and ranges from $15 to $50 per kW saved.

Residential load management programs are designed to manage kW use during summer peak demand periods. Three of the nine Texas utilities offer a residential demand response program to their customers. Of the three, two of the programs utilize a smart thermostat control strategy and the other utilizes direct load control devices. Incentives for these programs differ by whether the utility's service territory is part of the ERCOT market or not. Utilities in the ERCOT market receive an incentive based on the evaluated kW savings that is achieved during the load control season, whereas non-ERCOT utilities pay a flat enrollment incentive and a flat incentive per program year. Participants are given the opportunity to opt-out of a load control event.

Participants in two of the three residential programs are evaluated individually with the high 3-of-5 method described in TRM 5.0, while the other is evaluated using the new deemed savings value for residential demand response smart thermostat programs. The availability of AMI meters dictates which methodology a utility will follow to calculate savings.

All utilities define their control seasons as June 1 to September 30, with possible load control events happening within the window of 1 to 7 p.m. on weekday non-holidays for ERCOT utilities and 2 to 8 p.m. on weekday non-holidays for non-ERCOT utilities.

Residential programs in Texas have seen dramatic increases in evaluated kW savings over the past few years as participation has steadily increased. This increase in participation and savings can be attributed to the adoption and successful marketing of programs that utilize smart thermostats.

5.1 SUMMARY RESULTS

The total evaluated savings of the programs were 296,759 kW and 1,293,042 kWh. These results show a slight decrease compared to PY2017, by roughly 4 MW (4,000 kW). Figure 5-1 summarizes evaluated MW and MWh savings of all load management programs from PY2012 to PY2018.

Figure 5-1. Total Statewide Evaluated Gross Demand Reduction and Energy Savings by Program Year — Load Management Programs

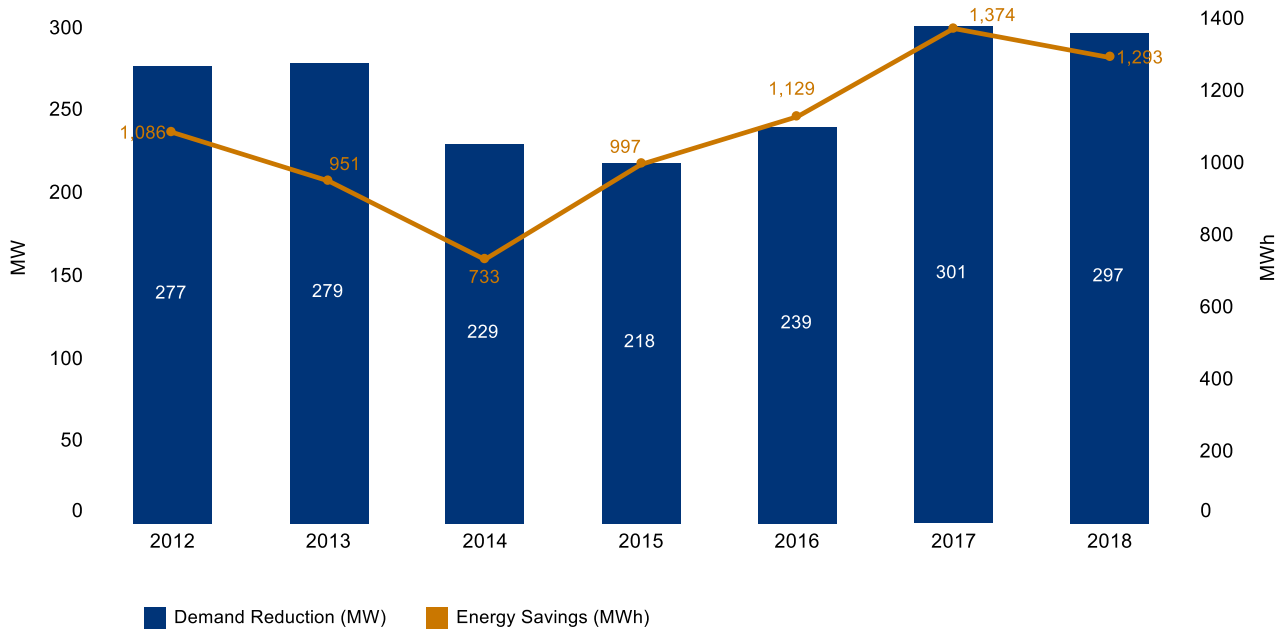
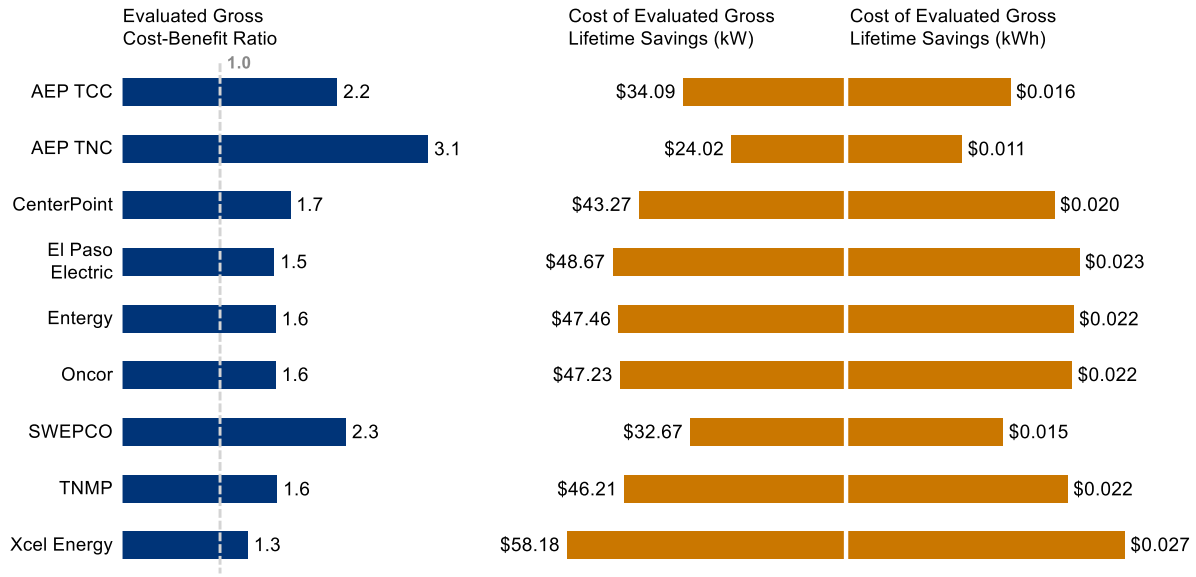


Figure 5-2 summarizes the cost-effectiveness of each utility's energy efficiency portfolio based on evaluated savings of all load management programs in PY2018. All portfolios were cost-effective, ranging from 1.5 to 3.5. The cost per kW ranged from $20.98 to $50.12 and the cost per kWh ranged from $0.010 to $0.024. 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.

Figure 5-2. Evaluated Cost-Benefit Ratio and Cost of Lifetime Savings — Load Management Programs PY2018



5.2 CROSS SECTOR KEY FINDINGS AND RECOMMENDATIONS

This section summarizes key findings and recommendations from the process evaluation activities that apply to both the residential and commercial programs. Specific process evaluation objectives included:

- Understand load management program designs, including recent or proposed changes and future directions
- Understand how load management programs coordinate with ERCOT or how load management programs are used in resource planning for non-ERCOT utilities
- Identify important influences on program operation and achievements
- Characterize program operations including types of customers participating and role of program sponsors/implementers
- Identify program areas that are working well, opportunities for improvement and program challenges

5.2.1 Evaluation Overview

The process evaluations included utility manager interviews, benchmarking research and participant surveys.

Utility Manager Interviews. The EM&V project manager interviewed the utilities' load management program managers and utility energy efficiency managers or directors from June 25 to July 1, 2019. All

eight utilities[26] participated with three to six staff members attending for each utility interview. The interviews were "semi-structured." Questions were not necessarily asked verbatim and instead followed the flow of the conversation with interviewees. Interviews ranged from 25-60 minutes in length, depending primarily upon whether the utility offers both residential and commercial load management programs and the amount of information shared.

Benchmarking Research. The EM&V team selected peer utilities of interest to review and compare against the Texas electric utilities' programs. The utilities were selected for geographic coverage across the U.S. so that both coasts and territories in the middle are represented. Utilities chosen were also comparable to one or more of the Texas utilities in terms of number of customers served. The regulation or deregulation of the utilities varies considerably. Most of the utilities selected are vertically integrated, which limits direct comparisons with the ERCOT utilities that operate in a competitive retail space. These limitations should be kept in mind. The benchmarking study characterizes Texas programs and compares against other programs throughout the nation on program design, implementation and delivery and outcomes.

Participant Surveys. Telephone surveys were conducted with program participants to characterize the customer experience in the following areas: program awareness, decision-making, experience with curtailment events, satisfaction with the program and suggestions for program improvement.

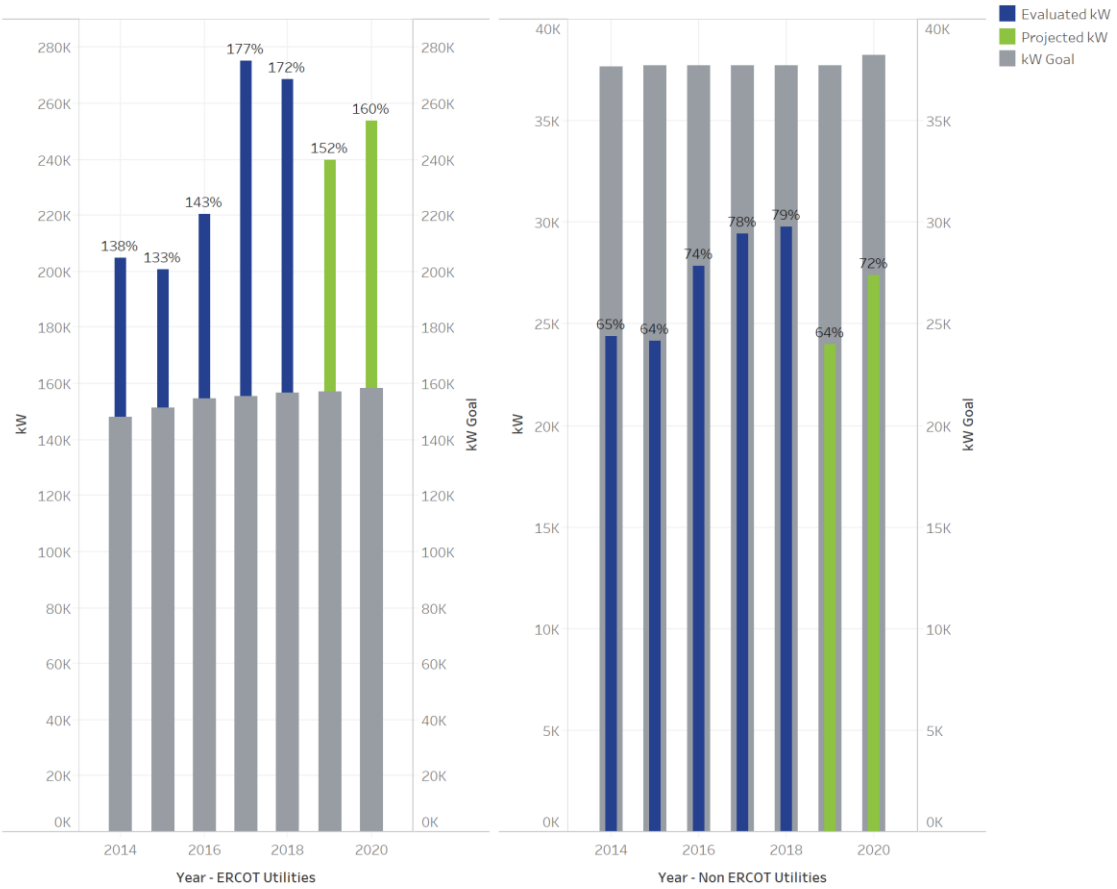
5.2.2 Key Findings and Recommendations

Key Finding #1: The load management programs make up a large percentage of portfolio kW goals in current and future program years.

All of the utilities reported that the load management programs are a strategic offering in their portfolio necessary for them to meet their portfolio kW demand reduction goals. The extent to which utilities rely on these programs in relation to kW goals is higher for ERCOT utilities than for the vertically integrated utilities Figure 5-3. Utilities either plan on continuing their reliance on load management programs to meet goals or slightly increase it through 2020.

[26] For the process interviews, AEP Texas is represented as one utility although they do run different programs in AEP TCC and AEP TNC territories.

Figure 5-3. Load Management kW Achievements Versus Goal 2018-2019, Projected Percent of Goal 2019-2020



Source: Statewide EM&V Database and utilities' Energy Efficiency Plans and Reports

While all utilities reported the programs as "important" or "very important" in meeting their demand goals, some utilities try to be more conservative about the percent of their kW goal that is from load management programs. This is because they either think load management programs' contribution toward kW goals could be limited in the future or because load management should play a role in their portfolio, but one that is distinct from their energy efficiency offerings, which also result in kW reductions.

For those who plan to increase load management savings in their portfolio, this will be largely through residential demand response smart thermostats. Some utilities that do not currently have increases in their portfolios are still preparing to increase demand response if needed through residential smart thermostats. Likewise, there is strong utility interest in small commercial smart thermostats for possible demand response as well as annual savings.

Recommendation #1: Discuss the role of load management as part of overall energy efficiency portfolio goals.

Key Finding #2: The programs could support utilities' system reliability.

All ERCOT utilities report the primary objective of the programs is to serve as an ERCOT Tier 2 emergency resource before controlled outages. All ERCOT utilities' program participation requirements

do also reserve the right for the utility to call curtailment events for its own system needs. Only one ERCOT utility is currently using the program for its own system reliability. One time in recent years, this utility called an event for a congested feeder station when capacity was needed. In addition, this utility calls an unscheduled event every summer peak season to manage its system peak. The utility uses ERCOT's forecasts each summer to call an unscheduled event on what it believes will be the peak day of the summer season. The utility offers tiered incentive levels for participants that curtail for system needs and to those who participate as an emergency resource for ERCOT.

The non-ERCOT utilities report using the program as an emergency capacity resource in their integrated resource planning and also saw the value of the programs to meet its own system needs in the future. In terms of coordinating with their independent system operator (ISO), Southwest Power Pool (SPP) is long on capacity and does not have a need for the programs. The Midwest Independent System Operator (MISO) has called events and the applicable utility is coordinating with MISO. However, MISO needs do not always accommodate the Texas program requirements. For example, several of the last MISO events were called on weekends, which are excluded from the Texas demand response control period.

All eight utilities saw possible benefits of the programs for grid reliability. Several have investigated how to do this. The most common example of how the programs could support grid reliability was geographic targeting in congested or high growth areas. utilities discussed that demand response could be part of a package of energy efficiency, battery backup and renewable energy to increase grid reliability in specific locations. While most utilities saw the value of the programs to increase grid reliability, utilities discussed that the programs are not currently designed to curtail beyond summer peak so they would need to change in program design, implementation and administration. For example, utilities are not currently recruiting customers by a specific geography. Another example of when the programs could help system reliability is when a transmission line goes down. Some of the utilities noted that re-designing the programs to meet grid reliability goals could be difficult given the administrative costs involved, and some of the utilities have administrative cost-cap concerns. Another utility mentioned that a change in the mix of its participants would be needed outside of summer peak. For example, this utility mentioned that customers who do direct load control through their energy management systems would be a better fit for winter peak since winter peak hours occur outside of normal business hours at that time of the year.

Another barrier to the programs serving grid reliability goals is the strictly defined peak period in Texas, because the programs would be needed year-round. Most utilities did see value in expanding the demand response control period. For ERCOT, the most recent needs have been in shoulder seasons[27] or winter. As already mentioned above, weekend capacity needs were also discussed. One utility was concerned about the administrative burden on the utility of expanding the control season and how savings would be calculated in time for reporting. Some utilities also mentioned that an expansion of the programs for winter and summer peak would also need to be considered in the savings methodology that currently only allows winter or summer peak kW reductions to be claimed.

Recommendation #2: Discuss the pros and cons of expanding the control season

[27] The shoulder season includes the months preceding winter and summer peak seasons. Due to typically lower peak demands during the shoulder season, planned generation, transmission and distribution maintenance oftentimes takes place during the shoulder seasons.

Key Finding #3: The TRM calculation methodologies have been well-received by most utilities.

The TRM demand response methodologies were consistently reported as an area that is working well. Several utilities reported that the clarity introduced by having consistent demand response TRM methodologies is a positive support for their programs. In addition, several utilities reported their territories frequently experience storms during the control season that can result in outages. The flexibility of the TRM baseline of using the high 5-of-10 days for commercial or 3-out-of-5 for residential can still allow customers to participate even if they experience an outage.

One utility felt the interval meter data analysis needed for the TRM calculation was data-intensive given the number of days looked at historically across a large number of customers. There was discussion about how with large, heterogeneous commercial customers, it would be challenging to find a more streamlined solution that could effectively calculate demand impacts. The current commercial baseline provides more flexibility than a commonly used baseline in other jurisdictions of the high 8-out-of-10. In addition, the TRM calculation methodology was informed by ERCOT methodologies and is the least data-intensive of the ERCOT baseline methodologies. However, in contrast to commercial, a deemed savings for residential customers is realistic and feasible. A residential demand response deemed savings value has been developed for one non-ERCOT utility and was first in the PY2019 TRM.

Recommendation #3: Utilities interested in developing a residential demand response deemed savings value should work with the EM&V team to pursue this option.

Key Finding #4: The transmission and distribution (T&D) utilities coordinate with ERCOT on their programs but differ in the levels of communication.

The T&D utilities provide a memorandum of understanding (MOU) to ERCOT on the amount of load reduction the programs can provide. This is provided sometime in May. This year, ERCOT requested the MOU by May 15. In years past, some utilities provided it before June 1 while others have been sending the MOU mid-May. Utilities sign up customers well in advance of the MOU. They report completing their program recruitment before the MOU and providing ERCOT a list of ESIIDs of their participating customers. They believe that doing their recruitment first is helpful to ERCOT. Utilities' outreach and program rules are clear about not participating in both the utility and ERCOT programs at the same time. ERCOT has four participation times with two timeframes that overlap with the utilities. Therefore, a customer could participate in a utility program and an ERCOT program for the two time periods not covered under the utility program.

Some utilities report regularly communicating with ERCOT monthly about the programs, providing a year-end report and removing from their kW impacts any participants that "double dipped" by participating in both a utility and ERCOT program. Other utilities do not communicate with ERCOT after the MOU and ESIIDs are provided and assume that ERCOT makes sure there is no duplication or rely on ERCOT to let them know if they have a duplicate participant. It was reported that duplicate participants can occur and this is normally a result of staff turnover at the customer facility. Also, in years past ERCOT provided a list of ESIIDs of their participants monthly, but in 2019 ERCOT instead sent a web link with participant information.

Recommendation #4: Establish consistent guidelines on timing and frequency of utility and ERCOT communications as well as protocols for verifying that there is no duplicate participation between utility and ERCOT programs.

Key Finding #5: Direct load control and smart thermostats are an increasing resource for demand response.

While the utilities are not doing any direct load control of commercial customers themselves as part of the programs, they believe aggregators are. They also believe a growing number of customers are doing direct load control through their energy management systems although many still do manual curtailment. Some utilities thought national chains are the most likely to direct load control. Though it is outside of the program activities, some of the vertically integrated utilities key account staff work with customers on how to reduce load to help them manage their demand charges. There was considerable utility interest in a small commercial thermostat measure to reach this sector that does not currently participate in demand response.

Utilities with residential demand response programs are using smart thermostats to directly control load in homes by small increases in temperatures for air conditioners. Several of the utilities that do not currently have a residential demand response program are incentivizing residential smart thermostats for the annual savings through an energy efficiency program. They report this measure could also be tapped into for demand response. Many of the utilities are actively considering this option for the future.

Recommendation #5: Utilities interested in developing a small commercial thermostat measure should work with the EM&V team to pursue this option.

5.3 COMMERCIAL LOAD MANAGEMENT PROGRAMS

This section summarizes the key findings and recommendations from the PY2018 evaluation of the Commercial Load Management programs offered by the nine Texas utilities.

5.3.1 EM&V Overview

The EM&V team applied the savings calculation methodology prescribed in the PY2018 TRM 5.0 on a census of records to calculate energy savings and demand reductions from interval meter data. Process evaluation activities included participant surveys, benchmarking research and program staff interviews.

5.3.2 Key Findings and Recommendations

Key findings and applicable recommendations for commercial load management programs are presented below.

Key Finding #1: Utilities demonstrated strong capabilities to apply the TRM calculation method to savings.

PY2018 is the third year in which utilities and the EM&V team have applied the demand savings algorithm for commercial load management programs described in TRM 5.0. Now that the difficulties have been worked through in PY2016 and PY2017, and there is a mutual understanding of the high 5-of-10 approach, the utility companies, implementers, and EM&V team were largely in agreement on final demand savings calculations.

Recommendation #1: Continue implementing the demand savings algorithm described in TRM 5.0. If there are minor discrepancies in future program years, keeping active communications with the EM&V team to resolve minor calculation differences will be beneficial to both the EM&V team and the Texas utilities.

Key Finding #2: Texas commercial load management programs are in line with best practices but are not at the forefront of industry trends.

The Texas utilities are following industry best practices by having program eligibility requirements and incentive structures that are comparable to other utilities that offer similar curtailment strategies. In addition, Texas utilities offer CLM programs with a clear and concise control strategy, a curtailment incentive based on a consistent savings methodology in the Texas technical reference manual (TRM). However, Smart Electric Power Alliance (SEPA) noted that demand response programs using smart thermostats are growing in popularity.[28] SEPA observed that in 2016 96 percent of enrolled capacity was dispatched among this subset of demand response participants, a high participation level in demand response events. Further, SEPA noted that utilities are looking toward pairing distributed energy resources with demand response programs. The benchmarking research indicates that other utilities are beginning to utilize these different technologies in CLM programs while only one curtailment strategy is used in Texas.

Recommendation #2: Consider adding additional curtailment strategies to the programs if there is ever a need to curtail additional load. Other utilities around the nation have implemented direct load control devices and smart thermostats into their Commercial Load Management programs.

Key Finding #3: Texas Commercial Load Management programs are retaining commercial load participants fairly effectively.

Participation as measured by the number of customers has fluctuated annually but remained fairly stable over the past few years with about 600 commercial participants.

Recommendation #3: Continue to market the commercial load management programs effectively. If there is a need for higher participation, increase marketing efforts when the need arises.

Key Finding #4: Texas commercial load management programs have program information available, but materials should be updated annually.

All Texas utilities have program websites for their CLM programs with clear directions on how to enroll in the programs. The Texas utilities have program manuals available for download on their respective websites as well. While these manuals are available, some of them are not up to date with the current program year.

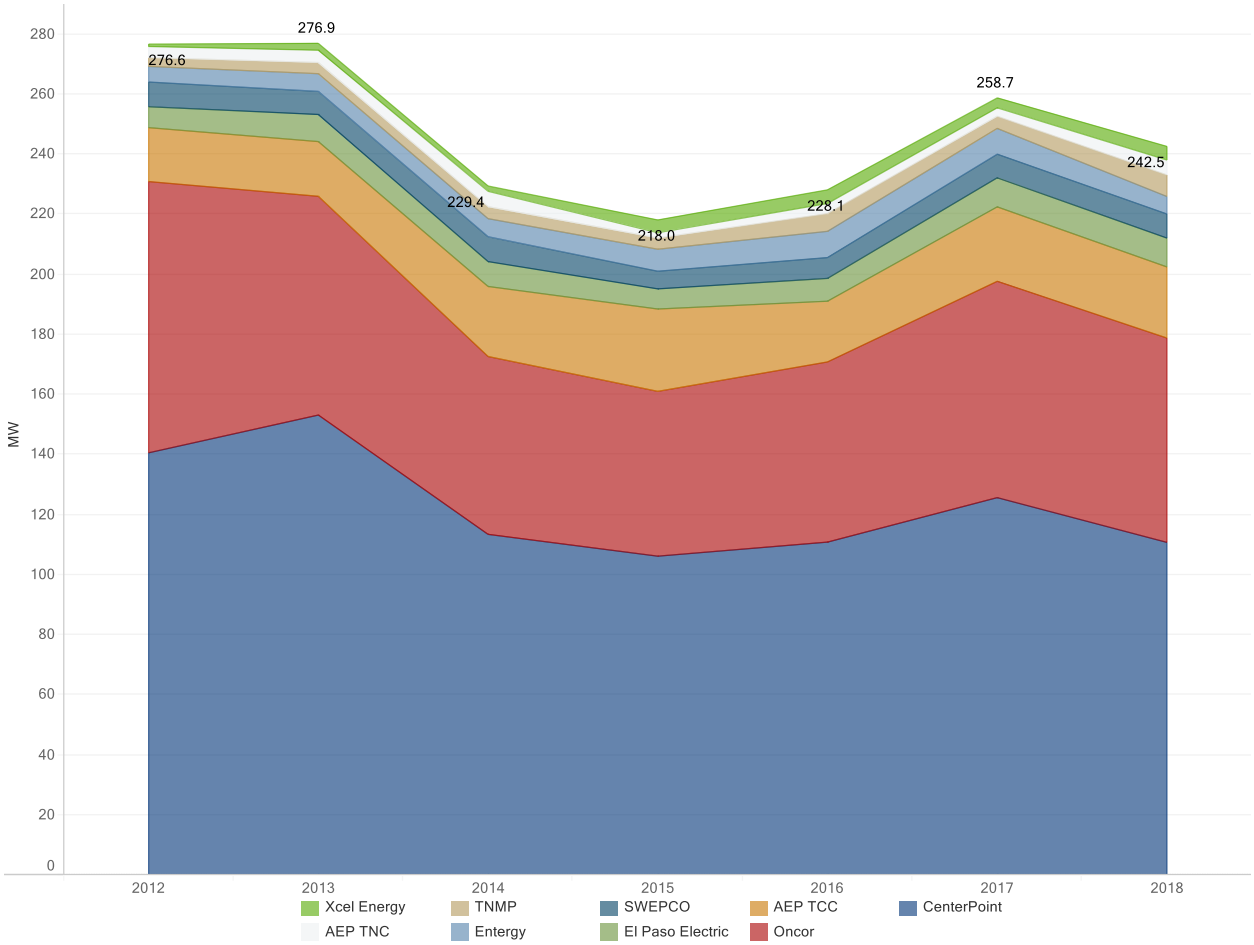
Recommendation #4: Program manuals should be updated annually even if program requirements and overall documentation do not change.

5.3.3 Impact

The total evaluated savings of all 10 commercial load management programs were 242,522 kW and 1,071,366 kWh. These results show a slight decrease in savings compared to PY2017, by roughly 17 MW (17,000 kW). This decrease in savings is likely due to the decrease in program participation and not due to poor program design or operation. Figure 5-4 shows total kW savings from commercial load management programs by program year.

[28] https://sepapower.org/knowledge/sepa-navigant-release-2017-utility-demand-response-market-snapshot/.

Figure 5-4. Evaluated Demand Savings of Commercial Load Management Programs (PY2012 – 2018)



Demand savings calculations from each utility were calculated largely the same as the evaluation calculations. There were no cases in which adjustments had to be made to individual meter savings calculations. This result supports the fact that both the EM&V team and the implementer/utilities are following the TRM algorithm for calculating saving precisely the same. While the TRM methodology was followed correctly by all utilities, realization rates for commercial load management programs are not 100 percent in PY2018. The reason for this discrepancy is that when comparing individual meter savings for one of the commercial load management programs, it was found that the utility did not set savings equal to zero for meters that produced a negative savings. Doing so is allowed per TRM 5.0. The EM&V team brought this to the attention of the utility and was told that the utility would not correct negative savings to zero and would report their original savings numbers. As a result, commercial load management programs received a realization rate of 100.2 percent for both kW and kWh.

5.3.4 Process

5.3.4.1 Benchmarking Research/ Documentation Review

This benchmarking study characterizes utility programs identified by the PUCT EM&V team as being of interest to review and compare against the Texas electric utilities' commercial load management programs. The utilities were selected for geographic coverage across the U.S. so that both coasts and

territories in the middle are represented. Utilities chosen were also comparable to one or more of the Texas utilities in terms of number of customers served. The regulation or deregulation of the utilities varies considerably. The majority of the utilities are vertically integrated, which limits direct comparisons with the ERCOT utilities operating in a competitive retail space, and these limitations should be kept in mind. This benchmarking study characterizes Texas utility CLM programs and compares against other CLM programs throughout the nation. Information collected for the target programs of interest included:

- **Program design.** Program control strategy,[29] program goals, outreach mediums, eligibility requirements, incentive structure
- **Program implementation and delivery.** Program procedures, notification strategies, demand response event dynamics, opt-out potential
- **Demand response outcomes.** Participation numbers and total energy savings.

The benchmarking research was conducted via targeting of specific utilities, then gathering information about their CLM programs. Information gathered from these programs was collected by inspecting program documentation provided by each respective utility website, assessing evaluation documents pertaining to these programs, and, where available, review of any public commission documentation. Data on CLM programs were collected for the following utilities/ISOs:

- Alliant Energy
- CPS Energy
- Duke Energy
- Florida Power & Light
- Pacific Gas & Electric
- San Diego Gas and Electric
- Southern California Edison

Details for these utilities is provided in Table 5-1. In addition, the benchmarking research includes programs run by the Electric Reliability Council of Texas (ERCOT).

Table 5-1. Utility Territory and Non-residential Customer Base

Program Administrator	Service Territory	Commercial and Industrial Customers Served
Alliant Energy	Iowa, Wisconsin	Unknown
NV Energy	Northern and Southern Nevada	153,687
CPS Energy	City of San Antonio, Texas	84,825
Duke Energy	Indiana, Northern Kentucky, Ohio, Western North Carolina, Northern South Carolina	569,486
Florida Power & Light	East Coast of Florida, some Gulf Coast areas	556,080

[29] Control strategy refers to how load is reduced. Common commercial control strategies include manual shut down of equipment, use of back-up generators, and direct load control of lighting and HVAC through energy management systems.

Program Administrator	Service Territory	Commercial and Industrial Customers Served
Pacific Gas & Electric	Northern and Central California	668,179
San Diego Gas & Electric	San Diego and surrounding region	156,575
Southern California Edison	Portions of Central and Southern California	642,263
ERCOT	Majority of Texas	24 million total customers

Program Design

Program Control Strategy

During the secondary research across eight different energy utilities, we found that some utilities have a common portfolio of demand response control strategies available for nonresidential customers and some that have different control strategies. The emergence of smart technologies has pushed utilities to adopt these technologies in the commercial sector. Florida Power & Light retains the use of these devices for load curtailment during demand response events. Some utilities, such as Southern California Edison, combine one-way direct control units with critical peak pricing schedules to curtail peak demand from multiple directions. Other common demand response programs include curtailment incentives or critical peak pricing to curtail peak loads during demand response events. Texas ERCOT utilities cannot offer critical peak pricing, but retail electric providers can. Table 5-2 shows a list of control strategies offered by programs that were researched.

Texas utilities employ one type of control strategy, the curtailment incentive. There are benefits of offering only curtailment incentive as a control strategy. The first benefit is that there is no additional equipment that needs to be installed at a commercial building. For direct control units and smart thermostats, a technician needs to go on site and install this equipment in order for these control strategies to be utilized. In addition, the utilities will need to upkeep this equipment in order for the program to work correctly, which will require additional resources over time. With the curtailment incentive strategy, the strategy only requires businesses to decrease or cease operation of equipment at their facility to reduce demand in the way they chose.

During this benchmarking research, we found that there are CLM programs in other utilities that offer other control strategies. In the case of CPS Energy, it is offering the curtailment incentive strategy as well as smart thermostats and direct load control.

Table 5-2. Program Offerings

Program Administrator	Control Strategies Employed
Texas Utilities	Curtailment incentive
NV Energy	Direct control unit, smart thermostat, programmable communicating thermostat, universal gateway, smart lighting, refrigeration controls
Alliant Energy	Curtailment incentive
CPS Energy	Curtailment incentive, direct control unit, smart thermostat
Duke Energy	Curtailment incentive
Florida Power & Light	Direct control unit
Pacific Gas & Electric	Critical peak pricing
San Diego Gas & Electric	Critical peak pricing
Southern California Edison	Critical peak pricing, direct control unit

Program Administrator	Control Strategies Employed
ERCOT	Curtailment incentive

Program Goals

Non-residential demand response goals were not found among the publicly available program documentation, program evaluations, or PUC documentation, except for Pacific Gas & Electric. In its critical peak pricing schedule, Pacific Gas & Electric set a goal of at least nine events called per year, with no strict participation goals noted.

Outreach Media

Outreach tactics employed are highlighted in Table 5-3. All researched utilities had a program webpage with extensive information on incentives, eligibility requirements, and processes involved in the implementation of the program following program enrollment.

For researched utilities employing critical peak pricing—Pacific Gas & Electric and San Diego Gas & Electric—it appears that program marketing was not used as a recruitment tactic. Instead, both utilities began to default large C&I customers on to critical peak pricing schedules in 2008. These customers were then able to opt out of the pricing schedule to a different time-of-use (TOU) pricing schedule if not interested in remaining under critical peak pricing. Small and medium C&I customers were defaulted into critical peak pricing schedules beginning in 2014, and also given the choice of opting out of the pricing schedule to a different TOU pricing schedule if they were not interested in remaining under critical peak pricing.

Table 5-3. Outreach Media

Program Administrator	Outreach Media
Texas Utilities	Program websites available, direct outreach (mail, email or phone call) to prior and prospective participants
NV Energy	Website, online video, bill inserts, email
Alliant Energy	Program website available[30]
CPS Energy	Program website available[31]
Duke Energy	Program website available[32]
Florida Power & Light	Program website available[33]
Pacific Gas & Electric	Program website available[34] CPP made default rate schedule beginning 2008
San Diego Gas & Electric	Program website available[35] CPP made default rate schedule beginning 2010
Southern California Edison	Program website available[36] Direct mail, bill inserts, email, phone

[30] https://www.alliantenergy.com/CustomerService/AlliantEnergyService/RatesandTariffs.
[31] https://www.cpsenergy.com/en/my-business/savenow/comm-dr.html.
[32] https://www.duke-energy.com/business/products/powershare.
[33] https://www.fpl.com/business/save/programs/oncall.html.
[34] https://www.pge.com/en_US/business/rate-plans/rate-plans/peak-day-pricing/peak-day-pricing.page.
[35] https://www.sdge.com/business/demand-response/cpp.
[36] Summer Discount Plan: https://goo.gl/EuHKfu; Critical Peak Pricing: https://goo.gl/XzSEZW.

Program Administrator	Outreach Media
ERCOT	Program website available

Eligibility Requirements

Most demand response programs in the nonresidential sector have been limited to non-agricultural C&I customers. Of those customers, there are primarily limitations to eligibility depending on the amount of curtailable load of the prospective C&I demand response participant. Demand response programs employing direct control units on nonresidential customers generally limit eligibility based on kWh of consumption per ton of eligible HVAC equipment. Critical peak pricing programs generally impart a more lenient restriction on curtailable load, with C&I customers that have at least 20 kW of curtailable load during the load control season generally being eligible for enrollment in critical peak pricing programs. The curtailment incentive programs researched limited eligible C&I customers to those with at least 40 to 250 kW of curtailable load.

Eligibility requirements associated with researched programs are described in more detail in Table 5-4.

Table 5-4. Eligibility Requirements

Program Administrator	Program Name	Eligibility Requirements
Texas Utilities	Commercial Load Management	**ERCOT Utilities:** Minimum demand savings of 50-100 kW. Must have AMI (“smart meter”) metering capabilities. Must be able to curtail with a 30-minute notice. **Non-ERCOT Utilities:** Minimum demand savings of 100-250 kW. Must have AMI (“smart meter”) metering capabilities, installed by the utility at no cost to the customer if they do not already have one. Must be able to curtail with one-hour notice. **ERCOT/non-ERCOT Utilities:** Curtailable load must not be a load that negatively impacts the environment or is incentivized through other utility energy efficiency programs.
NV Energy	PowerShift	**BuildingIQ Energy Optimization.** Facility must offer over 500,000 sq. ft. of conditioned space area under central plant cooling or large rooftop air conditioning units (60+ tons each) and be equipped with a building energy management system enabled with BACnet/IP networked communications. **Bring-Your-Own Equipment.** Facility must have an existing building energy management system, networked thermostats, lighting controls, or other load controlling equipment that is already OpenADR2.0 certified. **Universal Gateway.** Facility must have an existing building energy management system, lighting controls, or other load controlling equipment that can respond to two dry contact relay signals during a

Program Administrator	Program Name	Eligibility Requirements
		DR Event request. Provide outbound Internet access to OpenADR2.0 gateway device over port 443. **Networked Thermostats.** Facility must have dedicated thermostat-controlled HVAC equipment with an aggregate cooling load greater than 40 kW. Provide outbound Internet access to OpenADR2.0 gateway device over port 443. **Direct Control Units.** Facility must have at least five (5) rooftop package HVAC units greater than 10-tons each with an overall facility average greater than 20-tons. **Freezer Controls.** Walk-in freezer with dedicated compressor system. **Delta T AHU Water-Cooling Optimization.** Large tonnage air handling units. **Fitness Test Cooling Optimization.** Facility must have central plant cooling equipment and multiple air handling units serving variable air volume systems. **MultiPro Multispeed & Multipurpose Thermostat.** Must have central plant cooling equipment. **Programmable Communicating Thermostat.** Facility must have dedicated thermostat-controlled HVAC equipment.
Alliant Energy	INTSERV Electric Interruptible Program	Non-agricultural commercial and industrial customers At least 200 kW of curtailable load during summer months
CPS Energy	Commercial Demand Response	**Smart thermostats + direct control units.** Customer must have less than 50 kW of curtailable load if operating on site. Must have curtailable load of less than 25 kW per site if operating more than one site. **Curtailment incentives.** Customer must have curtailable load of 50 kW if operating one site. Must have curtailable load of at least 25 kW per site if operating more than one site.
Duke Energy	PowerShare	Non-agricultural commercial and industrial customers At least 100 kW of curtailable load during any given day
Florida Power & Light	Business OnCall	Non-agricultural commercial and industrial customers AC must normally operate between 3:00 PM and 5:00 PM at least four days per week

Program Administrator	Program Name	Eligibility Requirements
Pacific Gas & Electric	Peak Day Pricing	Non-agricultural commercial and industrial customers Prior to November 2014: 200 kW of curtailable load during load control season After November 2014: At least 20 kW of curtailable load during load control season
San Diego Gas & Electric	No official name	Non-agricultural commercial and industrial customers Prior to January 2016: 200 kW of curtailable load during load control season After January 2016: At least 20 kW of curtailable load during load control season
Southern California Edison	Summer Discount Plan + CPP	Non-agricultural commercial and industrial customers Must have HVAC usage of 0.20 kWh per ton during one of the summer discount events during the year prior to enrollment. 0.20 kWh per ton must be maintained following enrollment.
ERCOT	ERS	Minimum demand savings of 100 kW. Must have AMI ("smart meter") metering capabilities. Must be able to curtail with a 10-30-minute notice.

Incentive Structure

Across all researched programs, most incentives were received in the form of bill credits per kW of load curtailed during an event. For programs using direct control units, incentives were based on program participation as opposed to actual load reductions during an event.

Table 5-5. Incentive Structures of Researched Utilities

Program Administrator	Program Name	Incentive Levels
Texas Utilities	Commercial Load Management	Incentive is based on kW reduction achieved during events. kW is calculated based on TRM methodology and verified by a third-party evaluator. There is a flat rate for kW reduction in the range of: **ERCOT utilities:** 15-40 $/kW. **Non-ERCOT utilities:** 25-50 $/kW.
NV Energy	PowerShift	**Programmable Communicating Thermostat, Smart Thermostat, Multipro Thermostat.** Free thermostat(s), professional installation. Up to $4,000 value, depending on number of free thermostats installed. **Direct Control Unit.** Free installation of direct control unit. **Universal Gateway**. Free installation and programming of energy management system. Free subscription to BuildingIQ services contained within universal gateway. $1.75 per kW per event if less than 10 kW reduction during event, $1.95 per kW per event if more than 10 kW reduction during event.

Program Administrator	Program Name	Incentive Levels
		Other measures. Free installation. No information included in program documentation about additional incentives tied to freezer control, Delta T AHU, and others.
Alliant Energy	INTSERV Electric Interruptible Program	Winter: $4.55 per kW reduced during events Summer: $7.06 per kW reduced during events
CPS Energy	Commercial Demand Response	**Smart thermostat and direct control unit.** Free installation of smart thermostat or direct control unit. **Curtailment incentive.** Incentive depends on the kW reduction per event. This incentive is disclosed at the time of contract signing and depends on site-level characteristics.
Duke Energy	PowerShare	Summer Only option: $28 per kW/year Extended Summer option: $36 per kW/year Annual option: $42 per kW/year
Florida Power & Light	Business OnCall	Free installation of direct control unit $2 per ton of HVAC per month during load control season
Pacific Gas & Electric	Peak Day Pricing	Bill protection for first-year enrollees Demand credits: On Peak—$5.92 per kW; Semi-Peak - $1.46 per kW
San Diego Gas & Electric	No official name	Bill protection for first-year enrollees Demand credits: On Peak—$11.03 per kW; Semi-Peak—None
Southern California Edison	Summer Discount Plan + CPP	**Critical Peak Pricing.** Bill protection for first-year enrollees Demand credits: On Peak—$11.44 per kW; Semi-Peak—None **Direct Control Unit.** 100 percent cycling: up to $225 per year 50 percent cycling: up to $80 per year 30 percent cycling: up to $15 per year
ERCOT	ERS	Incentive depends on the kW reduction per event. This incentive is disclosed at the time of contract signing and depends on site-level characteristics.

Curtailment Incentives

Alliant Energy and Duke Energy employed curtailment incentive strategies to curtail peak load on event days. Details pertaining to the program offerings by each of the utilities are highlighted in the Demand Response Event Dynamics section.

Both Alliant and Duke Energy offered incentives based on actual load curtailment during events in each year. Under Alliant Energy's INTSERV, during the summer months customers receive a $7.06 bill credit per kW reduction per event, whereas during the winter months this amount drops to $4.55 per kW per event. Net annual incentives from program participation depend on the number of events called, total kW reductions experienced throughout the year, and whether the customer buys through to opt out of certain events.

Duke Energy offers annual bill credits for kW reductions experienced during a program year. The extent of incentives received depends on the program option chosen by the customer. Should the customer choose the Summer Only option, limiting load control to non-holiday weekdays between June 1 and September 30, the customer receives an annual bill credit of up to $28 per kW reduced during load control season. Under the Extended Summer option, expanding load control to any day between May 1 and October 31, the customer receives an annual bill credit of up to $36 per kW reduced during load control season. Under the Annual option, with an unlimited load control season spanning the entire calendar year, the customer receives an annual bill credit of up to $42 per kW reduced during load control season.

Direct Control Units

To curtail peak loads in their service territories, Florida Power & Light and Southern California Edison included direct control units in their demand response portfolios. Incentive discussion here is limited to Florida Power & Light and Southern California Edison.

Under its Business OnCall program, Florida Power & Light offers free installation of direct control units on all HVAC units. During load control season, enrolled customers then receive $2 per ton of HVAC equipment controlled. This amount was received in the form of monthly bill credits.

Under its two program offerings—direct control units and critical peak pricing—Southern California Edison offered two sets of incentives. For its C&I customers under a critical peak pricing schedule, bill protection was offered for the first-year enrollees, alongside on-peak bill credits of $11.44 per kW for all enrolled customers. Bill protection allows new enrollees to be compensated for the annual difference in energy costs between participation in critical peak pricing and their original TOU rate schedule they had previously, should the costs under critical peak pricing be higher. For customers with direct control units, incentives depend on the cycling option chosen by the customer. Customers under the 30 percent cycling option receive a fixed $15 per year, those under the 50 percent cycling option receive a fixed $80 per year, and those under the 100 percent cycling option receive a fixed $225 per year.

Critical Peak Pricing

Pacific Gas & Electric and San Diego Gas & Electric offer similar incentives under their critical peak pricing programs. More specifically, customers are offered bill protection in their first year under critical peak pricing rate schedules, then an additional bill credit for each kW of power consumption during non-event hours of event days. For those customers enrolled in the Peak Day Pricing program offered by Pacific Gas and Electric, customers are eligible for non-event hour credits of $5.92 per kW during on-peak and $1.46 per kW during semi-peak periods. Like Southern California Edison, $11.03 per kW during on-peak period is offered on non-event hours by San Diego Gas & Electric.

Direct Control Units, Curtailment Incentives, and Smart Thermostats

Receipt of incentives by enrolled CPS Energy customers depends on the measure the customer is covered by. Incentives received by CPS Energy curtailment incentive participants are paid out according to actual kW reductions in load during demand response events. The amount per kW that is received depends on site-level characteristics and is determined by the time of contract signing with CPS. Incentives received by those with smart thermostats and direct control units are limited to free installation of the technology, with no annual incentive given for participation in the program.

Program Implementation and Delivery

Program Procedures

Table 5-6 highlights implementing parties in nonresidential demand response among researched utilities. For the most part, demand response was managed in-house. All utilities would have to trigger an event for their customers in order to push notifications out to their base of enrolled customers.

From here, utilities employing direct control units "ping" enrolled devices to begin load control. For utilities employing curtailment incentives and critical peak pricing, management of energy use is left to the customer once the demand response event begins.

Table 5-6. Program Delivery

Program Administrator	Delivery Method
TX Utilities	Internal. Unscheduled events may be called based on if ERCOT issues an EEA2 emergency alert, for ERCOT utilities. Unscheduled events may be called at the utility's discretion for non-ERCOT utilities.
NV Energy	Internal, Third-party (Pelican, Encycle, BuildingIQ)
Alliant Energy	Internal
CPS Energy	Internal
Duke Energy	Internal
Florida Power & Light	Internal
Pacific Gas & Electric	Internal
San Diego Gas & Electric	Internal
Southern California Edison	Internal
ERCOT	Internal

Notification Strategies

It is industry-standard for utilities to use notifications to keep enrolled C&I customers informed of scheduled demand response events. Notifications among sampled utilities are transmitted via phone, email, text, or fax, and can be sent to multiple contacts simultaneously. Five of the eight researched utilities schedule demand response events and notify enrolled customers within 24 hours of the event's scheduled start. Three of the eight researched utilities are not clear as to when notifications are sent out.

Table 5-7 highlights availability of notifications prior to or during an event.

Table 5-7. Notifications

Program Administrator	Program Name	Notifications
Texas Utilities	Commercial Load Management SOP	Phone call to project sponsor. **ERCOT:** 30 minutes prior to event (AEP – 1 hour) **Non-ERCOT:** One hour prior to event
NV Energy	PowerShift	Phone, email, or text, all to multiple contacts 24 hours before event
Alliant Energy	INTSERV Electric Interruptible Program	Phone, email, or text, all to multiple contacts Minimum 2 hours' notice

Program Administrator	Program Name	Notifications
CPS Energy	Commercial Demand Response	Phone, email, or text Within 2 hours in advance
Duke Energy	PowerShare	Phone, email, fax 15 minutes to 24 hours before event
Florida Power & Light	Business OnCall	Unknown
Pacific Gas & Electric	Peak Day Pricing	Phone, email, or text, all to multiple contacts By 2:00 p.m. the day prior to a SmartDay
San Diego Gas & Electric	No official name	Phone, email, or text, all to multiple contacts By 3:00 p.m. the day prior to event
Southern California Edison	Summer Discount Plan + CPP	Phone, email, or text, all to multiple contacts By 3:00 p.m. the day prior to event
ERCOT	ERS	Phone call 10-30 minutes prior to event

Demand Response Event Dynamics

Timing and limitations of load control seasons on demand response events are illustrated in Table 5-8. Demand response event limits are set by utilities engaging in direct control of participating C&I buildings. These depend on the state the demand response program is operating in and unique climate and demand conditions that are foreseen by the utility.

Table 5-8. Load Control of Researched Utilities

Program Administrator	Load Control Season	Load Control Times	Load Control Limitations
Texas Utilities	June 1–September 30, excluding holidays and weekends	1:00 p.m.–7:00 p.m.	1 hour minimum 4 hours maximum 1-2 events minimum (scheduled events) 5-14 events maximum (scheduled and unscheduled events)
NV Energy	June 1–September 30[t], not including holidays and weekends (Southern NV) July 1–September 30, not including holidays and weekends (Northern NV)	1:00 p.m.–7:00 p.m.	2 hours per event <= 2 events per week
Alliant Energy	Entire year	Unknown	4 hours per event 50 hours per year
CPS Energy	Smart thermostats + Direct Control Units: May 1–September 30, non-holiday weekdays.	3:00 p.m.–7:00 p.m.	Unknown

Program Administrator	Load Control Season	Load Control Times	Load Control Limitations
	Curtailment incentives: June 1–September 30, any day.	11:00 a.m.–7:00 p.m.	
Duke Energy	Summer Only Option: June 1–September 30, non-holiday weekdays. Extended Summer Option: May 1–October 31, any day. Annual Option: Entire year.	Summer Only: 12:00 p.m.–8:00 p.m. Extended Summer: 10:00 a.m.–10:00 p.m. Annual: 10:00 a.m.–10:00 p.m. (May 1–October 31); 6:00 a.m.–9:00 p.m. (November 1–April 30).	10 hours per event 10 events per year (Summer Only option) No restriction on number of events (Extended Summer and Annual options)
Florida Power & Light	April 1–October 31	Unknown	6 hours per event
Pacific Gas & Electric	May 1–October 31	2:00 p.m.–6:00 p.m.	4 hours per event 15 events per year
San Diego Gas & Electric	May 1–September 30, any day of week	11:00 a.m.–6:00 p.m.	7 hours per event 18 events per year
Southern California Edison	June 1–September 30, non-holiday weekdays (direct control unit) Year-round, non-holiday weekdays (critical peak pricing)	2:00 p.m.–6:00 p.m.	6 hours per event 9 events per year (minimum) 15 events per year (maximum)
ERCOT	February 1– May 31, June 1–September 30, October 1 – January 31 Not including holidays and weekends	1:00 p.m.–7:00 p.m.	12-hour maximum event duration. Unlimited maximum per season.

Due to the uniqueness of employed demand response tactics and the differences in program composition across researched utilities, we highlight demand response event dynamics for utilities employing (1) direct control units, (2) curtailment incentives, and (3) critical peak pricing in their demand response portfolios separately.

Direct Control Units

To curtail peak loads in their service territories, Florida Power & Light and Southern California Edison included direct control units in their demand response portfolios. This enables the utility to trigger an event to immediately curtail loads from enrolled HVAC equipment, removing a component of customer error that may be present in other demand response programs. Load control seasons, restrictions, and overall dynamics are discussed below for Florida Power & Light and Southern California Edison.

Florida Power & Light has a load control season for its C&I customers spanning April 1 to October 31. When an event is called, C&I customers can only have their load curtailed for enrolled HVAC units over a period of six hours. Florida Power & Light will determine appropriate cycling that occurs during this 6-hour period for enrolled HVAC units, shutting off compressors for enrolled units for 15 to 17.5 minutes

at a time for every 30 minutes that a demand response event is in effect. Documentation does not explicitly state whether there are limitations on the number of events that can be called per year.

Southern California Edison has a load control season that spans non-holiday weekdays from June 1 through September 30. Southern California Edison is limited to a period of 90 hours per enrolled customer per load control season under its direct load control program. Enrolled customers receive a notification at least 24 hours prior to the start of an event to modify energy use accordingly. On days when load control is utilized, enrolled equipment can be controlled for up to six hours per day. The extent to which loads on enrolled equipment are controlled depends on the cycling option chosen by the customer. For customers enrolled in the 30 percent cycling option, the direct control unit will shut off the HVAC compressor for 9 minutes out of every half-hour period. The compressor will then shut off for longer periods in higher cycling options, with those enrolled in the 50 percent option having their HVAC compressor shut off for 15 minutes out of every half-hour period, and those enrolled in the 100 percent option having their HVAC compressor shut off for the entirety of the demand response vent.

For Southern California Edison customers who are enrolled in critical peak pricing, the load control season spans the entire year, with each episode limited to a length of 6 hours. Customers are notified at least 24 hours prior to the start of an event to modify energy use accordingly. Southern California Edison is also limited to a period of 90 hours per enrolled customer per load control season under its critical peak pricing program.

For Southern California Edison customers simultaneously enrolled in both direct load control and critical peak pricing, load control season comes in two waves. Between June 1 and September 30, these customers are subject to both critical peak pricing and direct load control. Otherwise, for the period spanning October 1 through May 31, these customers are subject only to critical peak pricing schedules. Since load control restrictions are limited to each program, customers enrolled in both programs are subject to up to 180 hours of load control per year, with 180 hours reached if direct load control event days are different from critical peak pricing event days.

Curtailment Incentives

Alliant Energy, Duke Energy, ERCOT, and Texas utilities employ curtailment incentive strategies to curtail peak load on event days. Duke Energy rewards customers for meeting their curtailed load agreement. Alliant Energy caps use at the amount contained in the curtailment agreement. Details pertaining to the program offerings by each of the utilities are highlighted further below.

Alliant Energy employed curtailment incentives in its INTSERV interruptible service program. Event days can be called at any time during the year but are limited to 4 hours per event and 50 hours per year. Under the program, Alliant signs curtailment contracts with individual large C&I customers with at least 200 kW of curtailable load, binding large C&I customers to a reduced load during event days. Large C&I participants submit a new contract on January 1 of each year to maintain enrollment in the INTSERV program and to allow these customers to correct their curtailment commitments for event days. Once an agreement is reached between Alliant and the enrolled large C&I customer, Alliant will cap energy use during event hours at the contracted curtailment level. Opt-out potential is discussed further in the next section.

Duke Energy also employed curtailment incentives for its large C&I customers, and enrolled C&I customers would have to meet curtailment agreements via reductions of energy use during events, no matter the duration of these events. This contrasts with the experience for C&I customers under the INTSERV program offered by Alliant Energy, as those customers would have their usage automatically interrupted to remain in compliance with their curtailment contract.

Demand response events can be called at any time of the year for those enrolled in the Annual option contained in the PowerShare program. Under this Annual option, events can be called at any time

between 10:00 a.m. and 10:00 p.m. from May 1 through October 31, and at any time between 6:00 a.m. and 9:00 p.m from November 1 through April 30. For PowerShare participants enrolled in the Extended summer option, load control season includes all days between May 1 through October 31, 10:00 a.m. until 10:00 p.m., with no restriction on the duration or number of episodes called. Those customers enrolled in the Summer Only option face the shortest load control season, spanning non-holiday weekdays from June 1 through September 30, 12:00 p.m. until 8:00 p.m. with a maximum 10 hours per event and 10 events per year.

Once an event is called, PowerShare customers enrolled in the CallOption subset of the program receive a notification to reduce their load to a point at or below the level agreed upon in their curtailment agreement the morning of the event. QuoteOption customers instead elect a certain amount of curtailable load on the day of the event after receiving a notification 30 minutes prior to the event. Penalties applied for not meeting curtailment agreement are not clear based on available documentation. If the event is successfully completed at or below the curtailment agreement amount, then bill credits are received. (These are described in more detail in the Incentive Structure section).

Critical Peak Pricing

The main goal of critical peak pricing is to shift consumption from peak period to off-peak during an event day. This is done via imposition of an adder per kWh of consumption to penalize heavy consumption during event hours. When combined with non-event incentives, this adder is expected to be an effective means of discouraging consumption during the event period.

Pacific Gas & Electric will call an event—or SmartDay—any day between May 1 and October 31, including weekends and holidays. Events are called between 2:00 p.m. and 6:00 p.m. during the load control season. A maximum of 15 events may be called during the load control season, and these events may be no longer than 4 hours. During these events, electric rates for Peak Day Pricing customers will go up by the $1.20 per kWh adder.

San Diego Gas & Electric will call an event any day from May 1 through September 30 between 11:00 a.m. and 7:00 p.m. Events are limited to 7 hours in duration and there cannot be more than 18 events during any load control season. During events, electric rates for enrolled customers are raised, revised upward by a $1.35 per kWh adder, slightly higher than that imposed by Pacific Gas & Electric.

Direct Control Units, Curtailment Incentives, and Smart Thermostats

Of the programs covered in this benchmarking analysis, CPS Energy was the only utility to offer direct control units, curtailment incentives, and smart thermostats in its commercial demand response program. CPS Energy offered its C&I demand response customers the option of curtailment incentives, smart thermostats, or direct control units in order to curtail loads during demand response events. Only small commercial customers are able to participate in demand response with smart thermostats and direct control units, and only large commercial customers are able to participate in demand response with curtailment incentives.

Large commercial customers face curtailment incentive-based demand response events that can be called from June 1 through September 30 for both sets of measures, with an event being called at any point between 1:00 p.m. and 7:00 p.m. during this time span. Following notification receipt, the customer is required to curtail its use according to its curtailment contract. Customers can track their energy use through free access to 15-minute meter data to ensure compliance.

For small business customers with smart thermostats and direct control units, an event can only be called on weekdays between May 1 and September 30 between 3:00 p.m. and 7:00 p.m. Smart thermostat customers will then have their thermostat set-points changed to be within three degrees Fahrenheit of their pre-event set-point to maintain comfort. Customers with direct control units will have their HVAC compressors shut off for 10 minutes during every half-hour period that the event is in effect.

Direct control units will kick into effect at random times for 10 minutes at a time to ensure stress on the grid is distributed evenly during event hours.

Opt-out Potential

Potential for a customer to opt out of specific demand response events is relatively limited among the set of researched C&I demand response programs. Alliant Energy and CPS Energy were the only utilities that posted opt-out potential for specific events. Otherwise, the three California utilities provided information for how to move off the program. Duke Energy and Florida Power & Light provided no information for how to leave the program or opt out of specific events.

Through its INTSERV interruptible service demand response program, Alliant caps energy use to the amount detailed in the curtailment contract during events between the participant and Alliant. Alliant will contact the customer at least two hours prior to an event to allow customers to determine whether they would like to participate in an upcoming event. Should the customer decide not to participate in the event, they must contact Alliant to request to buy through. Under this option, the customer faces sharply increased prices per kWh of energy consumption applied to the difference between the agreed curtailment load and actual consumption during the event day. The customer must contact Alliant with intention to buy through at least one hour prior to the start of the event. It does not appear that there are any limits on the number of times a customer can do this during a load control season.

CPS Energy C&I customers enrolled in its demand response program with either curtailment incentives, a smart thermostat, or a direct control unit can opt out of specific events by calling CPS Energy. Customers with smart thermostats that have the Total Connect Comfort app on their smartphones may choose to opt-out of specific events instead. Customers with smart thermostats are encouraged to stay in the program for a minimum of three years. Opting out of the program before then will cause the customer to lose the smart thermostat. Otherwise, waiting until three years have passed will allow the customer to take ownership of the smart thermostat.

Participants in the Texas Utilities CLM programs can opt out of an event at any time or not take part in an event if desired. If a participant does opt out of an event, they will receive no incentive for the event as they will not have curtailed any demand during the event. Additionally, it is stated in the program manuals for these programs that if a participant does opt out, the participant will be looked at unfavorably by its utility during the next application to the program in the following program year.

Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison provided detailed information of how to move out of their critical pricing programs but did not enable customers to opt out of specific events. Customers in Southern California Edison's Summer Discount Plan with direct control units were also unable to opt out of specific events. Instead, demand response customers had to exit the demand response program completely in order to opt out of future events after a one-year refractory period. Due to California regulations, all C&I customers that choose to opt out must choose a similarly-structured TOU rate plan available.

Demand Response Outcomes

Participation Numbers and Total Energy Savings

Table 5-9 provides, where available, total commercial and industrial base of utilities, customers enrolled in demand response under the respective utilities, and demand response outcomes.

Table 5-9. Program Goals and Outcomes

Program Administrator	Customers Enrolled	Program Outcomes
Texas Utilities (2018)	574	**ERCOT utility savings:** 214,333 kW reduction in demand 571,369 kWh energy savings **Non-ERCOT utility savings:** 28,006 kW reduction in demand 167,572 kWh energy savings
NV Energy	7,951	**Savings:** 555,840 kWh savings across between 23 to 40 events and 7,951 customers. 7,816,180 kWh savings due to non-event day optimization of energy consumption.
Alliant Energy (2017)	301[37]	No evaluation found
CPS Energy [38] (2015)	2,310 - Smart Thermostats 278 - Curtailment Incentives	**Savings:** Smart Thermostats—705 kW across all customers across four demand response events Curtailment incentives—56,358 kW across all customers across four demand response events
Duke Energy	14[39] (KY—2014) 186[40] (NC + SC—2016) 38[41] (OH—2015)	**Savings:** KY—19.64 MWh total curtailed across four events among the 14 enrolled NC + SC—295.83 MW average curtailed in each of four events among the 186 enrolled OH—63.3 MW average curtailed in each of the two test events among the 38 enrolled. No true events triggered, only tests.
Florida Power & Light	Unknown	No evaluation found
Pacific Gas & Electric (2015)	208,804	**Large C&I (>=200 kW) savings:** 5.3% per customer per event 14.2 kW per customer per event day. 29.8 MW reduction per event across 2,093 large C&I customers.

[9] Enrollment numbers for Alliant's Iowa and Wisconsin customers gathered from two webinars held by Alliant Energy in 2017: https://www.alliantenergy.com/-/media/Files/PartnersinEnergy/IowaElectricInterruptibleWebinar_May2017.pdf?la=en https://www.alliantenergy.com/.z/media/Files/PartnersinEnergy/WisconsinElectricIntrruptibleWebinarMay2017.pdf?la=en.

[38] https://www.sanantonio.gov/Portals/0/Files/Sustainability/STEP/CPS-FY2015.pdf

[39] Duke Energy Kentucky EM&V, February 2017: https://psc.ky.gov/pscecf/2017-00324/debbie.gates%40duke-energy.com/08152017042243/Case_No._2017-00324_Appendix_E-G.pdf.

[40] http://www.energy.sc.gov/files/view/2017%20Duke%20Energy%20Carolinas%20Integrated%20Resource%20Plan.pdf.

[41] http://dis.puc.state.oh.us/TiffToPDf/A1001001A17D17B45101G03468.pdf.

Program Administrator	Customers Enrolled	Program Outcomes
		Small and medium (>=20 kW, <200 kW) C&I savings: 5.1 kW per customer per event. 5.8 MW reduction per event across 148,782 customers.
San Diego Gas & Electric (2015)	1,207	**Large C&I (>=200 kW) savings:** 8.6% per customer per event. 29.5 kW per customer per event. 24.4 MW reduction per event across 826 customers. **Small and medium (>=20 kW, <200 kW) C&I savings:** 6.5% per customer per event. 3.7 kW per customer per event. 1.3 MW reduction per event across 358 customers.
Southern California Edison	811 (2012, Direct Control) 2,677 (2015, Critical Peak Pricing)	**Savings from Direct Control Units:** 14% per customer per event 4.7 kW per customer per event 4 MW reduction per event across 811 customers **Savings from Critical Peak Pricing:** **large C&I (>=200 kW) savings:** 5% per customer per event 10.8 kW per customer per event 29 MW reduction per event across 2,677 customers **Small and medium (>=20 kW, <200 kW) C&I savings:** 1.6% per customer per event 1.2 kW per customer per event 0.2 kW reduction per event across 201 customers
ERCOT	441 (2019)	Three interruptions from 2011-2014. No other interruptions since end of 2014.

Five out of eight utilities included in our benchmarking research had documentation highlighting energy savings and participation estimates. These estimates were found in publicly available EM&V

documentation[42, 43, 44] based on impact evaluations conducted by a third-party. We encourage readers to investigate these in more detail.

For its PowerShare program with curtailment incentives, Duke Energy had a C&I base of 569,486, including 14 large C&I customers with at least 100 kW of curtailable load participated in the program during the 2014 program year. Duke Energy experienced savings of 19.64 MWh across all four events called during the 2014 program year. Duke Energy Carolinas called four events during PowerShare's 2016 program year, curtailing an average of 295.83 MW per event across the 186 participants. Duke Energy Ohio called no events during its 2015 program year but across its two tests curtailed an average of 63.3 MW across its 38 participants. Average per-event MWh savings across the 14 participants was 1.40 MWh. Average per-event MW savings per customer across Ohio and the Carolinas was 1.6 MW.

Pacific Gas & Electric had 668,179 C&I customers by the end of 2015. Under Peak Day Pricing, its critical peak pricing program, 208,804 were enrolled by the end of 2015. During Peak Day Pricing's 2015 program year, 150,875 customers participated in the 15 event days called. Across the 2,093 large C&I customers, there was an average of 5.3 percent savings per customer per event, a 14.2 kW reduction per customer per event. Aggregate savings among this customer segment amounted to 29.8 MW per event. Across the 148,782 small and medium C&I customers, there was an average of 0.8 percent savings per customer per event, a 5.1 kW reduction per customer per event. Aggregate savings among this customer segment amounted to 5.8 MW per event.

San Diego Gas & Electric had 156,575 C&I customers by the end of 2015. Of these, 1,207 were enrolled in critical peak pricing and participated in the five events that were called during 2015. Across the 826 large C&I customers under this rate schedule there was an average savings of 8.6 per customer per event, amounting to 29.5 kW per customer per event. Aggregate per-event savings amounted to 24.4 MW for this customer segment. Across the 358 small and medium C&I customers under this rate schedule there was an average savings of 6.5 percent per customer per event, amounting to 3.7 kW per customer per event. Aggregate per event savings amounted to 1.3 MW for this customer segment.

Southern California Edison had 642,263 C&I customers by the end of 2015. For its Summer Discount Plan with direct control units, 811 C&I customers were enrolled in 2012 (the most recent EM&V available). Savings of 14 percent per customer per event were estimated for the 2012 program year, amounting to 4.7 kW per customer per event. Aggregate per-event savings amounted to 4 MW for the Summer Discount Plan.

For Southern California Edison's critical peak pricing program, 2,677 C&I customers were enrolled and participated in the 12 events called in 2015. Across the 2,464 large C&I customers under this rate schedule there was an average savings of 5.1 percent per customer per event, amounting to 11.7 kW per customer per event. Aggregate per-event savings amounted to 28.8 MW for this customer segment. Across the 201 large C&I customers under this rate schedule there was an average savings of 1.6

[42] Duke Energy Kentucky EM&V, February 2017: https://psc.ky.gov/pscecf/2017-00324/debbie.gates%40duke-energy.com/08152017042243/Case_No._2017-00324_Appendix_E-G.pdf.

[43] Southern California Edison EM&V of whole demand response portfolio, May 2013: http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/D34266A20AEE3D6888257B7C00769745/$FILE/R.07-01-041_DR%20OIR_SDP%20DR%20Portfolio%20Summary%202012%20-%20Final%20-%20Update%2020130530.pdf.

[44] Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison EM&V of critical peak pricing, April 2016: http://www.calmac.org/publications/7._Statewide_2015_CPP_Report.pdf.

percent per customer per event, amounting to 1.2 kW per customer per event. Aggregate per-event savings amounted to 0.2 MW for this customer segment.

Conclusion

Texas utilities were found to be acting in accordance with industry best practices by having similar program eligibility requirements and incentive structures to other utilities that are offering curtailment incentives. All investor-owned Texas utilities offer CLM programs that employ the use of curtailment incentives as their only program offering. Other researched programs curtailed peak loads on event days via one-way direct control units, curtailment incentives, and critical peak pricing. Texas CLM programs are also only offered during the summer peak period. Some utilities offer programs throughout the year and there could be potential for expansion if beneficial to the Texas electric grid.

5.3.4.2 Program Staff Interviews

Key Finding #1: Programs are generally working well, with some modifications in incentive levels and the participant mix.

All of the utilities have been running commercial load management for many years. Utilities report the programs are working well and only minor "tweaks" have been made recently or are planned in the near future. Some utilities report looking for the "sweet spot" in incentive levels where the incentive is sufficient to retain participation and kW reductions without being set too high. Most utilities have either modified incentives recently or plan to do so. Non-ERCOT utilities report considering their independent system operator (ISO) needs when setting incentives even though they use statewide avoided costs. Utilities report that they often get "lucky" and customers reduce load more than they are required to do in their program participation contract. Many utilities compensate overperformances through a bonus if funds are available. In contrast, participants' incentives are negatively affected if they underperform. Utilities either zero out savings if they do not curtail as required by the technical reference manual (TRM) or count negative savings, which is a more conservative estimate of kW reductions than currently required by the TRM.

Participation is fairly stable from year to year across all of the utilities. However, many of the utilities are experiencing some changes in their participation mix. ERCOT utilities have a mix of aggregators and self-sponsored customers participating in programs. Non-ERCOT utilities only have self-sponsored customers to-date but have been approached by aggregators. How quickly programs become fully subscribed depends on the utility. The larger utilities tend to have programs that immediately fill while the smaller utilities tend to have longer enrollment periods and recruit customers.

Regardless of how quickly their programs subscribe, most utilities are looking to expand the diversity and reach of their customer mix. In general, utilities try to improve their participant mix by diversifying participants, with the goal of having more strong performers than poor performers in terms of load reduction during curtailment events. Utilities have a fairly good understanding of how self-sponsored customers are responding to curtailment events. Several utilities collect this information as part of the program application process. Customers with back-up generators were reported as good candidates for the programs, as are customers with energy management systems. Several utilities also feel schools are good candidates for both the financial benefit to these organizations that experience funding constraints and the number of facilities school systems have that can shed load during an event.

Recommendation #1: Utilities should collect information from customers or aggregators annually on how they curtail load if they do not already do so.

5.3.4.3 Participant Surveys

The EM&V team completed a telephone survey with Commercial Load Management program participants in order to provide process insights for these programs. This section summarizes the survey findings from this survey effort. Below we describe study objectives and methodology, detailed findings, and recommendations for consideration.

Study Methodology

This process study assessed program participants' experiences with the program. Specifically, the evaluation aimed to characterize the customer experience in the following areas:

- Program awareness
- Decision-making
- Experience with curtailment events
- Satisfaction with the program
- Suggestions for program improvement.

The EM&V team completed telephone surveys with 77 Commercial Load Management program participants between January 15 and February 1, 2019. Table 5-10 documents the number of completed surveys by utility.

Table 5-10. Number of Surveys Completed

Utility	Number of Respondents
CenterPoint	18
AEP TCC	13
AEP TNC	2
El Paso Electric	8
Xcel Energy	5
SWEPCO	5
TNMP	6
Entergy	7
Oncor	13
Total	**77**

The sample of customers was drawn from the PY2018 tracking database. Texas utilities were responsive to the EM&V team's data request for this customer survey; however, the tracking data quality varied. While some utilities were able to provide detailed tracking data including key contact names for customers enrolled in demand response and/or load management programs, other utilities provided tracking data that was far less complete. This was especially true when a utility relied on a third party to implement its program.

The survey respondent data was composed of accounts from various businesses, with at least 10 respondents each coming from the following commercial sectors: cotton gins (18 percent of

respondents), wastewater treatment (17 percent), manufacturing (13 percent), education (13 percent), and warehousing (11 percent). Most of the respondents (63 percent) said that their businesses were open and/or online 24 hours a day; seven days a week.

Participant Description

Forty-five percent of respondents surveyed operate modern facilities, defined within this analysis as operating a facility that was built after 1980. Customer buildings varied in size—41 percent of respondent facilities were larger than 100,000 square feet and 27 percent of respondent facilities were smaller than 1,500 square feet. All other respondents had facilities ranging from 1,500 square feet and 100,000 square feet.

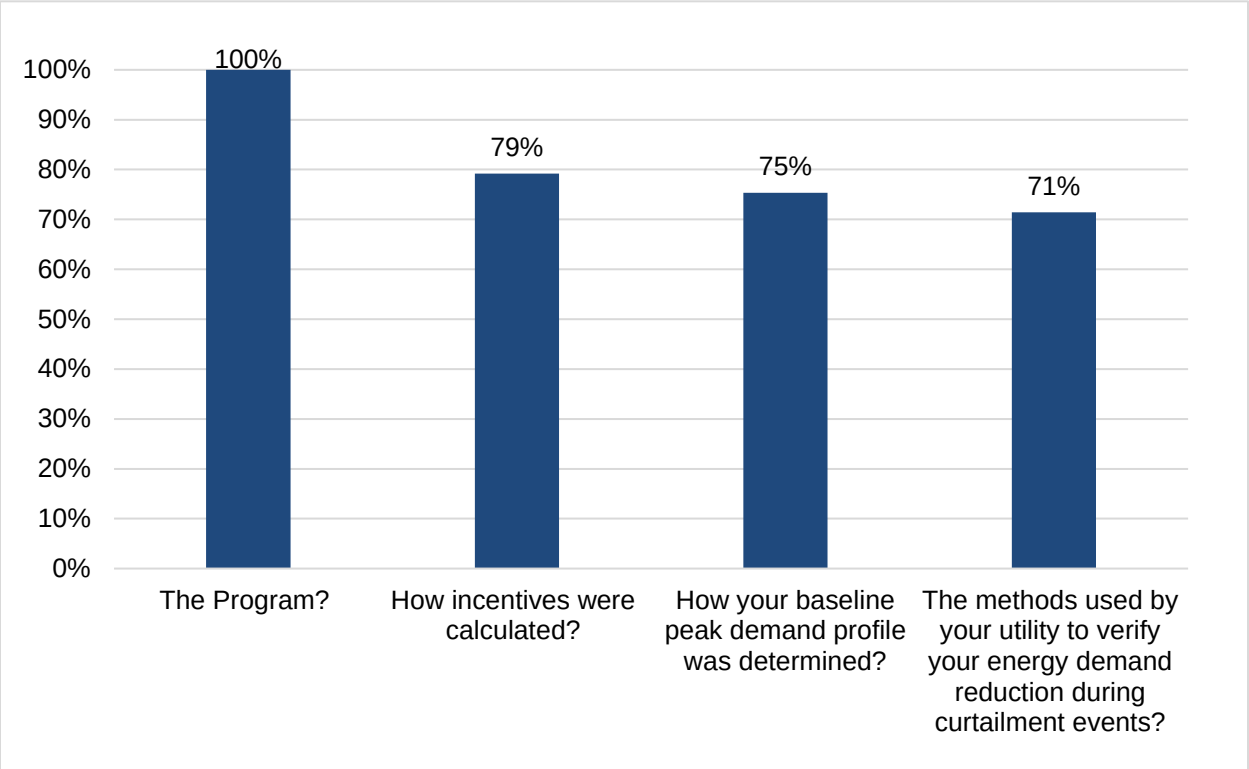
Approximately one-quarter of respondents (24 percent) reported undergoing organizational changes in the past year, such as recommissioning, adding floor area and/or capacity, renovating (two participants specifically noted recovering from Hurricane Harvey), and implementing energy efficiency protocols. More than half (58 percent) of respondents indicated that their operation schedule varied according to the season or production cycle.

Program Awareness and Understanding

Nearly all respondents attributed their program awareness to one of three main sources (multiple sources were allowed): a previous participant (54 percent), their utility (33 percent), or their third-party aggregator or ESCO (30 percent).

Surveyed respondents were asked to rate their familiarity with the program and program components using “very familiar,” “somewhat familiar,” or “not at all familiar.” All respondents expressed some level of familiarity with load management programs, and more than half (52 percent) said that they were “very familiar” with the programs offered. Respondents were slightly less knowledgeable in their understanding of other program details. Specifically, a portion of respondents said they were “not at all familiar” with calculation of incentives (21 percent), determination of baselines (25 percent), and curtailment of verification methods (29 percent). Figure 5-5 shows the percent of respondents who were either “very” or “somewhat” familiar with the program and program components.

Figure 5-5. Percent of Respondents Who Were Very or Somewhat Familiar with the Program and Program Components (n=77)



Source: Questions A2, A3, A3a, and A4.

Program Enrollment Process

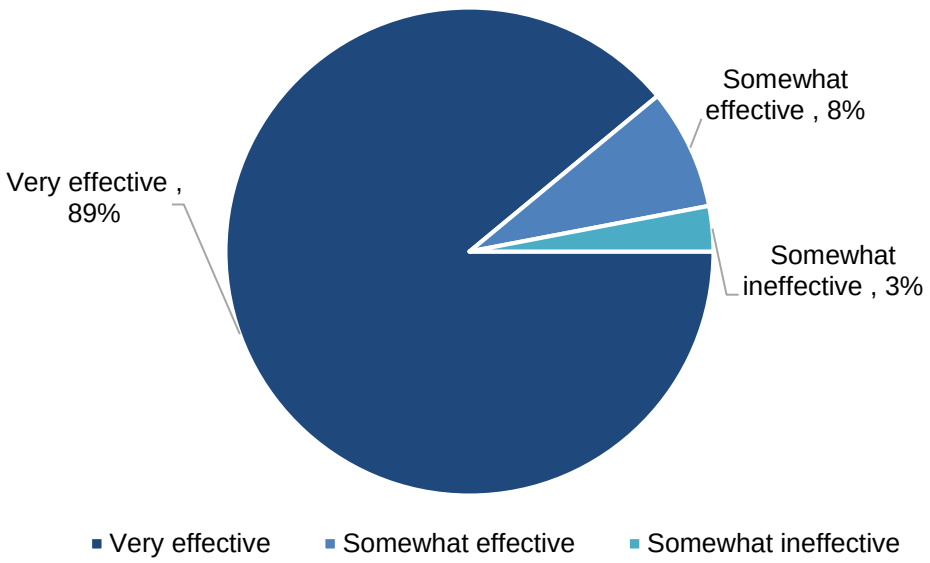
Surveyed respondents had different program sign-up experiences if they were self-sponsored instead of fostered through the program through a third-party aggregator or sponsor. For example, nearly all project-sponsored participants reported that either utility staff or a third-party aggregator initiated contact with them and explained the nature of the program. Almost all of these customers indicated that the assistance of utility staff or third-party aggregators was either “somewhat helpful” or “very helpful.” Another 40 percent of respondents said they signed up as an individual customer, without a project sponsor.

The Curtailment Process

Respondents were asked how they were notified of curtailment events in PY2018. (They could provide answers for more than one notice method.) Seventy-three percent of respondents said they received program emails, 62 percent said they received texts, and 56 percent said they received phone calls.

Figure 5-6 details how effective respondents thought these communications were. Among the 73 respondents who could recall the event notifications, 97 percent said the communications were “very” or “somewhat effective.”

Figure 5-6. Effectiveness of Curtailment Events (n=73)



Source: Question PA6. Don't know and refused responses were excluded from analysis.

Ninety percent of respondents said that they were able to reduce their energy usage for all program events. The actual amount of curtailable load reported by respondents varied and ranged anywhere from 10 percent to 100 percent of peak load. Table 5-11 displays the range of answers presented by the surveyed respondents. Nearly one-third (32 percent) of respondents who could recall the amount of load shed during PY2018 events indicated they shed 100 percent of their load.

Table 5-11. Average Percent of Peak Energy Demand Load Shed During PY2018 Curtailment Events

Average Percent Shed	Percent of Respondents
0%	0%
1 to 10%	12%
11 to 25%	5%
26 to 50%	17%
51 to 75%	17%
76 to 99%	18%
100%	32%
Respondents (n)	60

Source: Question PA0
Only respondents who were able to curtail load were included in this table. *Don't know* and *refused* responses are excluded.

More than half of the respondents (53 percent) who curtailed load indicated that demand reductions were manually operated; others indicated that such reductions were either fully automated (23 percent) or partially automated (23 percent). Seventy-one percent of respondents who participated in PY2018

events reported no loss in “personal comfort or productivity” for themselves or the building occupants because of demand reduction actions, while 29 percent confirmed they did experience some loss due to program participation. When probed to understand the program impacts, two respondents who confirmed some loss or discomfort due to program participation categorized it as lost production time. Factors such as staff complaints over lost work hours, a warm/uncomfortable environment, financial impact, and “the manpower it takes to shut down” were mentioned by one respondent each. Others reporting loss due to program participation did not expand their comments.

The majority of respondents (78 percent) recalled experiencing one to three curtailment events occurring during the season. More than half of respondents (59 percent) reported the number of events met expectations, 38 percent indicated there were fewer events than they expected, and 3 percent of respondents reported the number of events were more than expected.

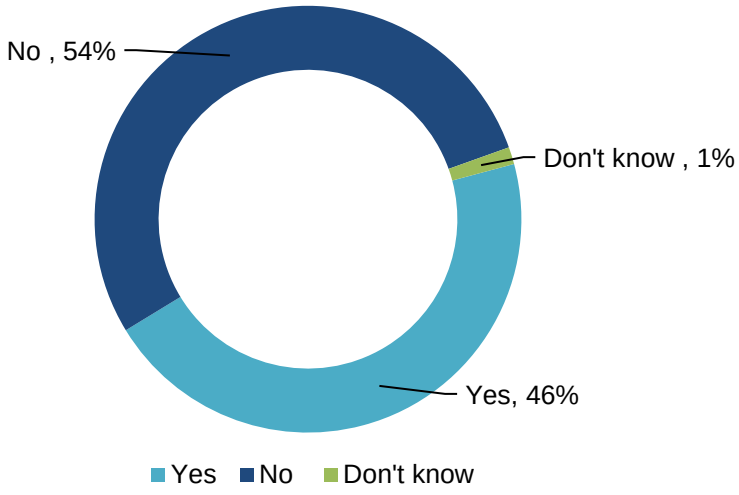
Few respondents (9 percent) reported not responding to curtailment events, but those who did cited examples such as “*could not reduce load on that particular event day*” (n=2) or “*inability to respond in time*” (n=2) as barriers. One respondent indicated they were already shut down on an event day and one respondent indicated that they did not receive an event notification in time. One respondent refused to give a reason for non-response to the curtailment event.

Customer satisfaction

In general, surveyed respondents were pleased with the program and overall program satisfaction was high. More than four out of every five respondents (87 percent) rated their overall program satisfaction an 8 or more, resulting in an overall mean satisfaction score of 9.0 on a 10-point scale (0=very dissatisfied, 10=very satisfied). High program satisfaction is further demonstrated by nearly all participants indicating they plan to continue participation in the program in PY2019; only two of 77 respondents indicated they would not. When asked why they would not continue participation, both attributed it to the uncertainty that came with a change in their third-party provider.

The high satisfaction scores continued when respondents were asked to recall their overall experience and satisfaction with their utility. Nine out of every 10 respondents (90 percent) rated their overall experience and satisfaction with their utility an 8 or more. The overall mean satisfaction score with the utility was 8.7 on a 10-point scale (0=very dissatisfied, 10=very satisfied). While there was high program and utility satisfaction, less than half (46 percent) of respondents have recommended the program to others, as presented in Figure 5-7.

Figure 5-7. Percent of Respondents that Recommended Program to Others (n=76)



Source: Question SAT5
Refused response is excluded

Customer Suggestions for Improvement

Surveyed respondents were asked for suggestions on how to improve the program. Seventy-five percent of respondents indicated that they did not have program feedback for change. Nearly one quarter (24 percent) of respondents did offer constructive feedback (multiple responses were allowed), and their comments are summarized in the paragraphs below. These suggestions reflect the statements made by surveyed respondents and are not necessarily endorsed by the EM&V team.

More advanced notification. When asked about the aspects of the program that should be changed, more advanced notification was mentioned by four respondents. Among the two that provided specifics about what they would welcome in notification changes, one mentioned that they wanted more than one key contact person notified by the program to increase opportunities for the company to become aware of approaching events. Another person requested notifications come earlier (more “advance warning”).

Change to curtailment events. Curtailment events may last up to four hours in duration and start and stop times can vary. Eleven respondents indicated they would like changes to the events themselves. Among those who expanded on their sentiment, one respondent would like events to have shorter duration, one would like them to be more specific, one would like them to come with more warning, and one would like them to be called less frequently.

Post-event follow-up. Four participants asked for more follow-up after events to have a better understanding if they curtailed properly, offering an opportunity to improve their program participation and ultimately, their incentive amounts.

Improve annual program application. Three participants explained the same scenario for program improvement—that they filled out an annual application to participate and the application seems to “lose” their information from year to year. Participants who continue on through the program would like the application to carry information across from year to year whenever possible.

Other suggestions for improvement. Other suggestions for improvement from respondents were: providing greater incentives, expand the program, and increase opportunities for automation.

5.3.4.4 Key Findings and Recommendations

Finding #1: Ninety-seven percent of respondents indicated the program communications surrounding events were "very" or "somewhat" helpful, and nearly all customers that received the alerts were able to curtail load throughout the season. Most respondents confirmed they received curtailment notifications through more than one of the communication channels (phone, text, and/or email); it is likely that the alerts across multiple channels increase the likelihood of participants receiving timely notification of the events.

Recommendation #1: Continue alerting Commercial Load Management program customers of events via multiple communication channels.

Finding #2: As noted earlier in this section, four participants asked for more follow-up after events to have a better understanding if they curtailed properly. Event feedback could be helpful to both the program—by helping to educate their participants on how to get the most out of each event—and to participants, as they gain the satisfaction of curtailing to the maximum amount possible for them and collecting the highest incentive amounts for their efforts.

Recommendation #2: Consider implementing an option to provide post-event follow-up.

Finding #3: Program tracking data lacked complete participation information when assembled by a third-party program partner.

Recommendation #3: Work with third-party program partners to improve participant tracking data.

5.4 RESIDENTIAL LOAD MANAGEMENT

This section summarizes the key findings and recommendations from the PY2018 evaluation of the Residential Load Management programs offered by three Texas utilities (El Paso Electric, CenterPoint Energy and Oncor). Other utilities did not offer a residential load management program.

5.4.1 EM&V Overview

Two utilities calculated savings using interval meter data following the TRM 5.0 calculation methodology. The third utility used deemed savings, also from TRM 5.0. Process evaluation activities included participant surveys, benchmarking research and program staff interviews.

5.4.2 Key Findings and Recommendations

Finding #1: Utilities demonstrated strong capabilities to apply the high 3 of 5 method in TRM 5.0 to savings.

The two utilities that applied the high 3 of 5 method to savings did so correctly and matched the EM&V team's evaluated savings.

Recommendation #1: Continue implementing the demand savings algorithm described in TRM 5.0. If there are minor discrepancies in future program years, keeping active communications with the EM&V team to resolve minor calculation differences will be beneficial to both the EM&V team and the Texas utilities.

Finding #2: There was confusion surrounding language in the TRM 5.0 on how to apply the new deemed savings values.

PY2018 marked the first year in which utilities could calculate savings using a deemed saving approach if AMI meters are not installed on participating homes. Upon evaluation of this program by the EM&V team and subsequent comparison to utility calculated savings, language in TRM 5.0 was found to be confusing regarding what qualifies a "participant." The EM&V team, the utility, and the organization that produced the deemed savings value came to a consensus on how to apply the deemed savings value and an evaluated savings result was agreed upon. There will be clarifications in the next version on TRM 5.0 to resolve this confusion as well as an update to the deemed savings value to reflect savings achieved by participants that do not opt-out of load control events.

Recommendation #2: Continue implementing the demand savings algorithm described in TRM 5.0 as agreed upon after the PY2018 evaluation. If there are minor discrepancies in future program years, keeping active communications with the EM&V team to resolve minor calculation differences will be beneficial to both the EM&V team and the Texas utilities.

Finding #3: The Texas Utilities that offer residential demand response programs are employing best practices by making smart thermostats in their demand response programs available to residential households.

The benchmarked utilities are increasingly moving away from traditional one-way direct control units to a more customer-friendly and transparent two-way smart thermostat.

Recommendation #3: Continue to offer these new technologies as a way for residential demand response programs to curtail peak load.

Finding #4: Texas utilities offer incentives that are larger than many other demand response programs, but this may also be resulting in larger demand reduction potential from these programs.

For its load control season spanning June 1 through September 30, customers enrolled in Texas utility residential demand response programs are eligible for incentives of up to $38.00 per kW reduced during an event. This is a larger incentive than many other demand response programs with incentives between $20.00 and $40.00 per year. The Texas utilities per-customer savings were approximately $1.32 kW per event on average in 2018. Per-customer savings are above those observed for many other utilities. For example, Southern California Edison's direct control units was $0.94 kW per customer and Pacific Gas & Electric's critical peak pricing with optional direct load control was $0.80 kW per customer per event.

Recommendation #4: If program cost-effectiveness is ever at risk, consider lowering incentives to regain cost-effectiveness while still maintaining participation.

Key Finding #5: While residential demand response programs have been growing in Texas, the benchmarking research indicates this resource could be increased if needed.

One of the Texas programs caps enrollment at 3,000 participants and the other two programs do not cap enrollment. The two programs that do not cap enrollment have a lower than average participant count when compared to benchmarked utilities. On average, the benchmarked utilities have 5 percent of their residential customer base enrolled in a residential demand response program, whereas the Texas utilities average 1 percent.

Recommendation #5: Consider allowing for additional participation if the residential demand response programs are under-performing with respect to peak load needs.

Key Finding #6: While residential programs are very popular with customers, utilities are seeing a need to modify incentive levels, program administration and participation limits.

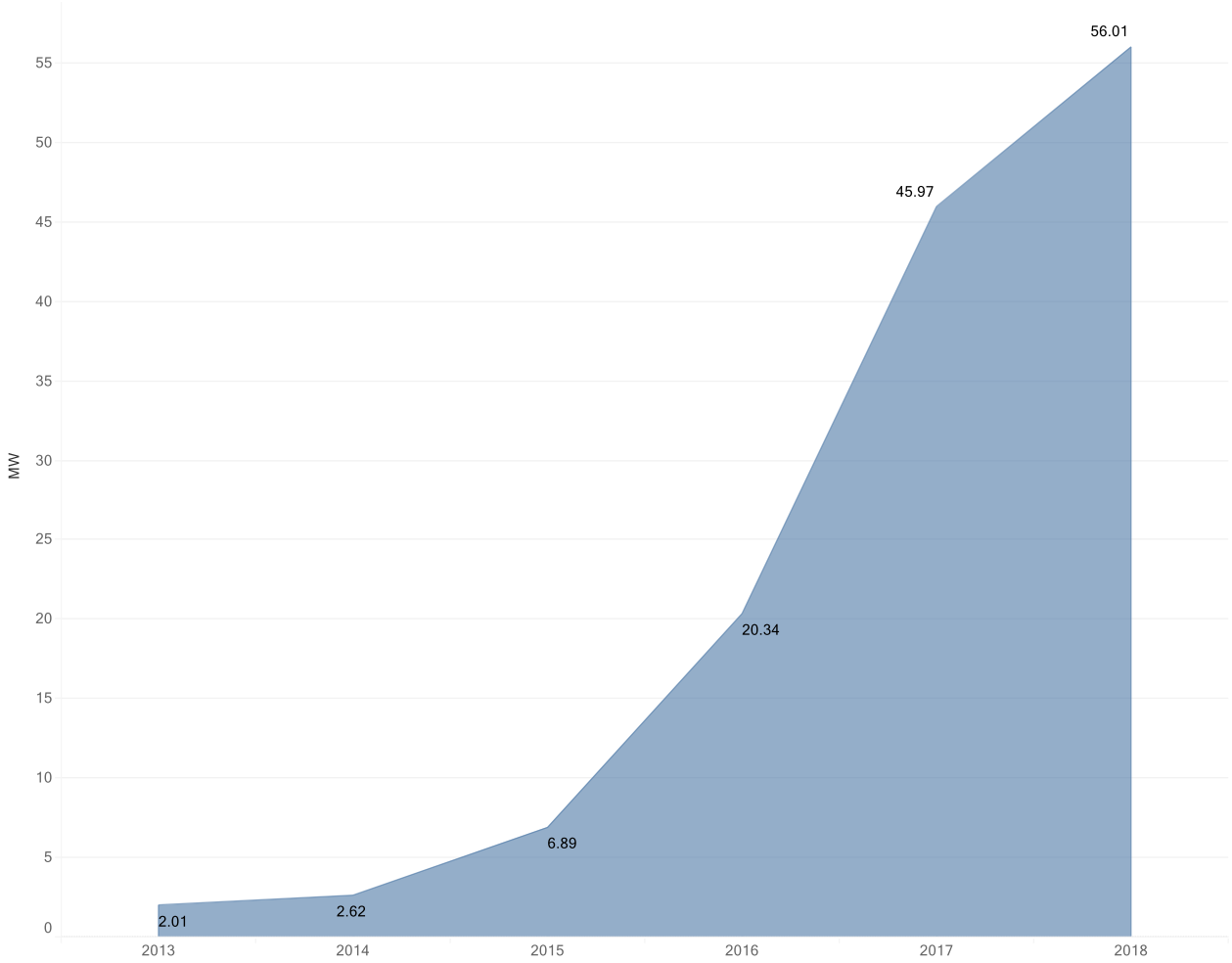
Even though the programs are a relatively new offering, participation has easily and quickly ramped up. Now, utilities are seeing the need for adjustments. Utilities are modifying their third-party implementation of the programs to be more cost-effective. Some service providers have been too costly and utilities either have recently or plan to decrease incentive levels for either the smart thermostat or the incentive per kW savings. One utility has already had to limit participation and turn interested parties away. Another utility is allowing some growth due to the uptake and interest in the program, but also anticipates the need to limit participation.

Recommendation #6: Consider available load relief comprehensively across residential and commercial offerings.

5.4.3 Impact

The total evaluated savings for the three programs were 51,010 kW and 264,250 kWh. These savings are up from PY2017 by approximately 5,000 kW and 6,000 kWh even though AEP dropped out of the residential demand response space. Oncor's and CenterPoint's programs were in their fourth year of implementation in PY2018. El Paso Electric's program was in its first year of implementation. Figure 5-8 shows total kW savings from residential demand response programs by program year.

Figure 5-8. Evaluated Demand Savings of Residential Load Management Programs (PY2012 – 2018)



Oncor and CenterPoint

Comparing the evaluated savings to the utility claimed savings from TRM 5.0 calculations shows agreement for both utilities. The EM&V team has worked with Oncor at a detailed level over the past three program years and, as a result, calculations matched exactly in PY2018. This agreement is supported by the fact that Oncor provided valuable documentation of how it addressed meters requiring specific treatment. The EM&V team and CenterPoint matched calculations exactly with documentation provided by CenterPoint about how special meters were handled.

El Paso Electric

For El Paso Electric, the EM&V team's calculations did not match the utility's calculations initially. Upon meeting with El Paso Electric, the evaluated savings calculated were found to be lower than what El Paso Electric was claiming. This difference in savings prompted a discussion between the EM&V team and El Paso Electric. During the discussion, the EM&V team found that the language in TRM 5.0 was being interpreted differently by each party. The TRM 5.0 language in question reads, "Event-level savings are calculated by multiplying kW savings per household/device by the participating number of devices on that event, then adding all the groups savings together." The EM&V team took this statement to mean that the kW savings per household/device was to be applied to meters that did not op-out of and otherwise had full participation in an event, whereas El Paso Electric applied the kW savings per household/device to meters that participated/were enrolled in the program during the 2018 program year, regardless of op-out status at the event level.

After this initial discussion with El Paso Electric, more clarification was needed to understand how the deemed savings value was calculated. At this time, Frontier Energy (the firm that produced the deemed savings value), was brought into the discussion. The deemed savings value was produced using a sample of 50 homes in the El Paso Electric territory; Frontier assumed that this sample of 50 homes would contain op-out rates similar to those the entire program population would exhibit. Therefore, the effects of op-out meters are accounted for in the deemed savings value. With an understanding of how the deemed savings value was calculated, the EM&V team agreed with El Paso Electric that the deemed savings value in TRM 5.0 is to be applied to participating meters in the program, regardless of participation at the event level.

With evaluated savings equaling calculated savings produced by utilities, residential demand programs received a realization rate of 100 percent for both kW and kWh.

5.4.4 Process

5.4.4.1 Benchmarking Research/ Documentation Review

This benchmarking study characterizes utility programs identified by the EM&V team as being of interest to review and compare against the Texas electric utilities' residential demand response programs. The utilities were selected for geographic coverage across the U.S. so that both coasts and territories in the middle are represented. Utilities chosen for the benchmarking study are similar to one or more of the Texas utilities in terms of number of customers served. The regulation or deregulation of the utilities varies considerably. The majority of the utilities are vertically integrated, which limits direct comparisons with the ERCOT utilities operating in a competitive retail space and these limitations should be kept in mind. Information collected for the target programs of interest included:

- **Program design:** Program control strategy,[45] program goals, outreach mediums, eligibility requirements, incentive structure
- **Program implementation and delivery:** Program procedures, notification strategies, demand response event dynamics, opt-out potential
- **Demand response outcomes:** Participation numbers and total demand reductions.

The benchmarking research was conducted via targeting of specific utilities, then gathering information about their residential demand response programs. Information gathered from these programs was collected by inspecting program documentation provided by each utility website, assessing evaluation documents pertaining to these programs, and, where available, inspection of any public commission documentation. Data on demand response programs were collected for eight utilities. Internet research was the main source of information. Utilities where Tetra Tech has current or recent EM&V work are noted with an * below and more information was available for those utilities. The following utilities are included in this benchmarking research:

- Commonwealth Edison (ComEd)
- Duke Energy Progress North Carolina*
- Entergy Arkansas*
- Florida Power & Light
- Kansas City Power & Light
- NV Energy*
- Pacific Gas & Electric
- Southern California Edison

In addition, the benchmarking research includes programs run by the Electric Reliability Council of Texas (ERCOT). Table 5-12 provides basic information about the utilities and ERCOT.

Table 5-12. Service Territory and Residential Customer Base

Program Administrator	Service Territory	Residential Customers Served
Commonwealth Edison	Northern Illinois	3,574,519
NV Energy	Northern and Southern Nevada	1,089,713
Duke Energy Progress N.C.	North Carolina	1,162,473
Entergy Arkansas	Central and Eastern Arkansas	589,522
Florida Power & Light	East Coast of Florida, some Gulf Coast areas	4,284,159
Kansas City Power & Light	Northwest Missouri, Eastern Kansas	469,606
Pacific Gas & Electric	Northern and Central California	4,760,208

[45] Control strategy refers to how load is reduced. The most comment control strategy for residential programs is changes in central air conditioning in homes.

Program Administrator	Service Territory	Residential Customers Served
Southern California Edison	Puget Sound region, Washington	4,406,932
ERCOT	Majority of Texas	24 million total customers

Program Design

Program Control Strategy

For the past few decades, residential demand response used one-way direct control units. Some utilities in the benchmark review still use one-way direct control units, including Duke Energy Progress, Entergy Arkansas, Florida Power & Light, and Southern California Edison. Customer involvement with this technology tends to be low and customers do not always know their own energy savings resulting from program participation.

Installation of smart technologies over the past decade has provided utilities with an enhanced portfolio of options to employ in demand response programs. Residential demand response is transitioning from one-way devices to those with two-way communication. Two of the three Texas utilities that were reviewed in this research are at the forefront in advancing the use of this technology in their demand response programs. Enrolled customers with two-way devices are now more involved than ever in demand response programs, engaging with their devices via online portals, smartphone apps, and frequent notifications from their utility.

ComEd has begun to combine two-way devices with its underlying portfolio of one-way direct control units. ComEd has employed direct control units under its Smart Ideas central AC cycling program since the mid-1990s. ComEd has recently combined the program with a residential smart thermostat program, allowing participating customers to take advantage of Nest's Rush Hour Rewards.[46] Customers now have the choice between (1) exclusively participating in Smart Ideas central AC cycling via installation of a direct control unit on participating cooling units or (2) combining central AC cycling with the installation of a Nest thermostat connected to household Wi-Fi. Participation in option 2 requires enrollment in Nest's Rush Hour Rewards.

Kansas City Power & Light and NV Energy currently employ demand response programs using two-way smart thermostat technology exclusively. Kansas City Power & Light offers both a bring-your-own-thermostat (BYOT) and professional installation of free Nest thermostats for participating households. Like ComEd, installation of Nest thermostats and participation in demand response under Kansas City Power & Light requires registration in Nest's Rush Hour Rewards.

Instead of combining one- and two-way devices like ComEd, Pacific Gas & Electric has joined the use of one-way direct control units with critical peak pricing to further improve demand reduction during peak periods. Critical peak pricing was introduced in 2013 and with it came further incentives for customers to reduce use during peak periods. A reliable notification system has allowed customers to receive notice prior to an event being called. This improved the ability to curtail load effectively during events. Table 5-13 lists technologies offered by the different programs.

Table 5-13. Program Offerings

Program Administrator	Technologies Employed
Texas Utilities	Direct Control Unit and Smart Thermostat
NV Energy	Smart Thermostats

[46] https://nest.com/support/article/What-is-Rush-Hour-Rewards.

Program Administrator	Technologies Employed
ComEd	Direct Control Unit (with optional Smart Thermostat)
Duke Energy Progress N.C.	Direct Control Unit
Entergy Arkansas	Direct Control Unit
Florida Power & Light	Direct Control Unit
Kansas City Power & Light	Smart Thermostat
Pacific Gas & Electric	Critical Peak Pricing (with optional direct control unit)
Southern California Edison	Direct Control Unit
ERCOT	Curtailment Incentive

Program Goals

The secondary reviews conducted for the benchmarking efforts were not able to reveal set program goals. For five out of the eight analyzed programs, participation and savings goals were not clearly indicated in program documentation, commission records, or evaluation documents. ComEd and Entergy Arkansas, on the other hand, have clear savings goals. Ability to reach participation numbers is assessed on an annual basis by an independent third-party EM&V contractor for both utilities.

Outreach Media

Most program administrators in the benchmarking effort target existing residential customers via email, direct mail, and bill inserts as part of their outreach activities. Detailed program webpages are available for consumers to learn more about the program after receiving outreach materials, highlighting detailed information on incentive amounts and how to sign up or apply for the demand response program.

Eligibility Requirements

Administrators who include thermostats in their programs, like the Texas utilities, require customers to have a Wi-Fi connection. Other common requirements are fairly consistent in that customers need to have a central air conditioner or heat pump. Some unique requirements include Duke Energy Progress N.C. where participants must be in a geographic area, and Southern California Edison where participants must meet a usage criterion. Eligibility requirements associated with researched programs are highlighted in Table 5-14.

Table 5-14. Eligibility Requirements

Program Administrator	Program Name	Eligibility Requirements
Texas Utilities	Residential Demand Response	Must have advanced metering infrastructure with the exception of one non-ERCOT utility, which is using a smart thermostat deemed savings. A load cannot be curtailed if it will negatively affect health or that is incentivized through another energy efficiency program. **For smart thermostat control strategies:** Single family homes with central air conditioning.

Program Administrator	Program Name	Eligibility Requirements
		Participants must bring their own Wi-Fi-enabled device.
NV Energy	PowerShift Smart Thermostat	Central air conditioning Broadband Internet access and router with an open port (NV Energy does not provide Internet access)
ComEd	Smart Ideas Central AC Cycling	Residential homeowner with central air conditioning. Wi-Fi availability if also enrolling in Nest's Rush Hour Rewards.
Duke Energy Progress NC	EnergyWise Home	Central air conditioning or heat pump. Residential electric service in the applicant's name. Must be in coverage area for paging signal.
Entergy Arkansas	Summer Advantage Program	Residential rate classes. Central air conditioning or heat pump.
Florida Power & Light	OnCall	Central air conditioning or heat pump. No other information available.
Kansas City Power & Light	Residential Thermostat Program with Rush Hour Rewards	Residential homeowners. Central air conditioning or heat pump. Wi-Fi availability.
Pacific Gas & Electric	SmartRate, SmartAC	Central air conditioning or heat pump.
Southern California Edison	Summer Discount Plan	Customers with over 1.5 kWh usage during one prior event during the prior calendar year.
ERCOT	ERS	Aggregated residential loads 30 minute ramp product. Minimum demand savings of 100 kW. Must have AMI ("smart meter") metering capabilities. Must be able to curtail with a 10-30-minute notice. While there is nothing that would prevent aggregated residential loads from participating in the 10 minute option, to-date they have all participated in the 30 minute notice option as they are more suited to a 30 minute ramp product.

Incentive Structure

Incentives varied depending on the type of technologies employed under demand response programs. A detailed summary of incentives is shown in Table 5-15. Generally, programs with more customer involvement via notifications and customer-side online portals to monitor energy use entailed more extensive incentive offerings. Customer incentives were commonly received in the form of bill credits on

an annual basis, ranging from $20.00 to $40.00. Additional incentives are offered at the time of installation. All programs make these incentives clear in marketing materials.

Table 5-15. Incentive Structures of Researched Utilities

Program Administrator	Program Name	Incentive Levels
Texas Utilities	Residential Demand Response	**ERCOT:** $38/kW **Non-ERCOT:** $125 enrollment incentive + $25/program year regardless of savings
NV Energy	PowerShift	Offers fixed rebates and participation rebates. Fixed Rebate: Legacy Meter: $5.00 per summer month Standard Meter: $7.50 per summer month Participation Rebate: Legacy Meters: $0.33 per hour after the first 12 hours Standard Meter: Energy Rebate (R $/kWh x S kWh) per hour
ComEd	Smart Ideas Central AC Cycling	$5.00 per month that received cycling (50% option). Maximum $20.00 annually. $10.00 per month that received cycling (100% option). Maximum $40.00 annually. $100 rebate for Nest thermostats. Additional $40.00 bill credit annually for those participating in Nest Rush Hour Rewards.
Duke Energy Progress NC	EnergyWise Home	$25.00 bill credit after installation, $25.00 bill credit per year enrolled thereafter.
Entergy Arkansas	Summer Advantage Program	$25.00 bill credit after installation, $25.00 per year enrolled thereafter (50% option). $40.00 bill credit after installation, $40.00 per year enrolled thereafter (75% option).
Florida Power & Light	OnCall	Monthly bill credit– totaling up to $137 annually, depending on the equipment and program options selected
Kansas City Power & Light	Residential Thermostat Program with Rush Hour Rewards	Free installation of free Nest thermostat, plus $25.00 bill credit annually (Option 1). $50.00 incentive for DIY installation of Nest thermostat (self-purchased), plus $25.00 bill credit annually (Option 2). Bring-your-own-thermostat (BYOT) and earn a $100 incentive, plus $25.00 bill credit annually (Option 3).
Pacific Gas & Electric	SmartRate, SmartAC	Rate reductions of $0.024 per kWh between June 1 and September 30, excluding SmartDays.

Program Administrator	Program Name	Incentive Levels
		Bill protection for first-year participants in program.
Southern California Edison	Summer Discount Plan	Rebate for controlled loads, depending on the tonnage of the unit controlled.
ERCOT	ERS	Incentive depends on the kW reduction per event. This incentive is disclosed at the time of contract signing and depends on site-level characteristics.

Direct Control Units

Residential customers with direct control units received incentives in the form of bill credits. To reward new residential participants, Duke Energy Progress and Entergy Arkansas applied bill credits to participating customers within 30 to 60 days of a direct control unit being installed on qualifying systems. Duke Energy Progress applied a $25.00 credit for new enrollees. Entergy Arkansas structured installation incentives so that these incentives would scale up depending on the cycling option elected by the customer. Customers opting for the 50 percent cycling option received a $25.00 bill credit after installation, whereas those who opted for 75 percent cycling received a $40.00 bill credit.

Bill credits were also given for those households continuing to participate in residential demand response. For ComEd Smart Ideas participants, bill credits were received depending on the number of events that were called and based on what cycling option chosen. Customers enrolled in the 50 percent cycling option would receive $5.00 per month that had an event, whereas those enrolled in the 100 percent option would receive $10.00 per month that had an event. The annual cap on bill credits for these customers was set at $20.00 and $40.00, respectively.

For Duke Energy Progress and Entergy Arkansas customers enrolled in demand response, bill credits were not paid contingent on whether an event was called. For Duke Energy Progress EnergyWise Home participants, a $25.00 bill credit was received at the end of a program year, so long as the customer was still enrolled in the program. Entergy Arkansas Summer Advantage Program participants received scaled incentives depending on their cycling option, receiving $25.00 if enrolled in the 50 percent cycling option and $40.00 if enrolled in the 75 percent cycling option.

Incentive amounts received for having a direct control unit installed under Pacific Gas & Electric's SmartRate and SmartAC programs were not provided. Additional incentives were provided for participation in the critical peak SmartRate program, and these are provided below.

Southern California Edison's Summer Discount Plan paid out bill credits to participating households. Bill credits depended on the tonnage of the unit on which the control device is installed. Incentive amounts based on tonnage follow a specific formula outlined in Southern California Edison documentation and are also conditional on the household's current rate plan and actual energy use at the household.

Smart Thermostats

Comparable demand response programs with smart thermostats were examined for ComEd, NV Energy and Kansas City Power & Light. Incentives are structured similarly to those received under demand response programs with direct control units. For ComEd's Smart Ideas program, participants who want to install a Nest thermostat receive a $100 rebate credit. In addition, $40.00 in bill credits are received annually on top of direct control unit credits as a reward for participating in Nest's Rush Hour Rewards events when events are called by ComEd.

Kansas City Power & Light residential smart thermostat program with Rush Hour Rewards had an annual bill credit of $25.00. Initial incentive amounts received by participating households depend on the installation option selected by the household. For households that opt for free installation of a free

Nest thermostat, no initial incentive is received aside from the free installation and free Nest device. Households may also opt to install a free Nest thermostat and enroll in the Rush Hour Rewards for an initial bill credit of $50.00. Households that already have a Nest thermostat installed earn a $100 bill credit after enrollment in Rush Hour Rewards.

Critical Peak Pricing

Critical peak pricing participation covered in this benchmarking is limited to Pacific Gas & Electric's SmartRate program. Incentives are received during the load control season, spanning June 1 through September 30 in Pacific Gas & Electric's service territory. On days that do not have an event called, a $0.024 per kWh reduction in rates is applied for participating households. Additional discounts can be applied for customers as Pacific Gas & Electric observes an enrolled customer's demand. In exchange for participation in SmartRate, the customer agrees to $0.60 per kWh added to his or her usual rate on an event day. For new customers, if participation in the program raises energy costs, bill protection is available to compensate for the difference. This is bounded by certain conditions on household energy use.

Program Implementation and Delivery

Program Procedures

To control load during a demand response event, utilities must trigger an event. For utilities using direct control units—ComEd, Duke Energy Progress, Florida Power & Light, NV Energy and Southern California Edison—direct control of cooling systems is managed in-house. A minority of utilities (for example, Entergy Arkansas) use a contractor for implementation but triggering of events is still managed in-house. Critical peak pricing used by Pacific Gas & Electric is also managed in-house.

For demand response programs using Nest smart thermostats, the utility needs to schedule an event with Nest directly. Through its Rush Hour Rewards program, Nest then triggers an event at a specified time for enrolled customers with Nest smart thermostats. Nest then releases control of the thermostat's set-point at the end of an event, returning the thermostat back to its customer-specified default temperature. Table 5-16 offers information on program delivery.

Table 5-16. Program Delivery

Program Administrator	Delivery Method
Texas Utilities	Internal with a third party (Ecofactor, Ecobee, Whisker Labs, Energy Hub, Reliant Energy Retail Services, Nest)
NV Energy	Internal, Third Party (Ecofactor, Ecobee)
ComEd	Internal, Third Party (Nest)
Duke Energy Progress NC	Internal
Entergy Arkansas	Internal, Third Party (Comverge)
Florida Power & Light	Internal
Kansas City Power & Light	Internal, Third Party (Nest, CLEAResult)
Pacific Gas & Electric	Internal
Southern California Edison	Internal
ERCOT	Internal

Notifications Strategies

Notifications received by enrolled residential households appear to be limited by the extent of technology employed in the demand response program. For programs with direct control units

employed, customers have the option of receiving email, phone, or text notifications. ComEd, however, appears to refrain from sending notifications about an event and instead only notifies its subset of customers who are enrolled in Nest's Rush Hour Rewards. Florida Power & Light has no specific documentation regarding the availability of notifications.

Customer involvement in demand response programs with smart thermostats employed tend to be among the highest in this benchmarking research. In addition to available notification via email, text, or phone, smart thermostats offered by Texas utilities, ComEd, and Kansas City Power & Light can receive notifications directly. Further, customers with smartphones can download a smartphone app to control their smart thermostats and be notified of any upcoming demand response events. Table 5-17 highlights availability of notifications prior to or during an event.

Table 5-17. Notifications

Program Administrator	Program Name	Notifications
Texas Utilities	Residential Demand Response	Email, web portal, text, and phone Notification given 30 minutes prior to interruption.
NV Energy	PowerShift	Email, text, phone, or smartphone app. Timing of notification unknown. Message on thermostat and registered notification device.
ComEd	Smart Ideas Central AC Cycling, Rush Hour Rewards	Email, text, phone, or smartphone app. Rush Hour Rewards only. Message on thermostat and registered notification device. Morning event – Customer warned day before. Afternoon event – Customer warned one-hour prior.
Duke Energy Progress NC	EnergyWise Home	Unknown.
Entergy Arkansas	Summer Advantage Program	Phone, text, email. Timing unknown.
Florida Power & Light	OnCall	Unknown.
Kansas City Power & Light	Residential Thermostat Program with Rush Hour Rewards	Email, text, phone, or smartphone app. Rush Hour Rewards only. Message on thermostat and registered notification device. Morning event – Customer warned day before. Afternoon event – Customer warned one-hour prior.
Pacific Gas & Electric	SmartRate, SmartAC	Phone, text, email. Notifications sent out by 2:00 PM the day prior to an event. Notifications can be sent to up to four individuals.
Southern California Edison	Summer Discount Plan	Phone, text, email.

Program Administrator	Program Name	Notifications
		Online portal to monitor event days, personal energy use.
ERCOT	ERS	Phone call 10-30 minutes prior to event to aggregator

Demand Response Event Dynamics

During a curtailment event, the utility can control the cooling unit for a set amount of time during each day during a specified period. More details on timing and limitations on demand response events are illustrated in Table 5-18. Demand response event limits are set by utilities engaging in direct control of participating households. These depend on the state the demand response program is operating in and unique climate and demand conditions that are foreseen by the utility.

Table 5-18. Load Control of Researched Utilities

Program Administrator	Load Control Season	Load Control Times	Load Control Limitations
Texas Utilities	June 1 – September 30, not including holidays and weekends.	**ERCOT:** 1:00 p.m. – 7:00 p.m. **Non-ERCOT:** 2:00 PM – 8:00 p.m.	**ERCOT:** 1-2 scheduled event(s) Unlimited unscheduled events 25 hours per year **Non-ERCOT:** Unknown number of events. 4-hour event maximum
NV Energy	June 1 – September 30, not including holidays and weekends (Southern NV) July 1 – September 30, not including holidays and weekends (Northern NV)	1:00 p.m. – 7:00 p.m.	2 hours per event 20 events per year
ComEd	June 1 – September 30, not including holidays and weekends	11:00 a.m. – 8:00 p.m.	Unknown
Duke Energy Progress N.C.	May 1 – September 30, not including holidays and weekends	1:00 p.m. – 7:00 p.m.	4 hours per event 60 hours per year
Entergy Arkansas	June 1 – September 30, not including holidays and weekends	12:00 p.m. – 7:00 p.m.	4 hours per event <= 3 consecutive days 60 hours per year
Florida Power & Light	April 1 – October 31, any day of week	Unknown	8 hours per event
Kansas City Power & Light	June 1 – September 30, any day of week	Any time	4 hours per event <= 3 consecutive days

Program Administrator	Load Control Season	Load Control Times	Load Control Limitations
			15 events per year
Pacific Gas & Electric	June 1 – September 30, any day of week	1:00 p.m.– 7:00 p.m.	4 hours per event 15 events per year
Southern California Edison	All year, any day of week	Anytime	6 hours per event 180 hours per year
ERCOT	February 1t – May 31, June 1 –September 30, October 1 – January 31 Not including holidays and weekends	1:00 p.m.–7:00 p.m.	12-hour maximum event duration. Unlimited maximum per season.

Direct Control Units

ComEd harnesses load control between June 1 and September 30 (known as a load control season). Weekends and holidays are exempt from direct control. During this time period, load control can be used between 11:00 a.m. and 8:00 p.m. During an event, a maximum of 15 minutes every half hour can be devoted to load control for the households enrolled in the Smart Ideas 50 percent option. For households enrolled in the 100 percent option, the cooling unit will be turned off for a period of up to three hours depending on the length of an event or, alternatively, it can be turned off for 15 minutes every half-hour over a period of up to six hours. ComEd does not appear to have a maximum number of events it can call during a load control season based on available information.

Duke Energy Progress uses a load control season of May 1 through September 30 and can use load control during an event between 1:00 p.m. and 7:00 p.m. Weekends and holidays are exempt from direct control. Events can last no longer than four hours if called. The enrolled air conditioner will have its compressor controlled for a portion of each half hour during the event. The amount of time per half hour is left to Duke Energy Progress' discretion. A limit of 60 event hours is placed on Duke Energy Progress per load control season.

Entergy Arkansas' load control season spans June 1 through September 30. An event can be called on non-holiday weekdays between 12:00 p.m. and 7:00 p.m. Events called during this time period can last no longer than four hours and can occur for no more than 3 consecutive days. A maximum of 60 hours may be called during the span of the load control season. If each event is four hours during a load control season, this limits Entergy Arkansas to 15 days of load control.

Southern California Edison has a load control season that spans the entire year. Southern California Edison is limited to a period of 180 hours per enrolled household per year of load control. On days when load control is used, air conditioners can be controlled for up to six hours per day. Under extenuating circumstances, SCE can exercise load control over a longer period of time. Extenuating circumstances include emergencies, overworked electrical grids, high wholesale energy prices, or testing.

Smart Thermostats

For Kansas City Power & Light and ComEd, Nest's Rush Hour Rewards are used to manage household energy use during a demand response event. Peak events are called by Kansas City Power & Light or ComEd and transmitted to Nest. Nest will then alter heating and cooling set-points for customers enrolled in Rush Hour Rewards to moderate energy use during peak events. Set-points will be changed depending on whether the customer is home at the time of an event.

Unlike the Texas utilities that use smart thermostats in their residential demand response programs, Kansas City Power & Light and ComEd customers can pre-cool their homes prior to an event. Pre-cooling will allow a target temperature to be reached by a certain time, usually by the start of an event. This target temperature is determined depending on customer preferences. Customers may opt out of the pre-cooling option at any time.

Customers can access their online portal highlighting past and current energy use at any time to view when Rush Hour events may have occurred during the last 10 days. Information about how their thermostat set-point changed during these times is also provided in the portal. This supposedly allows customers to course-correct their non-Rush Hour usage if they deem their thermostat set-point to be too strict on an average day.

Load control seasons for ComEd and Kansas City Power & Light span June 1 through September 30. For ComEd, weekends and holidays are exempt from events being called. During weekdays, load control can be used between 11:00 a.m. and 8:00 p.m. ComEd does not appear to face a maximum number of events it can call during a load control season based on available information. For Kansas City Power & Light, events may be called at any time of day during its load control season. The duration of events is currently capped at four hours, and a maximum of 15 peak events may be called at any time during the load control season. No more than three Rush Hour events may be called in a week.

Critical Peak Pricing

Pacific Gas & Electric will call an event—a “SmartDay” —anytime between June 1 and September 30, including weekends and holidays. Events are called between 1:00 p.m. and 7:00 p.m. during the load control season. A maximum of 15 events may be called during the load control season. During these events, electric rates for SmartRate customers will go up by the $0.60 per kWh adder highlighted under the incentives and pricing section. Combined with the rate discounts available during non-event hours, events are expected to shift energy use to off-peak, non-event hours.

Opt-out Potential

Opt-out capabilities associated with demand response programs were observed to be bounded by the level of technology employed. One-way direct control units allow customers the ability to opt out of specific events by overriding the direct control device. Smart thermostat customers may also opt out of certain events by overriding the device’s thermostat set-point that is triggered by a demand response event. Critical peak pricing offers no such capability to opt out of specific events.

Of those customers enrolled in demand response programs with direct control units, Duke Energy Progress customers with direct control units may opt out for two days of the load control season without penalty. If this is exceeded, demand response enrollees will be disqualified from receiving an annual bill credit for the respective year. Entergy Arkansas customers may also opt out of specific demand response events, but are limited to two events per year before being removed from the program. Southern California Edison Customers may opt out of specific events, but have incentives reduced if this option is used. Further, overriding more than five event days will disqualify customers from receiving their annual incentive.

Of those enrolled in demand response programs with smart thermostats, customers may opt out of a specific event by changing their thermostat set-point. This will not disqualify the customer from future participation in Rush Hour Rewards. It does not appear that there are limits on the number of time Nest-covered demand response customers are able to opt out.

Demand Response Outcomes

Of the demand response programs covered in this benchmarking, five out of eight had EM&V documentation written by a third party publicly available. Table 5-19 provides, when available, the number of customers enrolled in demand response and demand response outcomes.

Table 5-19. Program Participation and Outcomes

Program Administrator	Residential Customer Base[47]	Customers Enrolled	Program Outcomes
Texas Utilities	5,492,803	44,625	Savings: 56,010 kW (2018)
NV Energy	1,104,293	974 (2014)[48]	Savings: 1,086 kW per event on average.
ComEd	3,732,896	84,018	Savings: 84 MW
Duke Energy Progress NC	1,177,640	9,215	Savings: 11.6 MW
Entergy Arkansas	600,652	23,075	Savings: 37.6 MW
Florida Power & Light	4,428,929	Unknown	Unknown
Kansas City Power & Light	500,045	51,396	Unknown
Pacific Gas & Electric	4,737,686	475,497	Savings: 38 MW
Southern California Edison	4,489,693	292,763	Savings: 277 MW
ERCOT	Unknown	441 (2019)	Three interruptions from 2011-2014. No other interruptions since end of 2014.

Participation Numbers and Total Energy Savings

A review of total residential customers compared to the number of residential customers enrolled in the reviewed programs show that Texas utility residential demand response programs are not achieving the same customer engagement as other programs. On average, Texas utilities enroll roughly 1 percent of their customer base into a residential demand response program, whereas the other utilities research enrolled around 5 percent. A review of program outreach (Table 5-19) sheds some light on why this is the case. All Texas utilities offer a program website for their residential demand response programs and only one of the three does not offer a program manual on the website. Other utilities that were researched aggressively market the program with e-mails, bill inserts, and outbound calling, to name a few.

Although participation may be less, average savings per customer enrolled in a Texas utility demand response program is greater than other utilities. On average, a customer enrolled in a Texas utility

[47] For all but the Texas utilities, U.S. Energy Information Administration, Form EIA-861 2017 data files, released November 14, 2018. EIA-861 includes self-reported data on accounts, revenues, demand response portfolios, and other pertinent utility data. Report is released annually in November for the prior operating year. More can be found at https://www.eia.gov/electricity/data/eia861/.

[48] https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/recent-regulatory-filings/north/irp/Vol_09_SPPC_IRP.pdf.

demand response program saved 1.26 kW per event whereas other utility demand response customers saved an average of 0.98 kW per event.

Conclusion

Based on our benchmarking findings highlighted above, Texas utilities demand response programs are among the frontrunners in the market portfolio of demand response programs. Diffusion of smart technologies over the past decade has allowed Texas utilities to push ahead into providing two-way smart thermostats to their customers. Texas utilities have high per-customer savings, which may be a result of offering incentives that are larger than similar programs offered by other utilities. There is room to grow residential demand response programs if needed, as, on average, a smaller percent of Texas utilities' residential customers participate when compared to benchmarked utilities, though participation numbers have been growing.

5.4.4.2 Participant Surveys

The EM&V team completed a telephone survey with Residential Demand Response program participants in order to provide process insights for these programs. This section summarizes the survey findings from this survey effort. Below we describe the study objectives and methodology, detailed findings, and recommendations for consideration.

Study Methodology

This process study assessed program participants' experiences with the program. Specifically, the evaluation aimed to characterize the customer experience in the following areas:

- Program awareness
- Decision-making
- Experience with curtailment events
- Satisfaction with the program
- Suggestions for program improvement.

The EM&V team completed telephone surveys with 59 Residential Demand Response program participants across two study periods: The first one ran in December 2018 and the second study ran in February 2019. Table 5-20 documents the number of completed surveys by utility.

Table 5-20. Number of Surveys Completed

Utility	Number of Respondents
CenterPoint	14
El Paso Electric	31
Oncor	14
Total	**59**

The sample for the telephone survey was drawn from the list of customers in the PY2018 tracking databases. Texas utilities were responsive to the EM&V team's data request for this customer survey; however, the tracking data quality varied. While some utilities were able to offer data that included full

names and contact information for end customers enrolled in Residential demand Response programs, other utilities offered tracking data that was far less complete. This was especially true when a utility relied on a third party to implement its program.

Participant Description

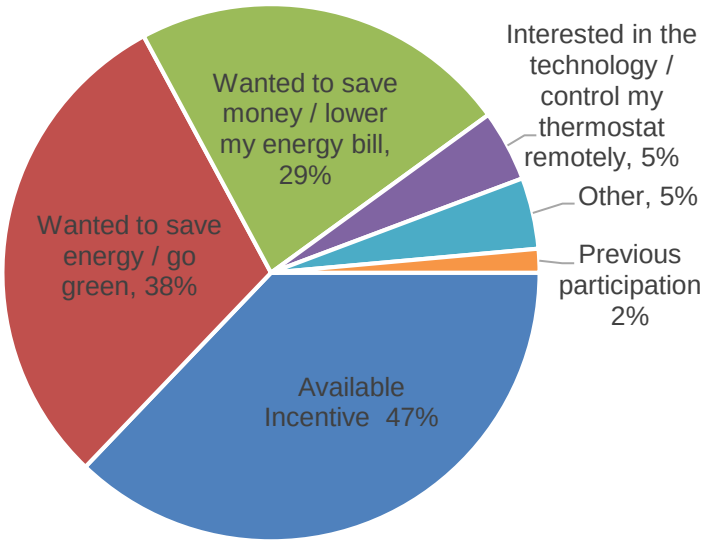
The telephone survey respondent data was composed mostly of homeowners, with 95 percent of the survey respondents saying that they owned their home and 5 percent saying they rent. Most respondents (89 percent) lived in single-family, detached homes; roughly half of the homes were built before or in 2000 and half after 2000. Nearly half (46 percent) of the respondents have lived in their homes for five years or less.

Program Awareness and Understanding

The top three sources to which respondents attributed their program awareness were email (33 percent), their smart thermostat vendor (27 percent), and word of mouth through family or friends (17 percent). Other sources mentioned less frequently, but by at least five participants, included other home energy or products vendors (i.e. Vivint, Reliant, Tri-Eagle Energy) or some other utility communication (i.e., social media).

Respondents were asked to share their reasons for participating in the program. As shown in Figure 5-9, respondents' reasons for participation varied and multiple responses were allowed. The available incentive was named by 47 percent of respondents as their main reason for participating in the program. Respondents also named saving energy (38 percent) or saving money on their energy bill (29 percent) as key participation drivers.

Figure 5-9. Main Motivation to Participate (n=55)



Source: Question PA2. Multiple responses were allowed; responses total more than 100 percent.

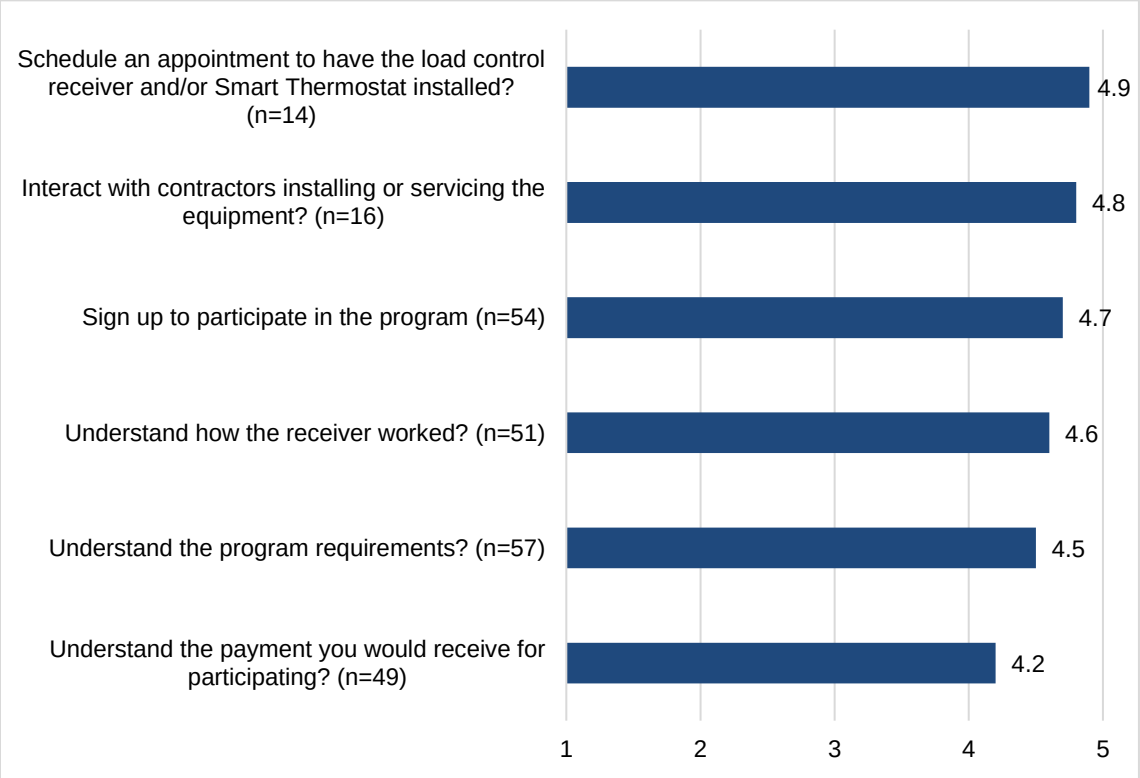
Program Experience

Survey respondents were asked to quantify how many cycling events they thought were called during the PY2018 summer season. Just over one-third of respondents (36 percent) reported they did not know. Respondents who thought they could recall events consistently named a value slightly higher than the actual number of cycling events for their utility territory.

Regardless of the respondent's perceptions about the number of events, the overall program experience did not appear to be impacted. That is, when respondents who could recall events were asked to report how a cycling event impacted them, 58 percent said the event had no effect. Among survey respondents who did say cycling events impacted them, the most mentioned response was that the temperature of their residence increased (32 percent of respondents). Other responses included *"we had to adjust the temperature setting"* (8 percent) and *"we used fans"* (2 percent).

Figure 5-10 details respondents' ease with various program components. Respondents were asked to use a 1 to 5 scale, where 1 was "very difficult" and 5 was "very easy" program interaction. All program components scored an average mean above 4, which is supported by the fact that nearly all respondents reported the process of scheduling an appointment to have a load control receiver and/or a smart thermostat installed as "very easy."

Figure 5-10. Ease with Various Aspects of the Residential Load Management Programs—Mean Scores



Source: Question P1a through P1f. Don't know, refused, and not applicable responses were excluded from analysis.

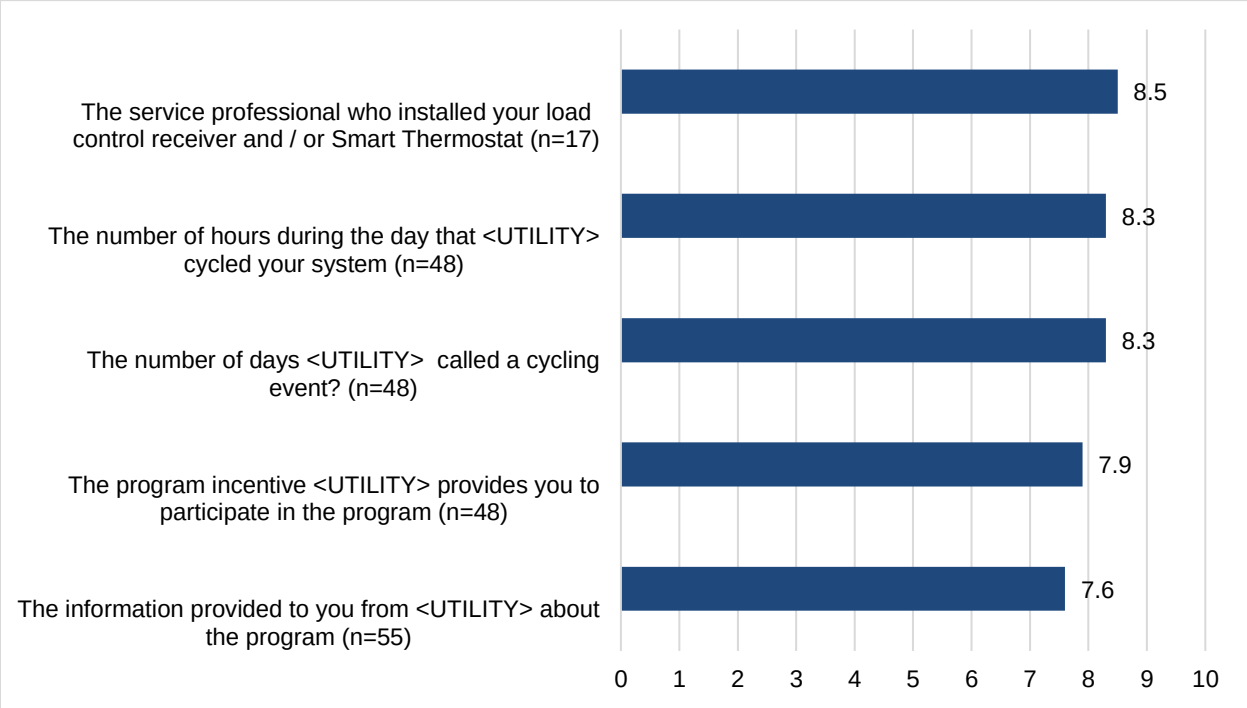
Eighty-one percent of survey respondents said that they had no initial concerns about participating in the program. Among those who did (11 respondents), five expressed concern about allowing the utility control of their home's energy systems during program events, three said that they thought the temperature increase would be uncomfortable during events, and one indicated that he/she had an installation concern, and in particular, was worried about the reliability of the home's internet

connection. One participant was concerned that the payment may not be worth the effort of program participation.

Customer Satisfaction

In general, survey respondents were satisfied with their overall program experience. Respondents were asked to rate their satisfaction with various aspects of the Residential Demand Response programs on a scale of 0 to 10, where 0 was “very dissatisfied” and 10 was “very satisfied.” Four out of every five respondents (80 percent) rated their overall program satisfaction an 8 or more, resulting in an overall mean satisfaction score of 8.5 on the 10-point scale. High program satisfaction is further demonstrated among program components for the service professional who installed a respondent’s load control receiver and/or smart thermostat, the number of hours during the day that the respondent’s utility cycled his/her system, and the number of days a respondent’s utility called a cycling event. All program components and the associated mean satisfaction score appear in Figure 5-11.

Figure 5-11. Satisfaction with Residential Load Management Programs Components—Mean Scores



Source: Question SAT3a through SAT3e. Don’t know, refused, and not applicable responses were excluded from analysis.

The high satisfaction scores continued when respondents were asked to recall their overall experience and satisfaction with their utility. More than four out of every five respondents (81 percent) rated their overall experience and satisfaction with their utility an 8 or more. The overall mean satisfaction score with the utility was 8.5 on a 10-point scale where 0 was “very dissatisfied” and 10 was “very satisfied.”

Additionally, nearly all (95 percent) respondents plan to continue their participation in the Residential Demand Response Programs into this next program year. Despite high program and utility satisfaction, respondents did not widely report recommending the program to others; 37 percent of respondents reported doing so. Given the high program and utility satisfaction that reportedly exists among respondents, there is a potential opportunity to encourage customers to promote their program experience through word of mouth or social media channels.

5.4.4.3 Key Findings and Recommendations

Finding #1: Hearing about the program from family and friends was a common way respondents claimed to have learned about the program, yet those that have participated did not report continuing to spread the word about the program. Given the high levels of program satisfaction and a generally positive program experience overall, current program participants could be a powerful marketing resource for the program going forward if increased participation is needed.

Recommendation #1: Encourage residential customers to spread the news of their positive program participation experience if increased participation is needed.

Finding #2: Program tracking data tended to lack complete participation information when assembled by a third-party implementation contractor.

Recommendation #2: Work with third-party program implementation contractor to improve participant tracking data.