

***Final Evaluation Report for PacifiCorp Residential Home
Energy Savings Program in California***

Final Evaluation Report, Program Years 2017-2018

Prepared for:
Pacific Power

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Prepared by:



ENERGY RESEARCH
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1 Executive Summary

This report provides results of the ADM Associates, Inc. (ADM) impact and process evaluation of the PacifiCorp 2017-2018 Home Energy Savings Program in California. The Home Energy Savings Program in the state of California provides incentives for PacifiCorp (also referred to as Pacific Power in this report) residential customers who purchase various eligible products or services.

During the 2017 and 2018 program years, the Home Energy Savings Program claimed gross energy savings of 3,035,313 kWh. The Home Energy Savings Program provided incentives for the following measure categories:

- **Appliances:** clothes washers and refrigerators
- **Building Shell:** insulation
- **Energy Kits:** mailed energy kits containing combinations of LEDs, bathroom and kitchen faucet aerators, and showerheads
- **Heating, ventilation, and air conditioning (HVAC):** evaporative coolers, heat pumps, and room air conditioners
- **Lighting:** LED bulbs and fixtures and CFL bulbs (2017 only)
- **Water Heating:** heat pump water heaters
- **Whole Homes:** whole homes new homes projects

For the impact evaluation, ADM determined the ex-post verified energy (kWh) savings that are achieved through Pacific Power's 2017-2018 Home Energy Savings Program in California. Pacific Power contracted with Navigant to assess program cost-effectiveness. The results of the cost-effectiveness assessment are also included in this report. For the process evaluation, ADM attempted to gain an in-depth understanding of program operations, challenges and evaluation needs through Pacific Power and implementation contractor key staff interviews, complemented with program documentation review and program participant surveys.

1.1 Evaluation Results

1.1.1 Impact Evaluation Results

Table 1-1 and Figure 1-1 present the impact evaluation results, including the claimed savings, evaluated gross savings, realization rates, evaluated net savings and net-to-gross (NTG) values for each measure category across both program years, 2017 and

2018. Table 1-2 and Table 1-3 present this information for each year 2017 and 2018 individually.

Table 1-1: California Home Energy Savings Program Claimed and Evaluated Savings by Measure Category, 2017-2018

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017-2018	Appliances	7,171	7,171	100%	2,251	31%
	Building Shell	11,324	11,324	100%	3,171	28%
	Energy Kits	943,089	1,038,435	110%	783,183	75%
	HVAC	1,011,465	1,009,792	100%	555,222	55%
	Lighting	997,613	706,168	71%	441,339	62%
	Water Heating	20,842	20,842	100%	11,463	55%
	Whole Homes	43,808	43,808	100%	24,094	55%
2017-2018 TOTAL		3,035,313	2,837,540	93%	1,820,723	64%

Figure 1-1: CA Home Energy Savings Program Energy Savings, 2017-2018

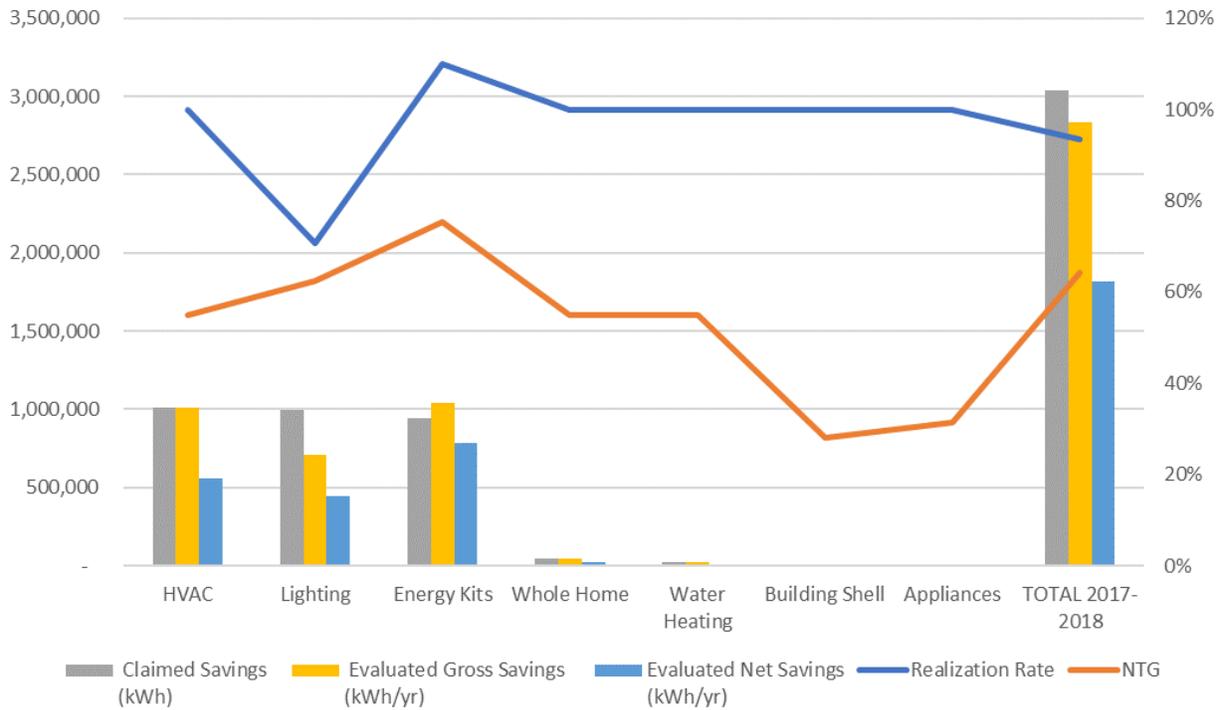


Table 1-2: California Home Energy Savings Program Claimed and Evaluated Savings by Measure Category, 2017

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017	Appliances	5,663	5,663	100%	1,784	31%
	Building Shell	4,768	4,768	100%	1,335	28%
	Energy Kits	488,993	521,881	107%	495,213	95%
	HVAC	495,399	494,506	100%	271,956	55%
	Lighting	853,244	589,561	69%	351,318	60%
	Water Heating	14,976	14,976	100%	8,237	55%
	Whole Homes	43,808	43,808	100%	24,094	55%
2017 TOTAL		1,906,852	1,675,163	88%	1,153,937	69%

Table 1-3: California Home Energy Savings Program Claimed and Evaluated Savings by Measure Category, 2018

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2018	Appliances	1,508	1,508	100%	467	31%
	Building Shell	6,556	6,556	100%	1,836	28%
	Energy Kits	454,096	516,554	114%	287,970	56%
	HVAC	516,066	515,286	100%	283,266	55%
	Lighting	144,369	116,608	81%	90,021	77%
	Water Heating	5,866	5,866	100%	3,226	55%
	Whole Homes	-	-	-	-	-
2018 TOTAL		1,128,461	1,162,378	103%	666,786	57%

1.1.2 Process Evaluation Results

Key process evaluation results include the following:

- **Survey respondents are satisfied with Pacific Power as their electricity provider.** The large majority of survey respondents reported being either very satisfied or satisfied with Pacific Power (PP) as their electricity service provider, with approximately 79% of General Population Survey respondents, 73% of Energy Kits Survey respondents and 92% of HVAC Survey respondents reporting that they were either very satisfied or satisfied.
- **Program participants are satisfied with Pacific Power’s Home Energy Savings Program.** Approximately 84% of Energy Kit Survey respondents and 89% of HVAC Survey respondents reported being either satisfied or very satisfied with the Home Energy Savings program overall.
- **Bill inserts and the Pacific Power website were the top ways participants learned of Pacific Power energy kits.** Program participant survey respondents

that received energy kits most commonly reported learning about the energy kits through bill inserts (51%) or the Pacific Power website (20%).

- **Word-of-mouth (e.g. friends, neighbors, relatives or colleagues) or a retailer were the top ways participants learned of Pacific Power incentives for HVAC equipment.** Program participant survey respondents that received incentives for HVAC equipment most commonly reported learning about the HVAC incentives through friends, neighbors, relatives or colleagues (16%), a retailer (16%), a Pacific Power representative (13%) or an internet advertisement (13%).
- **Energy efficiency, price and brightness of bulbs were important to customers when purchasing light bulbs.** General population survey respondents reported that the most important characteristics considered when purchasing light bulbs were energy efficiency (67%), price (54%), and the brightness of bulbs (47%).
- **Saving money on utility bills was most important to participants receiving energy kits.** Approximately 65% of Energy Kits Survey respondents reported that “saving money on utility bills” was the most important reason for requesting an energy kit and 28% reported this as the second most important reason. Additionally, 22% of survey respondents reported that “concern for the environment” was the most important reason for requesting an energy kit and 34% reported this as the second most important reason.
- **HVAC incentives were important drivers of participants’ decisions to install HVAC measures.** HVAC Survey respondents reported that the HVAC incentive was important or extremely important in driving their decision to install the HVAC measure 63% of the time.

1.1.3 Cost-Effectiveness Results

The California Home Energy Savings Program passes the cost-effectiveness for the Utility Cost Test (UCT) and the Participant Cost Test (PCT) during the combined 2017-2018 evaluation period. Table 1-4 below shows the cost-effectiveness results for the overall Program for the combination of program years 2017 and 2018, based on gross savings evaluated by ADM and NTG values mainly sourced from the California Public Utilities Commissions’ (CPUC) Database of Energy Efficiency Resources (DEER) database.

Table 1-4: 2017-2018 California Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
PacifiCorp Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0965	\$1,728,876	\$1,710,181	-\$18,695	0.99
Total Resource Cost Test (TRC) No Adder	\$0.0965	\$1,728,876	\$1,554,710	-\$174,166	0.90
Utility Cost Test (UCT)	\$0.0804	\$1,438,906	\$1,554,710	\$115,804	1.08
Rate Impact Test (RIM)		\$4,052,526	\$1,554,710	-\$2,497,816	0.38
Participant Cost Test (PCT)		\$1,507,554	\$4,709,531	\$3,201,977	3.12
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000129713				
Discounted Participant Payback (years)	4.02				

Table 1-5 below shows the California Home Energy Savings Program cost effectiveness results for 2017 and Table 1-6 shows cost-effectiveness results for 2018, based on gross savings evaluated by ADM and NTG values mainly sourced from the CPUC's DEER database. The Program passes the cost-effectiveness for the UCT and the PCT during each individual program year 2017 and 2018.

Table 1-5: 2017 California Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0873	\$974,050	\$949,209	-\$24,841	0.97
Total Resource Cost Test (TRC) No Adder	\$0.0873	\$974,050	\$862,917	-\$111,132	0.89
Utility Cost Test (UCT)	\$0.0749	\$836,253	\$862,917	\$26,665	1.03
Rate Impact Test (RIM)		\$2,496,027	\$862,917	-\$1,633,110	0.35
Participant Cost Test (PCT)		\$835,154	\$2,822,368	\$1,987,214	3.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000161297				
Discounted Participant Payback (years)	3.23				

Table 1-6: 2018 California Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1119	\$754,826	\$760,972	\$6,146	1.01
Total Resource Cost Test (TRC) No Adder	\$0.1119	\$754,826	\$691,793	-\$63,034	0.92
Utility Cost Test (UCT)	\$0.0894	\$602,654	\$691,793	\$89,139	1.15
Rate Impact Test (RIM)		\$1,556,499	\$691,793	-\$864,706	0.44
Participant Cost Test (PCT)		\$672,400	\$1,887,163	\$1,214,763	2.81
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000094694				
Discounted Participant Payback (years)	5.45				

1.2 Conclusions and Recommendations

ADM provides the following conclusions and recommendations to improve the program and the evaluation of the program in future years.

- **Lighting Measure Category:**

Conclusion: Pacific Power’s leakage rate of 7.4% in California is due to the small Pacific Power service territory in California and the location of two large retailers on the edge of the service territory. While the implementation contractor provided some documentation showing how the Retail Sales Allocation Tool (RSAT) is a predictor of bulb leakage in Pacific Power territories and is used to determine allocations of bulbs to participating stores, the full RSAT methodology is not transparent to ADM. In an effort to help Pacific Power further understand how the RSAT tool accounts for leakage and why the RSAT tool allocations differ from the results of ADM’s leakage analysis, ADM utilized a case-study methodology to provide increased transparency into the inputs and results of ADM’s leakage analysis for the major lighting retailers in the program. For instance, the RSAT tool results in a 100% allocation to the Crescent City Walmart location, indicating that there should be 0.0% lighting leakage for this location. ADM’s leakage analysis estimates a 26.8% leakage rate for this individual retailer and the case-study for this location shows that all leakage is occurring to the north of Pacific Power’s service territory. ADM concluded that there are no non-participating lighting retailers within the applicable drive time distance to reduce this leakage to the north. While the full RSAT methodology is not transparent to ADM, it is likely that the RSAT methodology incorporated a different assumption.

Recommendation: ADM recommends that the evaluation of subsequent program years includes further review of the RSAT allocation tool and the inputs into the tool in an effort to reduce lighting leakage from Pacific Power's California service territory.

- **Energy Kits Measure Category:**

Conclusion: The showerhead energy kits component had the lowest overall installation rate (ISR) of all energy kit components. This was driven by a 36% ISR for the second showerhead in the Best Kit – 2 Bathroom Energy Kits compared to a 68% ISR for the first showerhead. Respondents to the Energy Kits survey who did not install showerheads indicated that they disliked the pressure/water volume (25%), already had high-efficiency showerheads installed (22%) or the showerhead did not integrate well with their current plumbing (15%).

Recommendation: ADM recommends that Pacific Power consider including only one showerhead in the Best Kit – 2 Bathroom Energy Kits, which could increase the overall ISR for showerheads. Additionally, if not already done, RMP could ask qualifying questions regarding showerheads during the energy kit request process.

- **HVAC Measure Category:**

HVAC Conclusion: ADM's review of the heat pump HVAC measure found that the ex-ante claimed savings value for ductless heat pumps are based on the Residential Heating and Cooling Ductless Heat Pump RTF versions 1.3 and 2.0 that have since been updated.

HVAC Recommendation: Pacific Power should update its ex-ante claimed savings values for heat pump HVAC measures to reflect the most current RTF version source document available prior to the evaluation cycle.

2 Introduction and Purpose of Study

ADM Associates, Inc. (ADM) is under contract with PacifiCorp to perform evaluation, measurement and verification (EM&V) services to determine the ex-post verified energy (kWh) savings that are achieved through PacifiCorp's 2017-2018 Home Energy Savings Program in the states of California and Washington; and wattsmart Homes Program in Idaho, Utah and Wyoming.

This document is the Final Evaluation Report for the 2017-2018 Home Energy Savings Program in California. Henceforth in this document, ADM may refer to the California Home Energy Savings Program as "the Program." Program year 2017 (PY 2017) and program year 2018 (PY 2018) coincide with the respective calendar years. The purpose of this report is to present the results of the impact evaluation effort undertaken by ADM to verify the energy savings that resulted from the Program, as further described in subsequent sections. Additionally, this report presents the results of the process evaluation of the Program completed by ADM focusing on participant and program staff perspectives regarding the Program's implementation.

2.1 Description of the Programs

The Program in the state of California provides incentives for Pacific Power residential customers who purchase various eligible products or measures. Measures include energy-efficient appliances, lighting such as ENERGY STAR® light emitting diodes (LEDs), appliances, building shell measures, energy kits, heating, ventilation, and air conditioning (HVAC) equipment, heat pump water heaters and whole homes measures. The Program leverages relationships with manufacturers, distributors, and retailers to ensure effective program implementation and optimize participation.

Program incentives are provided to Pacific Power customers either at the point-of-sale as an instant incentive, or as a mail-in incentive application that upon approval is paid post-purchase. Point-of-sale incentives are also known as upstream or midstream incentives. A typical upstream incentive or 'upstream distribution method' is the instant incentive that the program provides for ENERGY STAR LEDs (this is also called an upstream measure). The LED incentive is provided to the LED manufacturer. Consumers benefit from upstream incentives by buying LEDs at discounted prices made possible by the incentive that was funded upstream. A point-of-sale incentive usually does not require the consumer to use a coupon or provide an incentive form. This is an efficient and cost-effective means to provide consumers instant incentives for relatively high-volume, low-cost measures such as LEDs.

The ‘downstream distribution method’ pays the specified incentive amount per energy-efficiency measure directly to the Pacific Power customer after the customer completes an application form for an eligible measure. The application form is usually completed online or mailed in. Typical downstream measures include energy-efficient appliances and relatively high-cost HVAC equipment and services.

2.2 Distribution Methods and Measure Categories

An overview of measure categories and measure types in the 2017-2018 Programs is shown in Table 2-1. For each measure type, the distribution method is indicated: upstream, midstream, or downstream.

Table 2-1: 2017-2018 California Measure Categories and Distribution Methods

Measure Category and Measure Type	Distribution Method	
	Upstream or Midstream	Downstream
Appliances		
Clothes Washers		Yes
Refrigerators		Yes
Building Shell		
Insulation		Yes
Energy Kits		
Lighting		Yes
Lighting and Plumbing		Yes
HVAC		
Cooling		Yes
Heat Pump		Yes
Lighting		
General Service Fixtures	Yes	
General Service Lamps	Yes	
Specialty Lamps	Yes	
Water Heating		
Heat Pump Water Heater		Yes
Whole Homes		
Whole Home		Yes

2.3 Program Participation

During the 2017-2018 program years, Pacific Power provided incentives to residential customers that resulted in the quantity of measures shown in Table 2-2 and Table 2-3. Pacific Power also provided upstream discounts for 4,411 lighting fixtures and 43,910 lighting bulbs in 2017 and 600 lighting fixtures and 12,848 lighting bulbs in 2018. Table 2-2 and Table 2-3 also show the associated claimed savings for each measure during 2017 and 2018.

Table 2-2: 2017 Claimed Program Quantity and Savings by Measure

Measure Category	Measure Type	Claimed Quantity	Quantity Type	Claimed kWh Savings
Appliances	Clothes Dryers	43	Measures	5,546
	Clothes Washers	1	Measures	117
Building Shell	Insulation	8,855	Square Feet	4,768
Energy Kits	Lighting	130	Kits	10,400
	Lighting and Plumbing	1,137	Kits	478,593
HVAC	Cooling	2	Measures	115
	Heat Pump	135	Measures	495,284
Lighting	General Service Fixtures	4,411	Fixtures	66,430
	General Service Lamps	36,914	Bulbs	606,153
	Specialty Lamps	6,996	Bulbs	180,661
Water Heating	Water Heater	9	Measures	14,976
Whole Homes	Whole Homes	20	Measures	43,808
2017 TOTAL				1,906,852

Table 2-3: 2018 Claimed Program Quantity and Savings by Measure

Measure Category	Measure Type	Claimed Quantity	Quantity Type	Claimed kWh Savings
Appliances	Clothes Washers	11	Measures	1,508
Building Shell	Insulation	5,862	Square Feet	6,556
Energy Kits	Lighting	147	Kits	8,708
	Lighting and Plumbing	1,137	Kits	445,388
HVAC	Cooling	14	Measures	816
	Heat Pump	136	Measures	515,250
Lighting	General Service Fixtures	600	Fixtures	8,191
	General Service Lamps	8,880	Bulbs	83,644
	Specialty Lamps	3,968	Bulbs	52,534
Water Heating	Water Heater	7	Measures	5,866
2018 TOTAL				1,128,461

2.4 Impact Evaluation Objectives

The primary objective of the impact evaluation is to determine ex-post verified gross energy (kWh) savings and net kWh savings. ADM executed the following steps to determine ex-post verified gross and net kWh savings.

- Reviewed and reconciled program tracking data to the claimed participation counts and ex-ante savings in the 2017 and 2018 annual reports.
- Administered participant surveys to determine actual installation rates at the measure level. Surveys were administered online-only in California.
- Determined gross unit energy savings (“UES”), which incorporate verified measure installation rates and employ engineering analyses for lighting and energy kits; or

employ deemed savings reviews for appliances, HVAC, building shell, and whole homes measures.

- For determining net energy savings and calculating cost-effectiveness, California standards utilize the CPUC's DEER NTG values. The NTG values for 2017 and 2018 presented in this report are mainly sourced from DEER. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling.
 - Net-to-gross and realization values used to determine net savings by measure category and program level.
- Achieved a minimum precision of better than $\pm 10\%$ with 90% statistical confidence ("90/10 precision") for gross realized savings estimates by program.
- Provided comprehensive documentation and transparency for all evaluation tasks.
- Estimated leakage impacts utilizing geospatial analysis (i.e., ArcGIS or similar) and corroborated results using a case-study approach for the largest lighting retailers in the program.
- Provided inputs for cost benefit analyses.
- Provided ongoing technical reviews and guidance throughout the evaluation cycle.
- There was no on-site verification or equipment monitoring.

2.5 Process Evaluation Objectives

The overarching approach to process evaluation is the following.

- To gain an in-depth understanding of program operations and the challenges and evaluation needs through Pacific Power and implementation contractor key staff interviews, complemented with program documentation review and program participant surveys.

Specifically, the process evaluation was designed to answer the following research questions.

- How well did Pacific Power staff, implementation staff, participants, and trade allies work together?
- How do participants learn about the program? What percentage is contacted directly by Pacific Power or implementation staff? What percentage hears about the program through another avenue and then contacts Pacific Power?
- Were program participants satisfied with their experiences? What was the level of satisfaction with the work performed, the scheduling/application process, and other aspects of program participation? What are the perceived energy and non-energy impacts associated with the program?

- What are key barriers and drivers to program success within Pacific Power's service territories? How can those be addressed to improve program operations in the future

3 Impact Evaluation

This chapter presents the findings of the impact evaluation for the California Home Energy Savings Program. Table 3-1 and Figure 3-1 present the impact evaluation results, including the claimed savings, evaluated gross savings, realization rates, evaluated net savings and net-to-gross (NTG) values for each measure category across both program years, 2017 and 2018. Table 3-2 presents the same information for each individual year, 2017 and 2018.

Table 3-1: California Home Energy Savings Program Claimed and Evaluated Savings for 2017-2018

Year	Measure Category	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	NTG
2017-2018	Appliances	Clothes Washers	7,054	7,054	100%	2,187	31%
		Refrigerator	117	117	100%	64	55%
	Building Shell	Insulation	11,324	11,324	100%	3,171	28%
	Energy Kits	LED Only	19,108	20,235	106%	18,783	93%
		Best Kit - 1 Bathroom	229,432	265,989	116%	197,062	74%
		Best Kit - 2 Bathroom	694,549	752,210	108%	567,338	75%
	HVAC	Cooling	931	931	100%	348	37%
		Heat Pump	1,010,534	1,008,861	100%	554,874	55%
	Lighting	General Service Fixtures	74,621	65,601	88%	36,080	55%
		General Service Lamps	689,797	475,657	69%	305,864	64%
		Specialty Lamps	233,195	164,910	71%	99,394	60%
	Water Heating	Water Heater	20,842	20,842	100%	11,463	55%
	Whole Homes	Whole Home	43,808	43,808	100%	24,094	55%
	2017-2018 Total			3,035,313	2,837,540	93%	1,820,723

Figure 3-1: CA Home Energy Savings Program Energy Savings, 2017-2018

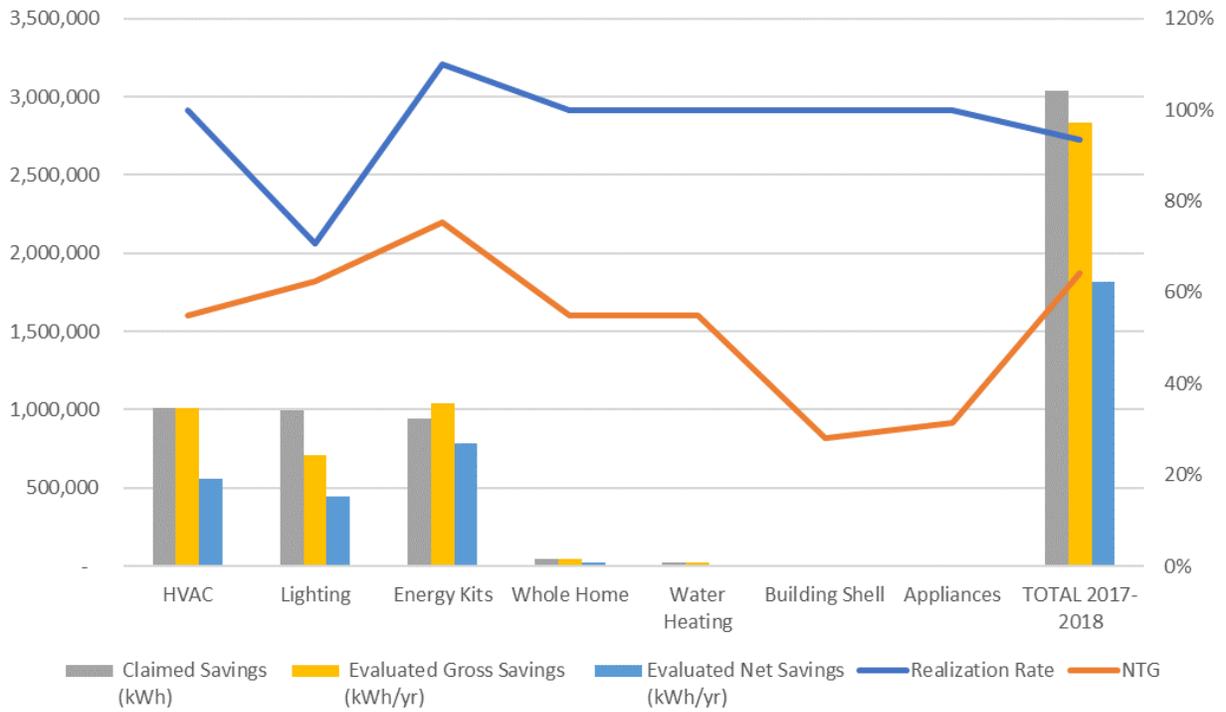


Table 3-2: California Home Energy Savings Program Claimed and Evaluated Savings for 2017 and 2018

Year	Measure Category	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	NTG
2017	Appliances	Clothes Washers	5,546	5,546	100%	1,719	31%
		Refrigerator	117	117	100%	64	55%
	Building Shell	Insulation	4,768	4,768	100%	1,335	28%
	Energy Kits	LED Only	10,400	9,497	91%	9,011	95%
		Best Kit - 1 Bathroom	114,459	127,269	111%	120,766	95%
		Best Kit - 2 Bathroom	364,134	385,115	106%	365,436	95%
	HVAC	Cooling	115	115	100%	41	36%
		Heat Pump	495,284	494,391	100%	271,915	55%
	Lighting	General Service Fixtures	66,430	57,322	86%	31,527	55%
		General Service Lamps	606,153	409,625	68%	245,775	60%
		Specialty Lamps	180,661	122,614	68%	74,016	60%
	Water Heating	Water Heater	14,976	14,976	100%	8,237	55%
	Whole Homes	Whole Home	43,808	43,808	100%	24,094	55%
	2017 Total			1,906,852	1,675,163	88%	1,153,937
2018	Appliances	Clothes Washers	1,508	1,508	100%	467	31%
		Refrigerator	-	-	-	-	-
	Building Shell	Insulation	6,556	6,556	100%	1,836	28%
	Energy Kits	LED Only	8,708	10,738	123%	9,772	91%
		Best Kit - 1 Bathroom	114,973	138,720	121%	76,296	55%
		Best Kit - 2 Bathroom	330,415	367,095	111%	201,902	55%
	HVAC	Cooling	816	816	100%	307	38%
		Heat Pump	515,250	514,470	100%	282,959	55%
	Lighting	General Service Fixtures	8,191	8,278	101%	4,553	55%
		General Service Lamps	83,644	66,032	79%	60,089	91%
		Specialty Lamps	52,534	42,297	81%	25,378	60%
	Water Heating	Water Heater	5,866	5,866	100%	3,226	55%
	Whole Homes	Whole Home	-	-	-	-	-
	2018 Total			1,128,461	1,162,378	103%	666,786

3.1 Impact Evaluation Approach

3.1.1 Data Collection and Measure Verification

During the period of this evaluation, ADM reviewed and reconciled program tracking data to the participation counts and ex-ante savings indicated in the 2017 and 2018 annual reports. ADM reviewed a census of program tracking data. In concert with tracking data reviews, ADM also reviewed the savings values and measure savings assumptions and calculations contained in the Technical Resource Library (TRL) files provided by Pacific Power. ADM issued data requests as needed to ensure that all data was collected that could be reasonably expected or required for this evaluation.

ADM conducted surveys to verify measure installation and collected additional primary data from program participants, including data related to purchasing decisions which was utilized in the freeridership and spillover analyses. ADM surveyed a representative sample of known participants and employed a general population survey for unknown participants (those who purchased upstream measures).

The following provides additional detail regarding data collection and measure verification activities.

- **Review of the program tracking database** is an essential first step for verifying data integrity. ADM assessed the program data management system DSMC – which facilitates data collection and organization. ADM reviewed a census of program tracking data contained in DSMC. Each program year’s dataset was reviewed for completeness, consistency, and compliance with the provided TRL files.
- **Review of measure savings assumptions and calculations** occurred concurrent with the DSMC data reviews mentioned above. Savings values are maintained in the Technical Reference Library (TRL). The TRL files sometimes include measure savings assumptions, calculations, source papers or files (e.g. Regional Technical Forum versions), and additional documentation that together comprise the generally accepted rules and guidance for evaluating the Programs. ADM reviewed all TRL documentation and included in this report any errors, omissions, or inconsistencies identified during ADM’s review.
- **Data requests** related to EM&V activities occurred throughout the period of this evaluation. ADM provided Pacific Power various data requests for DSMC and TRL data pulls and reports, and other program data and verification, as necessary.
- **Online surveys were developed/administered** to verify measure installation and collect additional primary data from program participants. ADM surveyed a

representative sample of known participants, i.e., customers who implemented downstream measures, for which incentives are provided to specific Pacific Power customers. ADM also employed a general population survey for Pacific Power customers to survey the unknown upstream customers. A general population survey is an effective tool to identify the upstream participants. Surveys were online-only for California.

3.1.2 Sample Design

A representative participant sample was developed for each of the following measure categories in California: energy kits, HVAC, and lighting. These measures account for approximately 97% of total claimed savings in California during the program years 2017 and 2018. ADM achieved a sampling precision of $\pm 10\%$ or better with 90% statistical confidence – or “90/10 precision” – for gross realized savings estimates at the measure category level for all significant measures, including the energy kits, HVAC, and lighting measure categories.

For measure categories for which program participants are known – i.e., downstream measures, including energy kit and HVAC measures – the sampling frame is the population of participants for a given measure category/state.

For upstream measure categories, including lighting measures – for which participants are not known. Therefore, for lighting measures in California, ADM employed a General Population Survey where the sampling frame is the population of Pacific Power residential customers in California excluding known participants in 2017-2018 Programs and known participants in other energy efficiency programs that Pacific Power implemented in 2017 or 2018.

Actual sample sizes were dependent on participant counts and specific measures installed. For the verification and evaluation activities listed below, ADM utilized the following sample sizes.

- Census review for all measures listed in the DSMC program tracking database to ensure appropriate use of deemed savings values (described in detail above).
- Review of a stratified sample of 70 lighting invoices associated with upstream lighting measures. The sampling precision was 9.64% at the 90% confidence interval.
- A sample of known program participants were surveyed for measure installation rates, net-to-gross (NTG) analyses, and process evaluation questions regarding the specific measures they implemented according to DSMC datasets. A sample

of all other residential customers was surveyed using a general population survey. Survey sample sizes per measure category are provided in the following Table 3-3.

Table 3-3: Impact Evaluation Survey Sample Size

Survey	Number of Survey Invites Sent	Number of Completed Surveys	Response Rate
General Population Survey	1,200	229	19%
Energy Kits Survey	1,199	109	9%
HVAC Survey	229	41	18%

3.1.3 Impact Evaluation Approach by Measure Category

Table 3-4 shows the methodology approach for each gross and net savings evaluation step for each measure. For the measure types with no adjustment made to the gross evaluated savings, ADM performed a review of the deemed savings values, savings assumptions and calculations, modeling files, and other information contained in the applicable TRL files, Regional Technical Forum (RTF) files and other sources of savings values. The NTG values for 2017 and 2018 used in this evaluation are mainly sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling.

Table 3-4: 2017-2018 Impact Evaluation Methodology Approach by Measure

Measure Category	Measure Type	Impact Evaluation Methodologies	Inputs to Gross Evaluated Savings	Inputs to Evaluated NTG
Appliances	Clothes Washers and Refrigerators	Deemed Savings Review	No adjustment	DEER
Building Shell	Insulation	Deemed Savings Review	No adjustment	DEER
Energy Kits	Lighting, and Lighting and Plumbing	Engineering Analysis / Energy Kits Survey	Energy Kits Survey	Pacific Power WA Energy Kits Survey
HVAC	Cooling	Deemed Savings Review	No adjustment	DEER
	Heat Pump	Deemed Savings Review	Updated RTF	DEER
Lighting	General Service Lamps and Fixtures	Engineering Analysis / General Population Survey	General Population Survey	DEER
	Specialty Lamps	Engineering Analysis / General Population Survey	General Population Survey	DEER
Water Heating	Water Heater	Deemed Savings Review	No adjustment	DEER
Whole Homes	Whole Homes	Deemed Savings Review	No adjustment	DEER

3.2 Evaluated Savings

ADM determined gross unit energy savings (“UES”) and evaluated net energy savings by incorporating verified measure installation rates, including installation rates by room, freeridership scores, and spillover from participant surveys together with engineering analyses for lighting and energy kits; and deemed savings reviews for appliances, HVAC, building shell measures, water heating, and whole homes measures.

ADM’s estimation of verified UES per measure takes into consideration California’s deemed savings values and the measure savings assumptions and calculations contained in the provided TRL files. California deemed savings values sometimes refer to the Regional Technical Forum (RTF), which maintains a library of UES measures.

3.2.1 Lighting

For lighting measure categories, Pacific Power claimed the following gross energy savings detailed in Table 3-5 for California in 2017 and 2018.

Table 3-5: 2017-2018 California Claimed Gross Energy Savings for Lighting Measures

Measure Category	Measure Type	2017 Quantity	2017 Savings (kWh)	2018 Quantity	2018 Savings (kWh)
Lighting	General Service Fixtures	4,411	66,430	600	8,191
	General Service Lamps	36,914	606,153	8,880	83,644
	Specialty Lamps	6,996	180,661	3,968	52,534
TOTAL		48,321	853,244	13,448	144,369

3.2.1.1 Database Review

For all lighting measures in California in 2017 and 2018, ADM reviewed and reconciled the program tracking data to the claimed participation counts and ex-ante savings in the 2017 and 2018 annual reports. Further, ADM conducted the review activities detailed below for lighting measures.

3.2.1.1.1 General Service Lamps and Specialty Lamps (ENERGY STAR®LEDs)

ADM conducted an ex-ante review of the Program’s 2017 and 2018 lighting measure data for general service lamps and specialty lamps. In this review, the following activities were performed:

- Verification of measure incentive requirements (e.g. ENERGY STAR® qualified status)
- Review of a sample of retailer and distributor invoices
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL documents and calculations

ADM reviewed each of the 40 individual lighting lamp measures for 2017 and 29 individual lighting lamp measures for 2018, including both general service lamps and specialty lamps. ADM verified for all lighting measures that the claimed savings per measure and the savings assumptions and calculations were supported by the applicable TRL, RTF and DEER documents. The TRL values for lighting measures in California were based off the RTF file ResLighting_v3.0 in 2017 and the RTF file ResLighting_v4.2 and DEER in 2018. Using the deemed values in conjunction with the total number of measures incentivized as provided in the program tracking database results in the claimed program energy savings.

3.2.1.1.2 General Service Fixtures

ADM conducted an ex-ante review of the Program's 2017 and 2018 lighting data for general service fixtures. In this review, the following activities were performed:

- Verification of measure incentive requirements (e.g. ENERGY STAR® qualified status)
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source documents and calculations

ADM reviewed the one individual lighting fixture measure for 2017 and one individual lighting fixture measures for 2018. ADM verified for all general service fixtures that the claimed savings per measure and the savings assumptions and calculations were supported by the applicable TRL and RTF documents. Using the deemed values in conjunction with the total number of measures incentivized as provided in the program tracking database results in the claimed program energy savings.

3.2.1.2 Inputs to Savings Calculation

ADM acquired information from the General Population survey in order to calculate an ex-post installation rate (ISR) factor and hours-of-use (HOU) value to generate the evaluated gross lighting program energy savings for both lamps and fixtures. The resulting ISR factor of 74.8% for lamps and 86.3% for fixtures and the daily HOU value of 1.95 for lamps and 1.58 for fixtures are shown in Table 3-6 below. The HOU values are based on results derived from the General Population survey regarding installation percentage by room type and HOU values by room type contained in a KEMA Study on

Residential Lighting End-Use Consumption.¹ Because ADM collected installation percentages by room type through the General Population survey, a study that includes HOU values by room type is appropriate to use in this case. Additionally, this is the most recent lighting study of its magnitude. The overall HOU values in the study are within the range of other HOU values and studies reviewed by ADM.

Table 3-6: Ex-post ISR factor and HOU value for California

Measure Type	Evaluated ISR	Evaluated Daily HOU
Lamps	74.8%	1.95
Fixtures	86.3%	1.58

ADM also determined the fraction of lighting measures that are installed in commercial premises or other non-residential premises (e.g., small medical or dental offices or schools, houses of worship, etc.). Although the Program is designed to encourage residential customers to purchase discounted LEDs in participating retail outlets, a fraction of residential customers may purchase an additional quantity for a small office or school or various non-residential premises. The fraction of upstream lighting measures installed in non-residential premises is also called “cross-sector sales.” ADM determined the fraction of cross-sector sales in California in the 2017-2018 Programs as 0.1% for lamps and 0.1% for fixtures through the General Population Survey.

3.2.1.3 Leakage Analysis

Leakage refers to cross-territory sales that occur when program discounted bulbs are installed outside of Pacific Power’s service territory. When this occurs, the energy and demand impacts from the discounted bulbs are not being realized within the territory that paid for and claimed the savings. Leakage was estimated for each of the retailers in the program. Table 3-7 shows the number of stores in California by retail channel that were included in the leakage analysis. Discount stores would include stores like Dollar Tree, while Do-it-Yourself stores include stores like Ace Hardware or Home Depot. Lastly, Mass Merchant would include stores like Walmart.

Table 3-7: Participating California Stores by Channel

Retail Channel	Number of Stores
Discount	4
DIY	5
Mass Merchant	2
Other	1
TOTAL	12

¹ Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates; DNV KEMA Energy and Sustainability, Pacific Northwest National Laboratory; December 2012.

Estimates of leakage were assessed using an approach that combined online survey responses with Geo-mapping. The leakage analysis centered on the following approach:

- First, ADM developed a mapping of concentric circles (drive times) surrounding each participating and non-participating lighting retailer. The initial modeling assumed the “reach” of a retailer is a 60-minute drive. If drive times overlap between one or more retailer locations, the drive times are split between the stores with the assumption that customers will drive to the nearest store.
- Second, ADM used 2010 Census block data from Environmental System Research Institute (ESRI) to determine the proportion of the population that falls within each drive time circle (from Step 1), as well as the proportion of the population that falls within the Pacific Power territory and within the state of the participating retailer. Thus, for each drive time circle for each retail location, the Evaluators determined the proportion of the population within the Pacific Power territory and within state, outside of Pacific Power territory and within state, and outside of the state of the participating retailer. ADM utilized a shapefile (a format commonly used in GIS that geographically displays the underlying tabular data) showing the service areas of Pacific Power in the analyzed states from Platts/McGraw-Hill.²
- Third, ADM used the General Population Survey to assess the shopping habits of customers within the radius of participating retailers. This was used to assess the total and maximum drive time that consumers accepted when shopping for products incentivized by the retail channel. This was used in modifying the initial 60-minute drive assumption established in Step 1. An online survey was performed for Pacific Power in 2019 and the results of this survey are shown in Table 3-8. This approach uses a log transformation of the drive times to smooth the data and estimates the cumulative percent via a second order polynomial regression. The log transformation takes the log of the drive time and uses that as the independent variable in the regression. A log transformation is common when the relationship between the variables is logarithmic and linear regression is being used, since linear regression assumes the data are linearly related.
- Fourth, ADM calculated the percentage of bulbs that leaked out of Pacific Power territory.
- Lastly, ADM utilized a case-study methodology to corroborate the leakage results for the largest participating retailers in the program. The case study approach incorporates a relative likelihood score related to visiting each of these major

² Source: http://www.platts.com/IM.Platts.Content/ProductsServices/Products/gismetadata/iou_terr.pdf.

participating retailers. The relative likelihood score is based on the drive time responses for each retailer channel, the population data collected by Census Tract for PacifiCorp’s service territory and surrounding areas, and the presence and location of non-participating lighting retailers that could impact a customer’s decision to visit a participating retailer.

Table 3-8: Online Survey Drive Time Estimates in California

Channel/ Drive time (minutes)	0-4	5-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	N
DIY	6%	11%	10%	4%	7%	5%	8%	9%	1%	39%	157
Discount	6%	18%	18%	17%	6%	7%	14%	3%	1%	9%	158
Mass Merchant	5%	15%	7%	6%	9%	8%	20%	9%	1%	19%	158
TOTAL	6%	15%	12%	9%	7%	7%	14%	7%	1%	22%	158

Table 3-9 shows the leakage estimate of 7.4% for California overall across all retailer channels and Table 3-10 provides leakage estimates by retail channel. Pacific Power’s leakage rate of 7.4% in California is driven in part by two retailer locations on the edge of the Pacific Power service territory in California. These two retailers include a Home Depot and a Walmart in Crescent City, California, and represent two of the three largest retailers (representing approximately 51.8% of total bulbs sold in 2018) that participate in Pacific Power’s lighting program. ADM corroborated the results of its leakage analysis for these two retailers through a case-study approach that incorporates a relative likelihood score related to visiting the major participating retailers. The relative likelihood score is based on the drive time responses for each retailer channel, the population data collected by Census Tract for PacifiCorp’s service territory and surrounding areas, and the presence and location of non-participating lighting retailers that could impact a customer’s decision to visit a participating retailer.

While the implementation contractor provided some documentation showing how RSAT is a predictor of bulb leakage in Pacific Power territories and is used to determine allocations of bulbs to participating stores, the full RSAT methodology is not transparent to ADM. In an effort to help Pacific Power further understand how the RSAT tool accounts for leakage and why the RSAT tool allocations differ from the results of ADM’s leakage analysis, ADM utilized a case-study methodology to provide increased transparency into the inputs and results of ADM’s leakage analysis for the major lighting retailers in the program. For instance, the RSAT tool results in a 100% allocation to the Crescent City Walmart location, indicating that there should be 0.0% lighting leakage for this location. ADM’s leakage analysis estimates a 26.8% leakage rate for this individual retailer and the case-study for this location shows that all leakage is occurring to the north of Pacific Power’s service territory. ADM concluded that there are no non-participating lighting retailers within the applicable drive time distance to reduce this leakage to the north. While the full RSAT methodology is not transparent to ADM, it is likely that the RSAT

methodology incorporated a different assumption. ADM recommends that the evaluation of subsequent program years includes further review of the RSAT allocation tool and the inputs into the tool in an effort to reduce lighting leakage from Pacific Power’s California service territory.

Table 3-9: Leakage Estimate in California

Quantity Sold	Leakage Quantity	Leakage Rate
13,448	994	7.4%

Table 3-10: Leakage Estimate by Retailer Type in California

Retailer Type	Quantity Sold	Leakage Quantity	Leakage Rate
Discount	1,374	2	0.2%
DIY	6,135	279	4.5%
Mass Merchant	5,939	713	12.0%
TOTAL	13,448	994	7.4%

Table 3-11 provides a benchmark comparison of the estimated California leakage rates with other leakage estimates for utilities ADM has evaluated in the past couple of years. The leakage estimates for these other states vary from a low of 10% overall leakage for OG&E Arkansas to a high of 50% for SWEPCO Arkansas. Pacific Power’s leakage rate of 7.4% in California is due to the small Pacific Power service territory in California and the location of two large retailers on the edge of the service territory.

Table 3-11: Leakage Benchmarking

Utility	State	Year	Leakage (Overall)	Leakage (Discount)	Leakage (DIY)	Leakage (Mass Merchant)
SWEPCO	AR	2018	50%	41%	65%	48%
Cleco	LA	2018	33%	33%	-	-
OG&E	AR	2018	10%	28%	0%	10%
RMP	UT	2018	8%	11%	5%	10%
PP	WA	2018	6%	14%	4%	7%
RMP	WY	2018	5%	4%	2%	9%
RMP	ID	2018	15%	9%	4%	18%
PP	CA	2018	7%	<1%	5%	12%

3.2.1.4 Gross Energy Savings

3.2.1.4.1 Engineering Calculation for Lighting Measure

For lamps and fixtures, the following formula is used to calculate annual energy (kWh) savings per measure:

Formula 3.1 Energy Savings for LEDs

$$LED\ kWh\ savings = \left(\frac{\Delta Watts}{1000} \right) * ISR * Hours * IEF_E$$

Where:

$\Delta Watts$ = Watts, baseline bulb - Watts, LED

ISR = “In Service Rate” or installation rate for LEDs purchased in 2017-2018 were determined from the RTF (2017) or DEER (2018) for claimed savings and from ADM’s analysis of Pacific Power customers’ responses to lighting-related questions in the general population survey (online survey) for evaluated savings; specifically, the general population survey contains various questions related to LED installation, including installation by room type;

$Hours$ = Hours of use were determined from RTF and DEER for claimed savings and from ADM’s analysis of Pacific Power’s customers’ responses to lighting-related questions in the general population survey for evaluated savings; the hours input is hours of use per year or the product of 365.25 days per year and the average daily hours of use for lighting;

IEF_E = Interactive Effects Factor to account for cooling energy savings and heating energy penalties (a deemed value from the RTF files);

Source of deemed values in California are the RTF or DEER files.

Example Calculation for Lighting Measure:

The following is an example of a retail 10 watt LED downlight bulb in 2017. The TRL source document for this measure indicates a UES of 35.3 kWh/yr and is based off the RTF file ResLighting_v3.0. The RTF file specifies an hours of use value of 2.0, an installation rate of 100%, and a heat exchange factor of 87.8%. Inserting these values into the equation above verifies the 35.3 kWh/yr savings. ADM verified the UES values for each individual lighting measure in 2017 and 2018.

Example 3.1 Energy Savings for LEDs

$$35.3 kWh = \left(\frac{65-55}{1000} \right) * (1 - 0.0) * (2.0 * 365.25) * (1 - (-.122))$$

Using the deemed UES values from the TRL source documents in conjunction with the total quantity of measures incentivized as provided in the program tracking database results in the ex-ante program energy savings. For this example of the retail 10 watt LED downlight bulb measure, the program tracking data indicates that this measure was incentivized 247 times in 2017. This results in ex-ante energy savings of 8,706.8 kWh/Yr for 2017. Appendix Table 7-1 shows the input values and UES savings for 2017 lighting measures.

3.2.1.4.2 Evaluated Gross Energy Savings for Lighting Measures

Table 3-12 below shows the claimed and evaluated gross savings by lighting measure category in addition to the realization rates. Appendix Table 7-2, Table 7-3, and Table 7-4 provide the claimed and evaluated gross savings for each individual lighting measure in 2017 and 2018 in addition to the realization rates. The realization rates for LED lamps in 2017 and 2018 were driven by a lower evaluated ISR of 75% compared to the RTF ISR assumption of 100% in 2017 and the TRL ISR assumption of 84% in 2018, and by a lower evaluated daily HOU of 1.95 compared to claimed daily HOU values of 2.0 in 2017 and deemed by DEER in 2018. CFL lamps comprised a small portion of lighting in 2017 and had higher realization rates of 80% due to a lower claimed ISR value of 71%. The realization rates for lamps include the 18.5% leakage calculated for California. The realization rates for general service fixtures were driven by a lower evaluated ISR of 86% compared to the RTF ISR assumption of 100% in 2017 and the TRL ISR assumption of 84% in 2018, and by a lower evaluated daily HOU of 1.95 compared to claimed daily HOU values of 2.0 in 2017 and deemed by DEER in 2018.

Table 3-12: 2017-2018 Claimed and Evaluated California Home Energy Savings Program Gross Lighting Savings

Measure Category	Year	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
Lighting	2017	General Service Fixtures	66,430	57,322	86.3%
		General Service Lamps	606,153	409,625	67.6%
		Specialty Lamps	180,661	122,614	67.9%
	2018	General Service Fixtures	8,191	8,278	101.1%
		General Service Lamps	83,644	66,032	78.9%
		Specialty Lamps	52,534	42,297	80.5%
2017-2018 TOTAL			997,613	706,168	70.8%

3.2.1.5 Evaluated Net Energy Savings

The lighting measure NTG values for 2017 and 2018 used in this evaluation are sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. Table 3-13 shows the NTG values for lighting measures in 2017 and 2018. Table 3-14 shows the net savings evaluation results, including the evaluated gross savings, evaluated net savings and the NTG for each lighting measure category in 2017 and 2018. The same information for each individual lighting measure in 2017 and 2018 is included in Appendix Table 7-5, Table 7-6, and Table 7-7.

Table 3-13: 2017-2018 Lighting DEER NTG Values

Measure Type	NTG
2017 LED Lamps	60.0%
2017 CFL Lamps	85.0%
2017 Fixtures	55.0%
2018 Lamps	60.0% - 91.0%
2018 Fixtures	55.0%

Table 3-14: 2017-2018 California Home Energy Savings Program Net Lighting Savings and NTG

Measure Category	Year	Measure Type	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
Lighting	2017	General Service Fixtures	57,322	31,527	55.0%
		General Service Lamps	409,625	245,775	91.0%
		Specialty Lamps	122,614	74,016	60.0%
	2018	General Service Fixtures	8,278	4,553	55.0%
		General Service Lamps	66,032	60,089	60.0%
		Specialty Lamps	42,297	25,378	60.4%
2017-2018 TOTAL			706,168	441,339	62.5%

3.2.2 Energy Kits

Pacific Power made Energy Kits available to customers in California who requested them. Kit configurations varied according to the characteristics of customer’s homes and include ENERGY STAR® and WaterSense® certified products. All Kits included four 9.5 W LED light bulbs. If the customer’s home utilized an electric water heater, kits also included energy saving faucet aerator and showerheads.

Table 3-15 details the kit configurations and Pacific Power claimed savings for each kit type offered in 2017 and 2018 and Table 3-16 shows the quantity of Energy Kits and the total Pacific Power claimed savings attributed to each kit type in 2017 and 2018. There was an Energy Kit TRL change during 2018, so there are multiple savings values for Energy Kits in 2018.

Table 3-15: 2017-2018 Energy Kit Configurations and Claimed Gross Energy Savings per Energy Kit

Configuration	Measure	Quantity per Energy Kit	2017 and 2018 (pre TRL change) Claimed Savings (kWh/yr) ¹	2018 (post TRL change) Claimed Savings (kWh/yr) ¹
LED Only	9.5 W LED A-Lamp	4	80.0	33.8
Best Kit - 1 Bathroom	9.5 W LED A-Lamp	4	294.2	241.1
	1.5GPM Aerator Kitchen	1		
	0.5GPM Aerator Bath	1		
	1.5GPM Showerhead	1		
Best Kit - 2 Bathroom	9.5 W LED A-Lamp	4	468.1	431.8
	1.5GPM Aerator Kitchen	1		
	0.5GPM Aerator Bath	2		
	1.5GPM Showerhead	2		

¹ There was an Energy Kit TRL change during 2018, so there are multiple UES values for Energy Kits in 2018.

Table 3-16: 2017-2018 Energy Kit Quantities and Total Claimed Gross Savings

Kit Type	2017 Quantity	2017 Total Claimed Savings (kWh/yr)	2018 Quantity	2018 Total Claimed Savings (kWh/yr)
LED Only	130	10,400	147	8,708
Best Kit – 1 Bathroom	389	114,459	424	114,973
Best Kit – 2 Bathroom	748	364,134	713	330,415
TOTAL	1,267	488,993	1,284	454,096

3.2.2.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 and 2018 energy kits measure data. In this review, the following activities were performed:

- Verification of measure incentive requirements (e.g. model numbers)
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking data include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source documents and calculations
- Calculate energy savings for individual components of each Energy Kit measure

ADM reviewed each energy kit component in each energy kit measure. ADM verified that the Pacific Power claimed savings were based on the applicable TRL source documents. Using the UES values in the TRL documents in conjunction with the total number of

measures incentivized as provided in the program tracking database results in the total claimed program energy savings shown in Table 3-16.

3.2.2.2 Inputs to Savings Calculation

ADM acquired information from the Energy Kits survey in order to calculate ex-post ISR factors to generate the evaluated gross program energy savings for Energy Kits. The resulting installation rates for each kit component are shown in Table 3-17 below.

Table 3-17: 2017-2018 Ex-Post Installation Rates for Kit Components

Energy Kit Component	Installation Rate
LED Lamps	89.9%
Showerheads	52.1%
Bathroom Aerator	66.7%
Kitchen Aerator	67.1%

3.2.2.3 Gross Energy Savings

3.2.2.3.1 Engineering Calculation for Energy Kit Measures

Ex-ante and ex-post energy savings can be calculated for the individual components of each measure using engineering formulas, inputs from the savings source documents and inputs gathered from primary surveying. Appendix B includes Table 7-8 and Table 7-9 that list the TRL, RTF, or other source documents or primary data used for each input in the formula for ex-post evaluated savings. LED annual energy (kWh) savings per lamp are calculated using the same formulas as provided above for lighting lamps and fixtures.

Faucet aerator annual energy (kWh) savings are calculated using the following formula:

Formula 3.4 Energy Savings for Aerators

$$\text{Savings (kWh)} = \text{ISR} \times (\text{F}_B - \text{F}_P) \times \text{T}_{\text{Person-Day}} \times \text{N}_{\text{Persons}} \times 365.25 \times \Delta T_L \times U_H \times U_E \times \text{WH}_E \div \text{Eff} \div (\text{F/home})$$

Where:

ISR = In-Service Rate determined from Energy Kits surveys

F_B = Average Baseline Flow Rate of aerator, (gallons per minute)

F_P = Average Post Measure Flow Rate, (gallons per minute)

T_{Person-Day} = Average time of hot water usage per person per day (minutes)

N_{Persons} = Average number of persons per household (state-specific values)

ΔT = Average temperature differential between hot and cold water (°F)

U_H = Unit Conversion: 8.33BTU/(Gallons-°F)

U_E = Unit Conversion: 1 kWh/3413 BTU

W_E = Fraction of Homes with Electric Water Heaters

Eff = Efficiency of Electric Water Heater

F/home = Average number of faucets in the home

Showerhead annual energy (kWh) savings are calculated using the following formula:

Formula 3.5 Energy Savings for Showerheads

$$\text{Savings (kWh)} = \text{ISR} \times [(F_B - F_P) \div F_B] \times G_{\text{Shower}} \times N_{\text{Persons}} \times 365 \times \Delta T \times U_H \times U_E \div \text{Eff} \div S$$

Where:

- ISR = In-Service Rate determined from Energy Kits surveys
- F_B = Average Baseline Flow Rate, (gallons per minute)
- F_P = Average Post Measure Flow Rate, (gallons per minute)
- G_{Shower} = Average gallons of hot water used per person per shower per day
- N_{Persons} = Average number of persons per household (state-specific values)
- ΔT = Average temperature differential between hot and cold water (°F)
- U_H = Unit Conversion: 8.33BTU/(Gallons-°F)
- U_E = Unit Conversion: 1 kWh/3413 BTU
- Eff = Efficiency of Electric Water Heater
- S = Average number of showers in the home

Example Ex-Ante Calculation for Energy Kits Measures:

The following example demonstrates the energy savings calculations for aerators and showerheads in a 2017 ‘Best Kit – 1 Bathroom’ Energy Kit that includes four 9.5 W LED A-Lamps, one 1.5 GPM Kitchen Aerator, one 0.5 GPM Bathroom Aerator, and one 1.5 GPM Showerhead. ADM’s calculations are based on inputs obtained from the applicable TRL, RTF and other source documents.

LED Energy Savings in Best Kit – 1 Bathroom Energy Kit:

$$80.0 \text{ kWh (per kit)} = 20.0 \text{ kWh (per bulb)} * 4$$

Aerator Energy Savings in Best Kit – 1 Bathroom Energy Kit:

$$111.37 \text{ kWh (kitchen)} = 0.602 * (2.2 - 1.5) * 4.5 * 2.4 * 365.25 * (93 - 64.77) * 8.345 * \left(\frac{1}{3413.14}\right) * 0.951 \div 0.98 \div 1$$

and

$$34.90 \text{ kWh (bathroom)} = 0.613 * (2.2 - 0.5) * 1.6 * 2.4 * 365.25 * (86 - 64.77) * 8.345 * \left(\frac{1}{3413.14}\right) * 0.951 \div 0.98 \div 2.11$$

Showerhead Energy Savings in Best Kit – 1 Bathroom Energy Kit:

$$137.53 \text{ kWh} = 0.634 * [(2.3-1.5)/2.3] * 11.7 * 2.4 * 365.25 * (128 - 53) * 8.345 * \left(\frac{1}{3413.14}\right) \div .98 \div 1.71$$

Total Energy Savings in Best Kit – 1 Bathroom Energy Kit:

$$363.80 \text{ kWh} = 80 + 111.37 + 34.90 + 137.53$$

ADM's calculated ex-ante savings values for some of the individual energy kit components were not exactly matched to the deemed UES values found in the Energy Kits source TRL documents. For instance, ADM was not able to reverse engineer the values for kitchen and bathroom aerators contained in the TRL documents from the known input values in the TRL and source documents. ADM calculated 2017 ex-ante values of 111.37 kWh/yr for kitchen aerators and 34.90 kWh/yr for bathroom aerators compared to the deemed 2017 UES values of 21.67 kWh/yr for kitchen aerators and 52.57 kWh/yr for bathroom aerators. The deemed UES values for these energy kit components are based on a potential study from a previous evaluation that utilized a whole house savings methodology, and thus ADM was not able to determine with certainty what is driving the difference in savings values. For the example of the 2017 Best Kit – 1 Bathroom' Energy Kit calculated above, the ADM calculated ex-ante savings of 363.80 kWh/Yr does not exactly match the Energy Kits TRL UES value and the Pacific Power claimed savings value of 294.24 kWh/Yr. Appendix B include tables that list the TRL, RTF, or other source documents used to calculate the evaluated savings for each individual component of the Energy Kits.

3.2.2.3.2 Evaluated Gross Energy Savings for Energy Kits Measures

Table 3-18 below shows claimed and evaluated gross savings as well as realization rates for each Energy Kits component. Table 3-19 shows claimed and evaluated gross savings for all Energy Kits in 2017 and 2018, as well as realization rates on the Energy Kit level. To calculate ex-post evaluated gross savings, ADM incorporated the verified ISR obtained through the Energy Kits surveys and utilized vetted inputs from the most recent TRL and RTF files for each kit component available prior to the evaluation cycle.

The different realization rates for the lighting Energy Kit component are driven by the difference in ex-ante claimed savings values across 2017 and 2018. The ex-ante claimed savings value of an LED lamp in the Energy Kit is 20.0 kWh/yr in 2017 and 8.44 kWh/yr in 2018 (post-TRL change). Compared to the evaluated gross savings value of 18.26 kWh/yr for this LED lamp, the realization rate for lighting varies from 91.3% in 2017 to 123.3% in 2018. For the showerheads Energy Kits component, the evaluated ISR of 52.1% likely impacts the 99.5% realization rate in 2017 and 2018 (pre-TRL change) and the 89.3% realization rate in 2018. For both the bathroom and kitchen aerator Energy Kits

components, the realization rates are driven by the difference in ex-ante claimed savings values. For instance, because the bathroom aerator had a claimed savings value of 52.57 kWh/yr in 2017 and 2018 (pre-TRL change) and a claimed savings value of 34.70 kWh./yr in 2018 (post-TRL change) the evaluated savings value of 34.90 kWh/yr across both years leads to different realization rates. The bathroom and kitchen aerator respective evaluated ISRs of 66.7% and 67.1% also would likely impact the realization rates, however because the claimed savings values are based off a potential whole house savings methodology it is not possible to know the precise drivers of the realization rates. While there is a range of realization rates across each Energy Kit component, the overall realization rate for Energy Kits in 2017 and 2018 is 110.1%.

Table 3-18: 2017-2018 Energy Kits Claimed and Evaluated Per-Component Gross Savings and Realization Rates

Year ¹	Energy Kit Component	Claimed Gross Savings Per Unit (kWh)	Evaluated Gross Savings Per Unit (kWh)	Realization Rate
2017 and 2018 (pre TRL change)	LED Lamps	20.00	18.26	91.3%
	Showerheads	140.00	139.30	99.5%
	Bathroom Aerator	52.57	48.39	92.0%
	Kitchen Aerator	21.67	66.43	306.6%
2018 (post TRL change)	LED Lamps	8.44	18.26	216.4%
	Showerheads	156.00	139.30	89.3%
	Bathroom Aerator	34.70	48.39	139.5%
	Kitchen Aerator	16.60	66.43	400.2%

¹ There was an Energy Kit TRL change during 2018, so there are multiple UES values for Energy Kits in 2018.

Table 3-19: 2017-2018 Energy Kits Claimed and Evaluated Gross Savings and Realization Rates

Year	Configuration	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	LED Only	10,400	9,497	91.3%
	Best Kit - 1 Bathroom	114,459	127,269	111.2%
	Best Kit - 2 Bathroom	364,134	385,115	105.8%
2018	LED Only	8,708	10,738	123.3%
	Best Kit - 1 Bathroom	114,973	138,720	120.7%
	Best Kit - 2 Bathroom	330,415	367,095	111.1%
2017-2018 TOTAL		943,089	1,038,435	110.1%

3.2.2.4 Evaluated Net Energy Savings

The energy kit measure NTG values for 2017 are sourced from a prior ADM evaluation for Pacific Power’s Washington service territory because the DEER database does not have energy kit or non-lighting energy kit component specific NTG values. For measures in which the DEER database does not have NTG values, the default NTG value is 55.0%. However, based on ADM’s benchmarking and prior evaluations, this default value would

be low for energy kits. ADM has completed an evaluation for Pacific Power’s Washington service territory that included primary data collection on energy kit NTG values, and the resulting NTG value of 94.89% is more appropriate to use. In 2018, the NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling and thus ADM sourced the 2018 NTG values from the CPUC’s DEER database, including the 55.0% default NTG value for energy kits. Table 3-20 shows the NTG values for Energy Kits measures and Table 3-21 shows the net savings evaluation results, including the evaluated gross savings, evaluated net savings and NTG for each Energy Kits configuration.

Table 3-20: 2017-2018 Freeridership, Spillover and NTG for Energy Kits

Year	Measure Category	NTG
2017	LED Only	94.9%
	Best Kit - 1 Bathroom	94.9%
	Best Kit - 2 Bathroom	94.9%
2018	LED Only	91.0%
	Best Kit - 1 Bathroom	55.0%
	Best Kit - 2 Bathroom	55.0%

Table 3-21: 2017-2018 Energy Kits Evaluated Net Energy Savings and NTG

Year	Configuration	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	LED Only	9,497	9,011	94.9%
	Best Kit - 1 Bathroom	127,269	120,766	94.9%
	Best Kit - 2 Bathroom	385,115	365,436	94.9%
2018	LED Only	10,738	9,772	91.0%
	Best Kit - 1 Bathroom	138,720	76,296	55.0%
	Best Kit - 2 Bathroom	367,095	201,902	55.0%
2017-2018 TOTAL		1,038,435	783,183	75.4%

3.2.3 HVAC

The HVAC measure category included cooling and heat pump measures across the Program years 2017 and 2018. The following Table 3-22 shows the quantity of HVAC measures installed and the claimed savings attributed to each HVAC measure in 2017 and 2018. HVAC measures accounted for approximately 33% of total Program savings in 2017 and 2018 and heat pump HVAC measures accounted for over 99% of total HVAC measure savings in 2017 and 2018.

Table 3-22: 2017-2018 HVAC Measure Quantities and Claimed Savings

Measure Type	2017 Quantity	2017 Claimed Savings (kWh)	2018 Quantity	2018 Claimed Savings (kWh)
Cooling	2	115	14	816
Heat Pump	135	495,284	136	515,250
TOTAL	137	495,399	150	516,066

3.2.3.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 and 2018 HVAC measure data. In this review, the following activities were performed:

- Verification of measure incentive requirements for a sample of HVAC measure items (e.g. AHRI numbers and model numbers)
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source documents and calculations

ADM reviewed all eight individual HVAC measures in 2017 and all nine individual HVAC measures in 2018 and verified for all individual measures that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each of these measures accurately reflected the quantity of that measure installed in 2017 and 2018.

3.2.3.2 Inputs to Savings Calculation

ADM applied a 100% ISR for the HVAC measure categories, supported by the results obtained through the California HVAC Survey that indicated that all respondents installed the incentivized HVAC measure.

3.2.3.3 Evaluated Gross Savings

ADM conducted a deemed savings review of the cooling and heat pump HVAC measure claimed savings values in California, including the TRL files provided and the RTF source savings documents. ADM concludes that the UES values in the TRL files for the cooling HVAC measures are within the bounds of reasonable estimates based on the engineering review and thus did not adjust the savings values for these measures. For the heat pump HVAC measures, ADM used an updated UES value from a more recent RTF source document for heat pumps that was available prior to the program year 2017. This results

in the realization rates and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-23. Each measure type is discussed in more detail below.

Table 3-23: 2017-2018 HVAC Measure Gross Evaluation Results

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	Cooling	115	115	100.0%
	Heat Pump	495,284	494,391	99.8%
2018	Cooling	816	816	100.0%
	Heat Pump	515,250	514,470	99.8%
2017-2018 TOTAL		1,011,465	1,009,792	99.8%

3.2.3.3.1 Cooling

The cooling measure HVAC group represented approximately 0.03% of the overall program savings in 2017 and 2018. ADM conducted a deemed savings review of the cooling measure claimed savings values, including the TRL files provided. ADM concludes that the UES values in the TRL are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values for cooling measures.

3.2.3.3.2 Heat Pump

The heat pump measure HVAC group represented 33.29% of the overall program savings in 2017 and 2018. ADM conducted a deemed savings review of the heat pump measure claimed savings values, including the TRL files provided and the supporting RTF files. ADM’s review found that the ex-ante claimed savings value for ductless heat pumps are based on the Residential Heating and Cooling Ductless Heat Pump RTF versions 1.3 and 2.0 that have since been updated. In RTF version 1.3, the UES value for single-head ductless heat pumps is 3,500 kWh/yr. This UES value assumes no impact from climate zone and is applicable to all heating and cooling zones in the Pacific Northwest. In RTF version 2.0, the UES value was updated to 2,604 kWh/yr and does apply a heating and cooling zone to the UES value. There have been several updates to the RTF versions that went into effect prior to the program years 2017 and 2018. These updates have included a differentiation between baseline conditions of zonal heating or forced air furnace (FAF) heating and thus represent more accurate UES value estimates than prior RTF versions. Therefore, ADM’s gross evaluated savings values for ductless heat pumps are based off the Residential Single Family Existing HVAC RTF version 4.1 (adopted on July 18, 2016) for zonal heat baseline conditions and the Residential Ductless Heat Pump on Forced Air Furnace RTF version 1.5 (adopted on December 2, 2016) for FAF baseline conditions.

Further, ADM applied California-specific data to the UES values to calculate the final gross evaluated savings values for ductless heat pumps. Specifically, ADM applied the

TRL assumptions regarding California-specific population distribution and the conversion from RTF climate zone to California-specific climate zone, which is based on specific heating degree days for both the Klamath and Mount Shasta regions. Additionally, ADM proportionately applied the baseline condition assumption from the prior program evaluation cycle that approximately 72% of participants used zonal heating systems and 28% used electric FAF prior to installing ductless heat pumps.³ ADM also held constant the ex-ante ratio for single-head to multi-head ductless heat pump UES values because the RTF values do not specifically consider multi-head ductless heat pumps. The resulting gross evaluated UES savings value is 3,493 kWh/yr for single-head ductless heat pumps in California and 4,715 kWh/yr for multi-head ductless heat pumps in California, and result in the realization rates shows in Table 3-23.

For the heat pump conversion and heat pump upgrade HVAC measures, ADM also conducted a deemed savings review of the TRL files provided and the supporting RTF files. For these heat pump measures, ADM concludes that the UES values in the TRL are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values as they are based off the more recently adopted RTF versions prior to the program years.

3.2.3.4 *Evaluated Net Savings*

The HVAC measure NTG values for 2017 and 2018 used in this evaluation are sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. For measures in which there is not a specific NTG value calculated in California, the default DEER NTG value is 55%. Table 3-24 shows the NTG values for HVAC measures in 2017 and 2018 and Table 3-25 shows the evaluated net savings and NTG for HVAC measures in 2017 and 2018.

Table 3-24: 2017-2018 HVAC DEER NTG Values

Measure Type	2017 and 2018 DEER NTG
Ductless Heat Pump	55.0%
Heat Pump Conversion	55.0%
Heat Pump Upgrade	55.0%
New Homes Ductless Heat Pump	55.0%
Evaporative Cooler	55.0%
Room Air Conditioner	36.0%

³ Cadmus 2015-2016 Report: California Home Energy Savings Program Evaluation, December 6, 2017, p.52.

Table 3-25: 2017-2018 HVAC Measure Net Evaluation Results

Year	Measure Category	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	Cooling	115	41	36.0%
	Heat Pump	494,391	271,915	55.0%
2018	Cooling	816	307	37.6%
	Heat Pump	514,470	282,959	55.0%
2017-2018 TOTAL		1,009,792	555,222	55.0%

3.2.4 Whole Homes

The following Table 3-26 shows the quantity of whole homes measures installed and the claimed savings in 2017. The whole home measure category represented 2.3% of overall claimed program savings in 2017.

Table 3-26: 2017 Whole Homes Quantities and Claimed Savings

Measure Category	Quantity	Claimed Savings (kWh)
2017 Whole Homes	20	43,808
2017 TOTAL	20	43,808

3.2.4.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 whole homes measure data. In this review, the following activities were performed:

- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source document and calculations

ADM reviewed the one individual whole homes measure in 2017. ADM verified that the UES value claimed by Pacific Power was supported by the applicable TRL document. Further, ADM verified that the total claimed savings for this measure accurately reflected the quantity installed in 2017.

3.2.4.2 Inputs to Savings Calculation

ADM did not survey the whole home measure category program participants separately to calculate an ISR. ADM applied a 100% ISR for the whole homes measure category.

3.2.4.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the whole homes measure claimed savings values in California, including the TRL file provided. ADM reviewed the individual new home whole home performance path measure TRL file and determined that the UES values are site specific and based off of modeling using REM/Design™ version 14.4. The TRL file indicates the baseline case assumptions, including the use of Title 24 Building Energy Efficiency Standards and the efficient case assumptions of 15% and 30% above code. ADM’s review indicates that the assumptions, modeling tools, and UES values in the TRL files for the whole homes measure are within the bounds of reasonable estimates. ADM did not adjust the savings values for the whole homes measure, resulting in a 100% realization rate and the evaluated gross energy savings in 2017 shown in Table 3-27.

Table 3-27: 2017 Evaluated Gross Energy Savings and Realization Rates for Whole Homes Measures

Measure Category	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
2017 Whole Homes	43,808	43,808	100.0%
2017 TOTAL	43,808	43,808	100.0%

3.2.4.4 Evaluated Net Energy Savings

The whole homes measure NTG value for 2017 used in this evaluation are sourced from the CPUC’s DEER database. The NTG value for whole homes measures is 55% and reflects the default DEER NTG value for California measures in which there is not a specific NTG value calculated. Table 3-28 shows the evaluated net savings and NTG for the whole homes measure in 2017.

Table 3-28: 2017 Evaluated Net Energy Savings and NTG for Whole Homes Measures

Measure Category	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
2017 Whole Homes	43,808	24,094	55.0%
2017 TOTAL	43,808	24,094	55.0%

3.2.5 Water Heating

The following Table 3-29 shows the quantity of water heating measures installed and the claimed savings in each year 2017 and 2018. The water heating measure category represented approximately 0.69% of overall claimed program savings in 2017 and 2018.

Table 3-29: 2017-2018 Water Heating Quantities and Claimed Savings

Measure Category	Quantity	Claimed Savings (kWh)
2017 Water Heating	9	14,976
2018 Water Heating	7	5,866
TOTAL	16	20,842

3.2.5.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 and 2018 water heating measure data. In this review, the following activities were performed:

- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source document and calculations

ADM reviewed all four of the individual water heating measures in 2017 and five individual water heating measures in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2017 and 2018.

3.2.5.2 Inputs to Savings Calculation

Due to the low savings attributed to water heating measures, ADM did not survey these program participants separately to calculate an ISR. ADM applied a 100% ISR for the water heating measure category. It is uncommon for participants to not install or remove large water heater purchases.

3.2.5.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the water heating measure claimed savings values in California, including the TRL files provided and the source savings documents, including the Residential Heat Pump Water Heater RTF version 1.2 file. The RTF uses the Simplified Energy Enthalpy Model (SEEM) to simulate water heater energy use for baseline and efficient cases. The TRL and RTF savings values are estimated for two tiers based on minimum Energy Factors of 1.8 for Tier 1 and 2.05-2.30 for Tier 2. ADM concludes that the assumptions and UES values in the TRL files for water heating measures are within the bounds of reasonable estimates and did not adjust the savings

values for water heating measures. Thus, water heating measures had a 100% realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-30.

Table 3-30: 2017-2018 Evaluated Gross Energy Savings and Realization Rates for Water Heating Measures

Measure Category	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
2017 Water Heating Measures	14,976	14,976	100.0%
2018 Water Heating Measures	5,866	5,866	100.0%
2017-2018 TOTAL	20,842	20,842	100.0%

3.2.5.4 Evaluated Net Energy Savings

The water heating measure NTG value for 2017 and 2018 used in this evaluation are sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. The NTG value for water heating measures is 55% and reflects the default DEER NTG value for California measures in which there is not a specific NTG value calculated. Table 3-31 shows the evaluated net savings and NTG values for water heating measures in 2017 and 2018.

Table 3-31: 2017-2018 Net Energy Savings and NTG for Water Heating Measures

Measure Category	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
2017 Water Heating Measures	14,976	8,237	55.0%
2018 Water Heating Measures	5,866	3,226	55.0%
2017-2018 TOTAL	20,842	11,463	55.0%

3.2.6 Building Shell

The building shell measure category included insulation measures across the Program years 2017 and 2018. The following Table 3-32 shows the quantity of building shell measures installed and the claimed savings attributed to the insulation building shell measure in 2017 and 2018. The building shell measure category represented 0.37% of overall claimed program savings in 2017 and 2018.

Table 3-32: 2017-2018 Building Shell Measure Quantities and Claimed Savings

Measure Type	2017 Quantity (sq. ft.)	2017 Claimed Savings (kWh)	2018 Quantity (sq. ft.)	2018 Claimed Savings (kWh)
Insulation	8,855	4,768	5,862	6,556
TOTAL	8,855	4,768	5,862	6,556

3.2.6.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 and 2018 building shell measure data. In this review, the following activities were performed:

- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source documents and calculations

ADM reviewed each of the three individual building shell measures incentivized in 2017 and the three individual building shell measures incentivized in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2017 and 2018.

3.2.6.2 Inputs to Savings Calculation

Due to the low savings attributed to building shell measures, ADM did not survey these program participants separately to calculate an ISR. ADM applied a 100% ISR for the building shell measure category.

3.2.6.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the building shell measure claimed savings values in California, including the TRL files provided and the source savings documents. ADM’s review included an analysis of the baseline and efficient case conditions for each insulation building shell measure. For attic insulation, the baseline is variable depending on the home vintage and the efficient case is either installing R-19 or R-30 insulation to achieve Title 24 requirements of R-38 or higher. For wall insulation, the baseline is no insulation and the efficient case is R-13 insulation. ADM concludes that the baseline and efficient case assumptions and the UES values in the TRL files for building shell measures are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values for building shell measures. Thus, building shell measures had a 100%

realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-33.

Table 3-33: 2017-2018 Evaluated Gross Energy Savings and Realization Rates for Building Shell Measures

Measure	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017 Insulation	4,768	4,768	100.0%
2018 Insulation	6,556	6,556	100.0%
2017-2018 TOTAL	11,324	11,324	100.0%

3.2.6.4 Evaluated Net Energy Savings

The building shell measure NTG values for 2017 and 2018 used in this evaluation are sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. The DEER NTG value for building shell measures is 28.0% in both 2017 and 2018. Table 3-34 shows the evaluated net savings and NTG values for building shell measures in 2017 and 2018.

Table 3-34: 2017-2018 Net Energy Savings and NTG for Building Shell Measures

Measure	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017 Insulation	4,768	1,335	28.0%
2018 Insulation	6,556	1,836	28.0%
2017-2018 TOTAL	11,324	3,171	28.0%

3.2.7 Appliances

The appliance measure category included clothes washers and refrigerators (2017 only) measures across the Program years 2017 and 2018. The following Table 3-35 shows the quantity of appliance measures installed and the claimed savings attributed to each appliance measure in 2017 and 2018. The appliance measure category represented 0.24% of overall claimed program savings in 2017 and 2018.

Table 3-35: 2017-2018 Appliance Measure Quantities and Total Claimed Savings

Measure Type	2017 Quantity	2017 Claimed Savings (kWh)	2018 Quantity	2018 Claimed Savings (kWh)
Clothes Washers	43	5,546	11	1,508
Refrigerators	1	117	-	-
TOTAL	44	5,663	11	1,508

3.2.7.1 Database Review

ADM conducted an ex-ante review of the Program’s 2017 and 2018 appliances measure data. In this review, the following activities were performed:

- Verification of measure incentive requirements for a sample of appliances (e.g. model numbers)
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL source documents and calculations

ADM reviewed each of the four individual appliance measures incentivized in 2017 and the three individual appliance measures incentivized in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2017 and 2018.

3.2.7.2 Inputs to Savings Calculation

Due to the low savings attributed to appliance measures, ADM did not survey these program participants separately to calculate an ISR. ADM applied a 100% ISR for the appliance measure category. It is uncommon for participants to not install or remove large appliance purchases.

3.2.7.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the appliance measure claimed savings values in California, including the TRL files provided and the Clothes Washer RTF version 4.0 file. ADM reviewed the baseline Modified Energy Factor (MEF) of 2.3, which is a weighted value from the CEC database and the efficient case requirement of an MEF of 3.2 or higher. ADM also benchmarked the RTF assumption of an average of 257 laundry cycles a year to the average of 216 laundry cycles a year acquired from the General

Population Survey. Although the RTF assumption is approximately 15% greater than the results of the General Population Survey, ADM concludes that the UES values in the TRL files for appliance measures are within the bounds of reasonable estimates and did not adjust the savings values for appliance measures. Thus, the appliance measures had a 100% realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-36.

Table 3-36: 2017-2018 Evaluated Gross Energy Savings and Realization Rates for Appliance Measures

Year	Measure	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	Clothes Washers	1,508	1,508	100.0%
	Refrigerators	5,546	5,546	100.0%
2018	Clothes Washers	117	117	100.0%
2017-2018 TOTAL		35,857	7,171	7,171

3.2.7.4 Evaluated Net Energy Savings

The appliance measure NTG value for 2017 and 2018 used in this evaluation are sourced from the CPUC’s DEER database. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. The DEER NTG value for clothes washer measures is 31.0% in both 2017 and 2018. The NTG value for the refrigerator measure is 55% and reflects the default DEER NTG value for California measures in which there is not a specific NTG value calculated. Table 3-37 shows the evaluated net savings and NTG values for appliance measures in 2017 and 2018.

Table 3-37: 2017-2018 Appliance Measure Net Savings and NTG

Year	Measure	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	Clothes Washers	1,508	1,719	31.0%
	Refrigerators	5,546	64	55.0%
2018	Clothes Washers	117	467	31.0%
2017-2018 TOTAL		7,171	2,251	31.4%

4 Process Evaluation

This chapter presents the findings of the process evaluation for the California Home Energy Savings Program. ADM's process evaluation included a review of the program materials, in-depth interviews with program staff, and general population and participant surveys.

4.1 Review of Program Materials and In-depth Interviews with Program Staff

4.1.1 Roles and Responsibilities

ADM evaluators interviewed program staff from Pacific Power, which included the Home Energy Savings program manager. The Home Energy Savings program manager is responsible for overseeing the program in California and Washington, which includes assessing cost effectiveness of the program, regulatory recovery, review and approving marketing campaigns, program participation and procedures, and design and implementation of procedures. The Evaluators also spoke with a program manager from CLEAResult. The program manager's responsibilities included implementation, contract management, client management, and overseeing day-to-day operations.

4.1.2 Program Design and Goals

The overall program savings goal for the Home Energy Savings Program is set at the state level in California. The delivery contract has separate targets for lighting, non-lighting, and kits. There is an adaptive management component built into the administration of the contract. Pacific Power staff indicated that they request that the implementation contractor assess the market and then develop the forecast based on that assessment. There is some flexibility for the state level goals (i.e., if one measure is overperforming, then a measure that is underperforming will be shifted). The contract budget is structured around the savings targets (kits, lighting, and non-lighting) and is not measure-specific.

In California, the goals and budgets for the programs changed midway through 2017. In addition, CLEAResult staff stated they were asked by Pacific Power, for 2018, to not actively pursue savings in California and to rely on organic growth, which changed the goals and budgets for that year as well. There is a concern about the cost effectiveness of running the program in California.

The following key findings are related to the Home Energy Savings Program performance and changes to the program:

- In 2018, savings achieved in California were a result of organic implementation and what naturally came in without active marketing and/or outreach.
- The program has not had significant design changes since 2014. In 2017, Pacific Power focused primarily on the application to extend the program through 2020. Program staff produced an application which proposed to establish targets to run the programs through 2020 while still being cost effective. Staff examined their measure list, worked with the implementer, and anticipated changes they would make. The changes (dropped measures and reduced incentives) were not made in 2017 or 2018 but will be implemented in 2019. It took about a year to receive final approval to run the programs through 2020.
- The implementation contract for CLEARResult ended March 31, 2019 and Nexant will be taking over program implementation.

The following key findings are related to Home Energy Savings Program participation:

- In both program years, there was a decline in the amount of participation in lighting – as the filing update was prepared, the number of qualified products was reduced. There was a reduction in the incentives offered to keep the program cost-effective. Pacific Power and CLEARResult both discussed the challenges for lighting measures in future program years.
- CLEARResult staff indicated that there was an increase in participation in whole homes measures in 2017.
- CLEARResult staff indicated they worked with trade allies in the territory to push for an increase in participation in ductless heat pumps.

4.1.3 Tracking and Reporting

Pacific Power tracks program activity for the Home Energy Savings Program, including the following data indicators:

- Non-lighting measures are captured through customer application (e.g. account number, address);
- Builder and/or contractor information;
- Technical requirements (appliance specifications);
- Lighting sales data (weekly or monthly) from retailers.

Pacific Power staff indicated that they are collecting all the necessary information and that the information is kept current enough to effectively manage the program. No

significant improvements were suggested. One staff member stated they would like to collect email addresses from customers.

4.1.4 Communication

Pacific Power staff has formal weekly meetings with implementation staff. In addition, there are quarterly meetings and ad hoc communication. Weekly meeting topics include program status and performance, long-term strategy, day-to-day tactical decisions, and marketing activities. There were no concerns raised about the current level of communication. One implementation staff noted it would be beneficial to have an internal messaging capability, such as instant messenger.

4.1.5 Marketing and Outreach

There were no active marketing campaigns in California in 2018. There are no planned changes to the marketing approach for the upcoming program year.

Trade allies can play an active role in program outreach. In 2017, there was collaboration with local contractors to do newspaper advertising to incentivize heat pumps in the California territory.

4.2 General Population Survey Results

This section presents key findings from surveys administered online by ADM Associates from April to May 2019 completed by 229 Pacific Power customers in California State. The surveys gathered information regarding these customers' energy efficient lighting purchases, incentive program awareness, measures installed and in-service rates, decision making and satisfaction. Survey efforts were designed to collect data for both the process evaluation and impact analyses.

4.2.1 Respondent LED Purchases

Survey respondents were surveyed on multiple aspects of their LED purchases. Approximately 84% of survey respondents indicated that they or someone in their household purchased LED light bulbs in 2017 or 2018 and approximately 30% of respondents indicated that they or a member of their household purchased an LED fixture in 2017 or 2018. The remaining respondents (14%) reported that no one in their household purchased LED light bulbs or LED fixtures in 2017 or 2018 or they did not recall whether a purchase had been made.

Approximately half of survey respondents (54%) reported making their LED lighting purchase from Home Depot. Approximately 42% of respondents reported purchasing their LED lighting at Walmart. Ace and Costco were also popular retailers among survey participants. Table 4-1 summarizes which retailers survey respondents reported purchasing LED lighting from in 2017 or 2018.

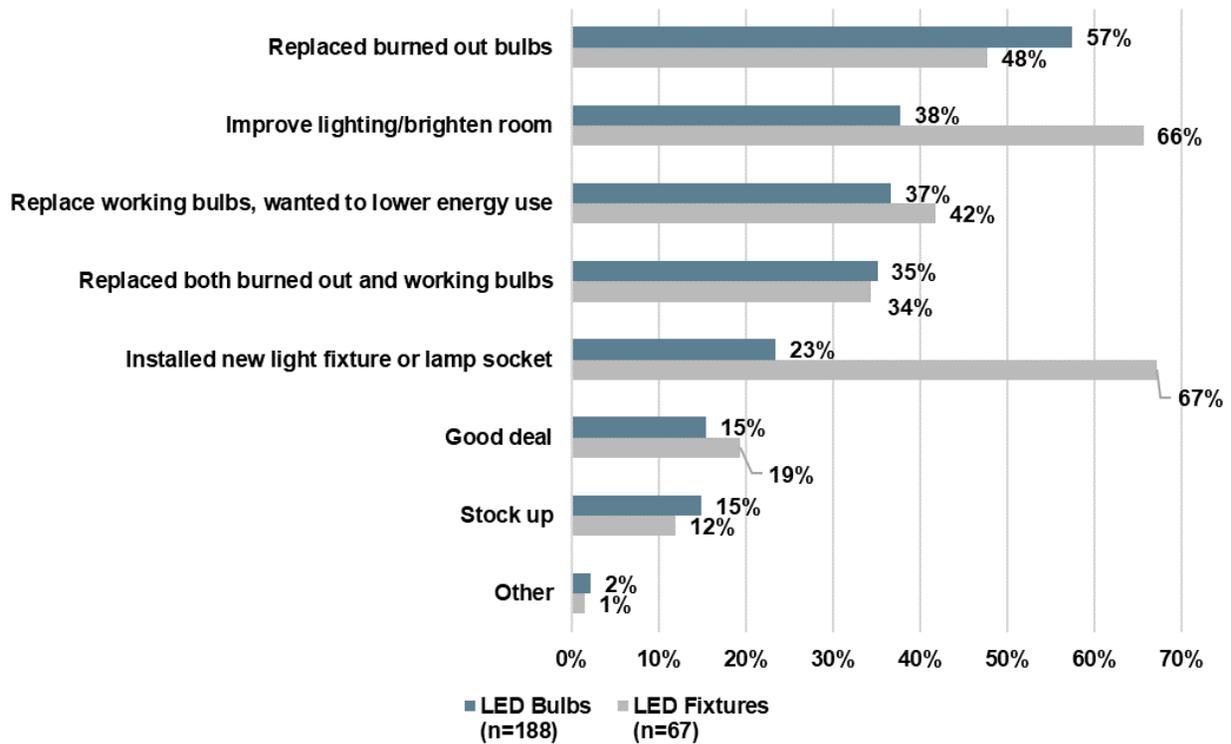
Table 4-1: Where did respondents purchase LED lighting?

From which of the following retail stores did you purchase your LED lighting?	Response	Percent of Responses (n = 195)
	The Home Depot	54%
	Walmart	42%
	Ace Hardware	31%
	Costco	20%
	Lowe's	13%
	Target	3%
	Batteries Plus	1%
	Other	19%
	I do not recall	2%

Note: The sum of percentages may not be 100% because respondents could choose more than one response.

Respondents provided information regarding their decision to purchase an LED bulb or fixture. Figure 4-1 summarizes survey respondents' reported reasons for purchasing LED lighting in 2017 or 2018. The most common reasons to replace LED bulbs were to replace burned out bulbs (57%), to improve lighting in a room (38%), and to lower energy use (37%). The most common reasons to replace LED fixtures were to install a new light fixture (67%), improve lighting in a room (66%), and to replace burned out bulbs (48%).

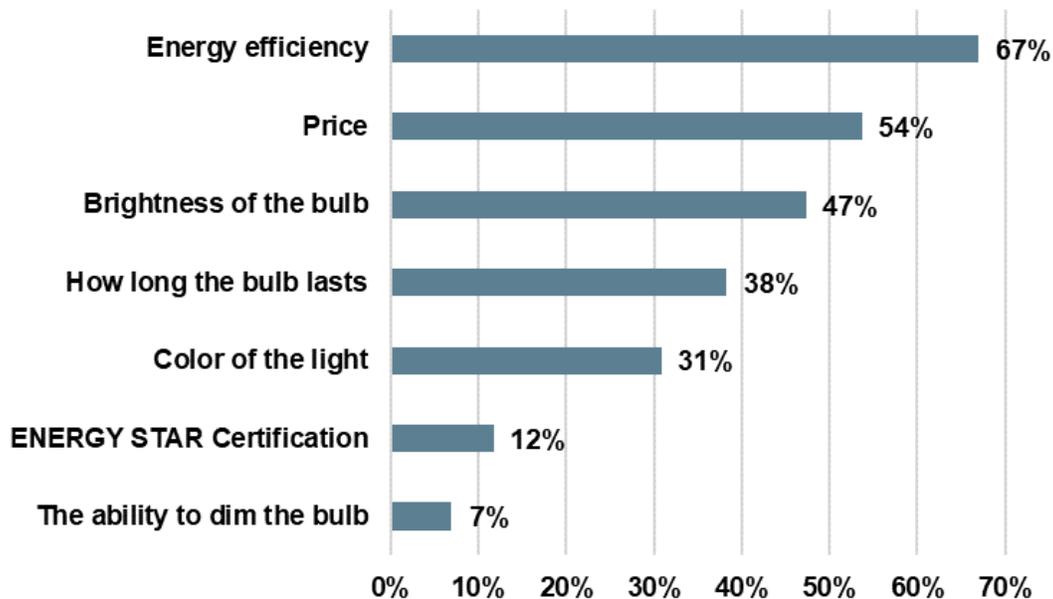
Figure 4-1: Why did respondents purchase LED Bulbs or LED Fixtures?



Note: The sum of percentages is not 100% because respondents could choose more than one response.

Respondents reported the most important characteristics they consider when they purchase light bulbs. About two-thirds of respondents reported that energy efficiency (67%) was an important characteristic. A significant portion of respondents also indicated that price (54%), brightness of the bulb (47%), and the length of the bulb’s life (38%) are important characteristics in their decision to purchase a bulb. Figure 4-2 shows the reasons survey respondents indicated were important when they purchased new light bulbs.

Figure 4-2: What are the most important characteristics when purchasing light bulbs?



n = 188

Note: The sum of percentages is not 100% because respondents could choose more than one response.

Respondents were surveyed on what kinds of bulbs and fixtures their new LED lighting was replacing. Approximately 44% of survey respondents indicated that at least one of the new LED bulbs they purchased was bought to replace a traditional incandescent bulb and approximately 33% of respondents reported that at least one of the new LED fixtures they purchased was bought to replace a traditional incandescent bulb or fixture. Approximately 17% of respondents were replacing an LED bulb with new LED bulbs.

4.2.2 Respondent Awareness of Incentives

ADM asked survey respondents about LED pricing and whether they recalled whether their LED bulb or LED fixture purchase was discounted. Most respondents reported that they did not recall whether the LED bulbs (78%) or LED fixtures (82%) they purchased were discounted and were not aware of any utility sponsored discount available for LED bulbs or fixtures (84%).

4.2.3 Respondent Satisfaction

ADM asked survey respondents who were aware of the lighting program about their satisfaction with different aspects of the incentive program and with their utility provider overall. Approximately 32% reported they were either very satisfied (7%) or satisfied (25%) with the incentive program overall. Most respondents (72%) were either very

satisfied (31%) or satisfied (41%) with the quality of the product purchased. Approximately 38% of respondents indicated they were very satisfied (14%) or satisfied (24%) with the savings on electricity bills since installing the incentivized lighting. Respondents reported high levels of overall satisfaction with Pacific Power. Approximately 79% of respondents reported being very satisfied (34%) or satisfied (45%) with Pacific Power, while only four percent reported being dissatisfied or very dissatisfied.

4.2.4 Respondent Home Characteristics

ADM gathered information from respondents regarding their home characteristics which is summarized in Table 4-2. Approximately 64% of respondents report living in single-family detached homes. The majority (75%) of respondents indicated that they owned their home. Respondents' reported approximate household income was roughly even across the possible survey response options. The majority of respondents reported that electricity was their primary fuel for home heating (61%), and water heating purposes (75%). The typical number of residents in respondents' homes were 2.7 (average) and 2 (median). Survey respondents reported their square footage of the home was on average about 1,844 square feet, and the median was 1,750 square feet.

Table 4-2: General Population Home Characteristics

Home Characteristics	Percentage of Respondents
Single Family, detached from any other house	70%
Single Family Home, factory manufactured/modular	13%
Single Family Home, mobile home	5%
Apartment in a building with 4 or more units	5%
Apartment in building with 2 to 3 units	2%
Single-family house attached to one or more other houses (e.g. duplex, row	2%
Other	1%
I prefer not to answer	1%
Own or Rent	
Own	75%
Rent	25%
Year Built	
Before 1950	16%
1950 to 1959	7%
1960 to 1969	7%
1970 to 1979	13%
1980 to 1989	18%
1990 to 1999	11%
2000 to 2009	16%
2010 to 2018	2%
Don't know	9%

Home Characteristics	Percentage of Respondents
What is the main fuel used for heating your home?	
Electricity	46%
Propane	9%
Natural Gas	<1%
Other	44%
What fuel does your main water heater use?	
Electricity	80%
Natural Gas	1%
Propane	11%
Other	7%
Don't know	1%
What is your approximate household income?	
Less than \$10,000	7%
\$10,000 to \$29,999	17%
\$30,000 to \$49,999	22%
\$50,000 to \$69,999	17%
\$70,000 to \$89,999	11%
\$90,000 to \$99,999	5%
\$100,000 to \$149,999	11%
\$150,000 or more	3%
Don't know	7%

4.3 Energy Kits Participant Survey Results

This section presents key findings from energy kit surveys, which were administered online by ADM. The surveys were completed by 109 customers who received energy kits in 2017 or 2018. Of these respondents, five reported that they had not received an energy kit or did not recall receiving an energy kit. The survey gathered information regarding program awareness, measures installed and in-service rates, decision making and overall satisfaction.

4.3.1 Program Awareness

Participants provided information and feedback regarding how they learned about the energy kits and their experience enrolling in the program. Over half of respondents reported hearing about the program through either a Pacific Power utility bill insert (51%). Approximately 20% of respondents reported learning about the program from Pacific Power's website while another ten percent of respondents reported that they learned of the program through a message printed on their bill. A summary of survey responses appears in Table 4-3.

Table 4-3: How did respondents learn about the program?

How did you hear about these kits?	Percent of Responses (n = 97)
Pacific Power bill insert	51%
Pacific Power Website	20%
Message printed on your bill	10%
Pacific Power newsletter	7%
Word of mouth (friend, relative, coworker, etc.)	4%
Newspaper/magazine/print media	2%
Pacific Power representative	2%
Contractor or plumber	1%
Other	1%
Don't know	13%

Note: The sum of percentages is not 100% because respondents could choose more than one response

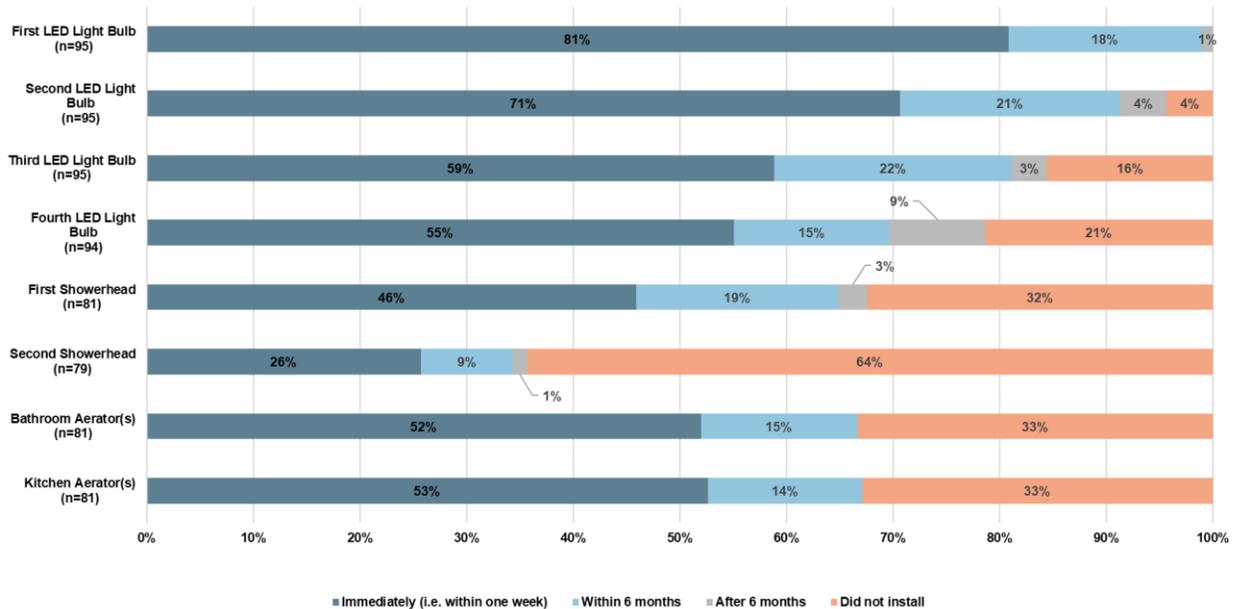
4.3.2 Participant Experience and Installation of Measures

Survey respondents provided feedback regarding installing the energy kit components. To verify the contents of each survey respondents' energy kit, respondents indicated if their home had an electric water heat. Next, according to their response, they indicated if and when they had installed the various energy kit measures. Most respondents reported installing the first LED light bulb (81%), second LED light bulb (71%), third LED light bulb (59%) or fourth LED light bulb (55%) immediately (within one week). Respondents next reported installing the first LED light bulb (18%), second LED light bulb (21%), third LED light bulb (22%) or fourth LED light bulb (15%) within six months. No survey respondents reported that they had not installed their first LED light bulb and only four percent of respondents reported that they had not installed their second LED light bulb. A larger portion of respondents reported that the third (16%) and fourth (21%) LED bulbs they received were not installed.

Regarding the first high efficiency showerhead, approximately 46% of respondents reported installing it immediately and 19% within six months. Approximately 26% of survey respondents that were asked about a second high efficiency showerhead reported installing it immediately and nine percent within six months. Approximately 32% of respondents reported that the first showerhead had not been installed and 64% for the second showerhead.

Regarding aerators, approximately 52% of respondents reported installing the bathroom aerator immediately and 15% within six months. Approximately 53% reported installing the kitchen aerator immediately and 14% within six months. Approximately 33% of respondents reported that they had not installed their bathroom aerator and the same for kitchen aerators. Figure 4-3 displays respondents' timeline for installing various energy kit measures.

Figure 4-3: Respondent Timeline for Installing Energy Kit Measures



Energy kit recipients who reported that they had not installed certain measures provided the reasons that these measures were not installed. See Table 4-4 for complete results. Of the respondents who reported they did not install one or more of the LED bulbs from the energy kit, 75% indicated they were waiting for their current lights to burn out. Approximately four percent of respondents reported that the LED bulbs were not the correct wattage and approximately four percent reported that the LED bulbs did not fit into their fixtures. Regarding high efficiency showerheads that were not installed, the most frequently cited specific reason was the respondent disliked the pressure/water volume (25%). Other frequently cited specific reasons for not installing the showerheads were that the respondent already had high efficiency showerheads installed throughout their house (22%) and that the showerheads found in the kit did not integrate well with their home’s plumbing (15%). Of the respondents who reported having uninstalled faucet aerators, two prominent reasons emerged. One was that they already had faucet aerators installed in all of their sinks (37%) and the other was that the faucet aerators did not integrate well with their plumbing (26%).

Table 4-4: Reasons for not Installing Energy Kit Components

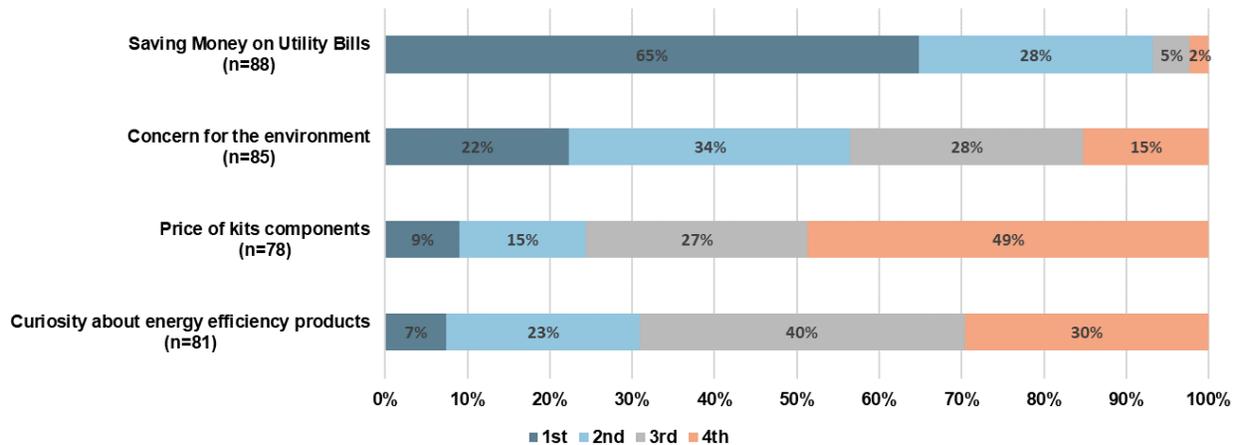
Reason for not installing measure	Percentage of Responses
LEDs (n = 24)	
Waiting for current lights to burn out	75%
Not the correct wattage	4%
Did not fit into my fixtures	4%
Other	13%
Don't know	8%
Showerheads (n = 55)	
Disliked the pressure/water volume	25%
High-efficiency shower-heads already installed in all showers	22%
Did not integrate well with current plumbing	15%
Disliked the way it looked	13%
Other	35%
Don't know	5%
Faucet Aerators (n = 35)	
Faucet aerators already installed in all sinks	37%
Did not integrate well with current plumbing	26%
Disliked the pressure/water volume	11%
Misplaced	9%
Disliked the way it looked	3%
Other	17%
Don't know	6%

Note: The sum of percentages is not 100% because respondents could choose more than one response

4.3.3 Participant Motivations

Respondents provided feedback regarding what influenced them to request the energy kit. Approximately 65% of respondents ranked “saving money on utility bills” as their strongest motivation to request a kit, while a further 28% ranked it as their second strongest motivation. Another finding from the survey is that respondents are motivated to request energy kits due to having concerns about the environment. Approximately 56% of respondents ranked this motivation as being first (22%) or second (34%) most important to them. Figure 4-4 displays respondents’ ranking of different reasons for requesting an energy kit.

Figure 4-4: Survey Respondents' Ranking of Reasons for Requesting an Energy Kit



Most respondents indicated that they did not have plans to purchase and install aerators or high-efficiency showerheads before participating in the program, but most respondents did plan to purchase and install LED bulbs. A summary of participant responses as to whether they were already planning on purchasing energy kit components appears in Table 4-5.

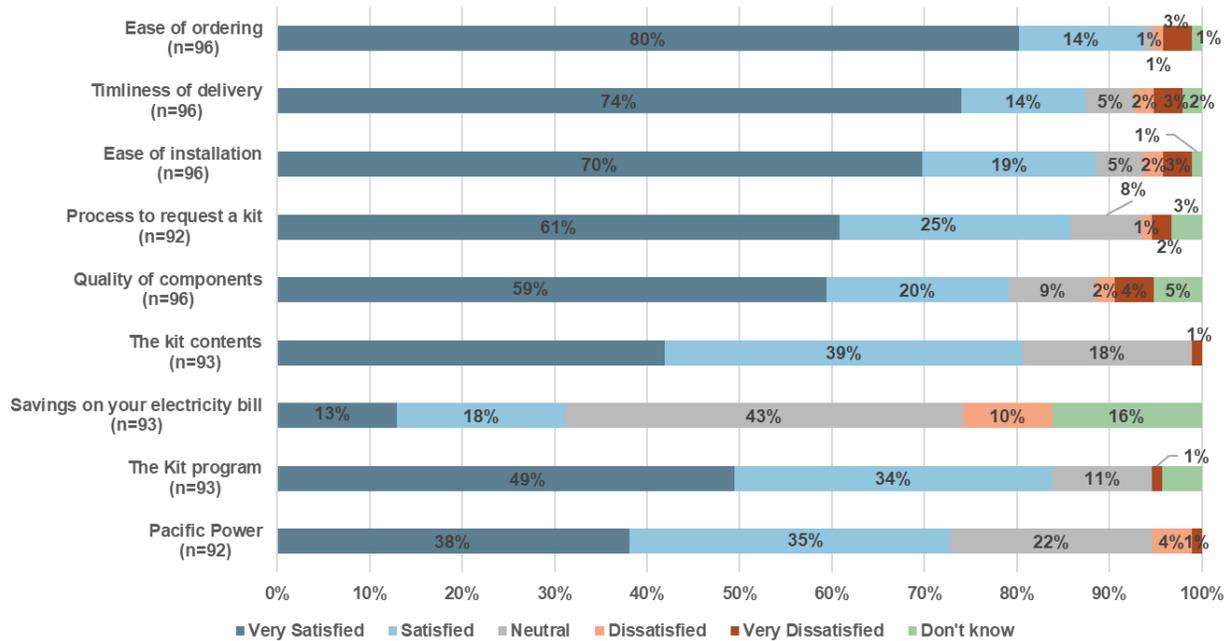
Table 4-5: Were Respondents Already Planning on Purchasing Energy Kit Components?

Before you learned that the Kits were available, were you planning to purchase and install the following energy efficient measures?	Measure	Yes	No	Don't Know
	Faucet Aerator(s)	14%	77%	9%
	Showerhead(s)	29%	66%	5%
	LED Light Bulbs	87%	12%	1%

4.3.4 Participant Satisfaction

Respondents provided feedback regarding their level of satisfaction with specific aspects of the program, as well as their overall experience with the program. Respondents found that the most satisfying aspects (i.e. either satisfied or very satisfied) of the program were the ease of ordering (94%), timeliness of delivery (88%) the ease of installation (89%), and the process to request a kit (86%). Overall satisfaction with the program was 84%, and overall satisfaction with Pacific Power was 73%. Figure 4-5 displays survey respondents' satisfaction with the program as well as their satisfaction with specific aspects of their experience with the program.

Figure 4-5: Customer Satisfaction with Energy Kit Program



4.3.5 Home Characteristics

Respondents’ home characteristics are summarized in Table 4-6. Respondents most often reported living in single-family, detached homes (77%) and most often owned their home (85%). The decade in which respondents’ homes were built are spread fairly evenly across each time interval included in the survey, with the largest segments of respondents’ homes being built between 2000 and 2009 (21%) or 1970 to 1979 (18%) . Approximately 45% of respondents reported having an approximate household income of \$69,999 or less. Approximately 57% of respondents indicated natural gas is their primary home heating fuel and 48% indicated electricity is their primary water heating fuel. The average home size was approximately two people. Survey respondents reported their square footage of the home was on average about 1,674 square feet.

Table 4-6: Energy Kit Participants Home Characteristics

Home Characteristics	Percentage of Respondents
Single Family, detached from any other house	77%
Single Family, factory manufactured/modular	11%
Single Family, mobile home	6%
Apartment in building with 2 to 3 units	2%
Apartment in a building with 4 or more units	2%
Single Family attached to one or more other houses	1%
Own or Rent	
Own	85%
Rent	15%
Year Built	
Before 1950	12%
1950 to 1959	13%
1960 to 1969	8%
1970 to 1979	18%
1980 to 1989	11%
1990 to 1999	9%
2000 to 2009	21%
2010 to 2018	2%
Don't know	5%
What is the main fuel used for heating your home?	
Natural Gas	57%
Electricity	32%
Propane	11%
What fuel does your main water heater use?	
Electricity	48%
Natural Gas	45%
Propane	7%
What is your approximate household income?	
Less than \$10,000	1%
\$10,000 to \$29,999	12%
\$30,000 to \$49,999	16%
\$50,000 to \$69,999	16%
\$70,000 to \$89,999	16%
\$90,000 to \$99,999	7%
\$100,000 to \$149,999	13%
\$150,000 or more	7%
Don't know	13%

4.4 HVAC Participant Survey Results

This section presents key findings from HVAC program surveys administered online by ADM, completed by 41 respondents who reported receiving an incentive for HVAC measures in 2017 or 2018 through Pacific Power's Home Energy Savings Program. The

survey gathered information regarding program awareness, decision making and overall satisfaction.

4.4.1 Program Awareness

Respondents provided information regarding how they first learned about the incentive program as well as sources of information they utilized while they were making the decision to purchase the HVAC equipment. Approximately 16% of survey respondents reported that they learned of the program via word-of-mouth referrals, such as from friends, neighbors, relatives or colleagues. Another 16% reported that they learned about it from a retailer or store. Table 4-7 summarizes how survey respondents first learned about the program.

Table 4-7: How did respondents first learn about the program?

How did you first learn about the Program?	Percent of Responses (n = 32)
Friend, neighbor, relative, or colleague	16%
Retailer/store	16%
Pacific Power representative	13%
Internet advertisement	13%
Bill inserts	6%
Newspaper/magazine/print media	3%
Message printed on your bill	3%
Program website	3%
Other	3%
I don't know	26%

Regarding where respondents found information about the HVAC incentives offered by Pacific Power when they were deciding to implement the energy saving equipment, most respondents (52%) learned about incentives from an installation contractor. Approximately 19% of respondents learned about incentives from a retailer. A summary of responses to this question appears in Table 4-8.

Table 4-8: How did respondents get information about the incentive?

When you were deciding to implement the energy saving equipment, from where did you get information about the incentives offered by Pacific Power?	Percent of responses (n=28)
Installation contractor	52%
Retailer	19%
Pacific Power representative	7%
Friend, neighbor, relative or colleague	4%
Program website	4%
Did not look for any information	4%
I don't know	15%

Note: Totals can exceed 100% because respondents could select more than one response.

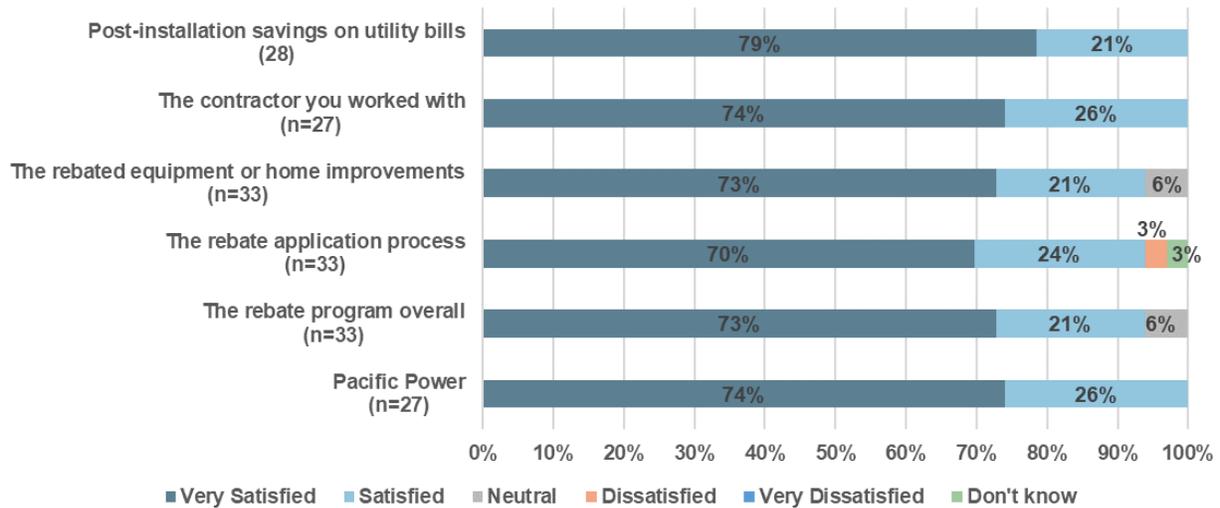
4.4.2 Participant Motivation

Survey respondents provided feedback regarding their decision-making process. Approximately 85% of respondents who received an HVAC incentive already had plans to install the HVAC measure prior to learning about the program. Respondents reported that the incentive was important or extremely important in driving their decision to install the HVAC measure 63% of the time.

4.4.3 Participant Satisfaction

Survey respondents provided feedback regarding their level of satisfaction with specific aspects of Pacific Power’s Home Energy Savings Program as well as the program overall. Respondents were satisfied or very satisfied with all aspects of the program. Satisfaction was highest with respect to respondents’ savings on utility bills, with 98% of respondents reporting to be satisfied or very satisfied. Approximately 89% of respondents reported being satisfied or very satisfied with the program and 92% of respondents reported being satisfied or very satisfied with Pacific Power overall. Only one percent of respondents reported being dissatisfied or very dissatisfied with Pacific Power. Figure 4-6 displays survey respondents’ overall satisfaction with Pacific Power and the Home Energy Savings Program, as well as their satisfaction with specific aspects of their experience with the program.

Figure 4-6: Customer Satisfaction with Pacific Power’s HVAC and Appliance Incentive Program



4.4.4 Home Characteristics

Respondents’ home characteristics are summarized in Table 4-9. All respondents reported living in a single-family home, and almost all of them (98%) reported owning their home. Electricity was the most common type of fuel used for heating homes (97%) and for fueling the homes’ main water heaters (97%). Most respondents (59%) reported living in a home built before 1980. The average size of respondents’ homes was 1,729 square feet, and the average number of inhabitants was slightly over two people.

Table 4-9: HVAC Participant Home Characteristics

Home Characteristics	Percentage of Respondents (n=32)
Single Family, detached from any other house	78%
Single Family, factory manufactured/modular	19%
Single Family, mobile home	3%
Own or Rent	
Own	93%
Rent	7%
Year Built	
Before 1950	16%
1950 to 1959	25%
1960 to 1969	3%
1970 to 1979	9%
1980 to 1989	6%
1990 to 1999	16%
2000 to 2009	9%
2010 to 2018	6%
Don't know	9%
What is the main fuel used for heating your home?	
Electricity	91%
Natural Gas	6%
Other/Don't Know	3%
What fuel does your main water heater use?	
Electricity	88%
Natural Gas	3%
Propane	3%
Other	3%
Don't know	1%
What is your approximate household income?	
Less than \$10,000	2%
\$10,000 to \$29,999	2%
\$30,000 to \$49,999	5%
\$50,000 to \$69,999	0%
\$70,000 to \$89,999	5%
\$90,000 to \$99,999	2%
\$100,000 to \$149,999	5%
\$150,000 or more	5%
Don't know/prefer not to answer	75%

5 Cost-Effectiveness

Pacific Power contracted with Navigant to calculate the Program cost-effectiveness based on gross savings evaluated by ADM and NTG values mainly sourced from the CPUC's DEER database. ADM sourced the NTG values for this evaluation mostly from the CPUC's DEER database for 2017 and 2018. The 2018 NTG values from DEER were prescribed to PacifiCorp to use in a CPUC Administrative Law Judge (ALJ) ruling. For measures in which there is not a specific NTG value calculated in California, the default DEER NTG value is 55%. For the energy kits measure, ADM used the NTG value from ADM's evaluation of Pacific Power's Washington service territory, because based on ADM's benchmarking and prior evaluations this NTG value is more appropriate to use than the default DEER value. ADM also provided the measure life and incremental cost inputs needed to calculate the cost-effectiveness of the Program. Measure life and incremental cost values were assigned on an individual measure basis and came from the TRL files or other information provided by Pacific Power. For the lighting measure category in 2017 and the beginning part of 2018 (prior to a lighting TRL update), Pacific Power used a reported measure cost from the program implementer combined with the incentive cost to determine incremental costs. ADM reviewed the methodology and the cost documentation provided by Pacific Power and the program implementer and finds that the incremental cost numbers under Pacific Power's approach in 2017 are reasonable and more representative of the costs of the measure during that time period than the TRL incremental cost values before being updated in 2018.

Table 5-1 provides the cost-effectiveness analysis inputs for each year, including net energy savings, discount rate, residential line loss, residential energy rate, inflation rate, and total program costs (based on the UCT).

Table 5-1: CA Home Energy Savings Program Cost-Effectiveness Inputs

Parameter	2017	2018
Net Savings (kWh/year)	1,153,937	666,786
Discount Rate	6.66%	6.57%
Residential Line Loss	11.43%	11.43%
Residential Energy Rate (\$/kWh)	\$0.1386	\$0.1319
Inflation Rate	1.90%	2.20%
Total Program Costs	\$836,253	\$602,654

Table 5-2 shows the cost-effectiveness results for the overall program for the combination of program years 2017 and 2018, based on gross savings evaluated by ADM and NTG values mainly sourced from the California Public Utilities Commission's (CPUC's) DEER database. The California Home Energy Savings Program passes the cost-effectiveness

for the UCT and the PCT during the combined 2017-2018 evaluation period. The overall Program achieved a 1.06 benefit/cost ratio for the combined years using the UCT.

Table 5-2: 2017-2018 CA Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0965	\$1,728,876	\$1,710,181	-\$18,695	0.99
Total Resource Cost Test (TRC) No Adder	\$0.0965	\$1,728,876	\$1,554,710	-\$174,166	0.90
Utility Cost Test (UCT)	\$0.0804	\$1,438,906	\$1,554,710	\$115,804	1.08
Rate Impact Test (RIM)		\$4,052,526	\$1,554,710	-\$2,497,816	0.38
Participant Cost Test (PCT)		\$1,507,554	\$4,709,531	\$3,201,977	3.12
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000129713				
Discounted Participant Payback (years)	4.02				

Table 5-3 shows the California Home Energy Savings Program cost-effectiveness results for 2017 and Table 5-4 shows cost-effectiveness results for 2018, based on gross savings evaluated by ADM and NTG values mainly sourced from the CPUC’s DEER database. The Program passes the cost-effectiveness for the UCT and the PCT during each individual program year 2017 and 2018. The overall Program achieved a 1.0 benefit/cost ratio for the 2017 program year and a 1.13 benefit/cost ratio for the 2018 program year using the UCT.

Table 5-3: 2017 CA Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0873	\$974,050	\$949,209	-\$24,841	0.97
Total Resource Cost Test (TRC) No Adder	\$0.0873	\$974,050	\$862,917	-\$111,132	0.89
Utility Cost Test (UCT)	\$0.0749	\$836,253	\$862,917	\$26,665	1.03
Rate Impact Test (RIM)		\$2,496,027	\$862,917	-\$1,633,110	0.35
Participant Cost Test (PCT)		\$835,154	\$2,822,368	\$1,987,214	3.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000161297				
Discounted Participant Payback (years)	3.23				

Table 5-4: CA 2018 Home Energy Savings Program Level Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1119	\$754,826	\$760,972	\$6,146	1.01
Total Resource Cost Test (TRC) No Adder	\$0.1119	\$754,826	\$691,793	-\$63,034	0.92
Utility Cost Test (UCT)	\$0.0894	\$602,654	\$691,793	\$89,139	1.15
Rate Impact Test (RIM)		\$1,556,499	\$691,793	-\$864,706	0.44
Participant Cost Test (PCT)		\$672,400	\$1,887,163	\$1,214,763	2.81
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000094694				
Discounted Participant Payback (years)	5.45				

Table 5-5 presents the benefit/cost ratio results for the Program for each cost-effectiveness test by program year.

Table 5-5: California Home Energy Savings Program Benefit/Cost Ratios by Program Year

Program Year	PTRC	TRC	UCT	RIM	PCT
2017	0.97	0.89	1.03	0.35	3.38
2018	1.01	0.92	1.15	0.44	2.81
2017-2018	0.99	0.90	1.08	0.38	3.12

Navigant also completed cost-effectiveness tests at the measure-category level for each individual program year. The benefit/cost ratio results by measure-category are presented in Table 5-6 and Table 5-7, based on gross savings evaluated by ADM and NTG values mainly sourced from the CPUC’s DEER database.

Table 5-6: California Home Energy Savings Program Benefit/Cost Ratios by Measure Category, 2017

Measure Group	PTRC	TRC	UCT	RIM	PCT
Appliances	0.22	0.20	0.22	0.15	1.18
Building Shell	0.39	0.36	0.30	0.20	2.67
Energy Kits - DHW	4.26	3.88	3.84	0.43	44.85
Energy Kits - Lighting	3.08	2.80	2.75	0.41	17.81
HVAC	0.55	0.50	0.59	0.30	2.16
Lighting	1.19	1.09	1.61	0.37	3.53
Water Heating	0.41	0.37	0.41	0.23	2.19
Whole Home	0.51	0.46	0.32	0.19	3.55
Total	0.97	0.89	1.03	0.35	3.38

Table 5-7: California Home Energy Savings Program Benefit/Cost Ratios by Measure Category, 2018

Measure Group	PTRC	TRC	UCT	RIM	PCT
Appliances	0.40	0.37	0.37	0.25	1.55
Building Shell	0.59	0.54	0.55	0.30	2.80
Energy Kits - DHW	5.72	5.20	4.57	0.63	43.40
Energy Kits - Lighting	7.34	6.67	6.36	0.68	18.38
HVAC	0.58	0.53	0.68	0.35	1.70
Lighting	1.52	1.38	1.91	0.53	4.36
Water Heating	0.63	0.57	0.49	0.29	2.38
Total	1.01	0.92	1.15	0.44	2.81

Further information on the cost-effectiveness test results for each measure category is presented in Appendix C.

6 Conclusions and Recommendations

The results from this evaluation study of Pacific Power’s 2017-2018 Home Energy Savings Program in California are summarized by measure category in Table 6-1:

Table 6-1: California Home Energy Savings Program Claimed and Evaluated Savings by Measure Category, 2017-2018

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017-2018	Appliances	7,171	7,171	100%	2,251	31%
	Building Shell	11,324	11,324	100%	3,171	28%
	Energy Kits	943,089	1,038,435	110%	783,183	75%
	HVAC	1,011,465	1,009,792	100%	555,222	55%
	Lighting	997,613	706,168	71%	441,339	62%
	Water Heating	20,842	20,842	100%	11,463	55%
	Whole Homes	43,808	43,808	100%	24,094	55%
2017-2018 TOTAL		3,035,313	2,837,540	93%	1,820,723	64%

ADM provides the following conclusions and recommendations to improve the program and the evaluation of the program in future years.

- **Lighting Measure Category:**
- **Conclusion:** Pacific Power’s leakage rate of 7.4% in California is due to the small Pacific Power service territory in California and the location of two large retailers on the edge of the service territory. While the implementation contractor provided some documentation showing how the Retail Sales Allocation Tool (RSAT) is a predictor of bulb leakage in Pacific Power territories and is used to determine allocations of bulbs to participating stores, the full RSAT methodology is not transparent to ADM. In an effort to help Pacific Power further understand how the RSAT tool accounts for leakage and why the RSAT tool allocations differ from the results of ADM’s leakage analysis, ADM utilized a case-study methodology to provide increased transparency into the inputs and results of ADM’s leakage analysis for the major lighting retailers in the program. For instance, the RSAT tool results in a 100% allocation to the Crescent City Walmart location, indicating that there should be 0.0% lighting leakage for this location. ADM’s leakage analysis estimates a 26.8% leakage rate for this individual retailer and the case-study for this location shows that all leakage is occurring to the north of Pacific Power’s service territory. ADM concluded that there are no non-participating lighting retailers within the applicable drive time distance to reduce this leakage to the north. While the full RSAT methodology is not transparent to ADM, it is likely that the RSAT methodology incorporated a different assumption.

- **Recommendation:** ADM recommends that the evaluation of subsequent program years includes further review of the RSAT allocation tool and the inputs into the tool in an effort to reduce lighting leakage from Pacific Power's California service territory.

- **Energy Kits Measure Category:**

Conclusion: The showerhead energy kits component had the lowest overall ISR of all energy kit components. This was driven by a 36% ISR for the second showerhead in the Best Kit – 2 Bathroom Energy Kits compared to a 68% ISR for the first showerhead. Respondents to the Energy Kits survey who did not install showerheads indicated that they disliked the pressure/water volume (25%), already had high-efficiency showerheads installed (22%) or the showerhead did not integrate well with their current plumbing (15%).

Recommendation: ADM recommends that Pacific Power consider including only one showerhead in the Best Kit – 2 Bathroom Energy Kits, which could increase the overall ISR for showerheads. Additionally, if not already done, RMP could ask qualifying questions regarding showerheads during the energy kit request process.

- **HVAC Measure Category:**

HVAC Conclusion: ADM's review of the heat pump HVAC measure found that the ex-ante claimed savings value for ductless heat pumps are based on the Residential Heating and Cooling Ductless Heat Pump RTF versions 1.3 and 2.0 that have since been updated.

HVAC Recommendation: Pacific Power should update its ex-ante claimed savings values for heat pump HVAC measures to reflect the most current RTF version source document available prior to the evaluation cycle.

7 Appendices

The following appendices accompany this Final Evaluation Report:

APPENDIX A: Lighting Tables

APPENDIX B: Energy Kits Individual Component Savings Calculations

APPENDIX C: Measure Category Cost-Effectiveness Results

7.1 Appendix A: Lighting Tables

Table 7-1: TRL Input Values and Engineering Calculation Ex-Ante UES Savings for 2017 CA Lighting Measures

Lighting Measures	Upgrade Wattage	Baseline Wattage	ΔWatts	ISR	HOU	IEF	Engineering Calculation Savings
CFL Specialty - Daylight: 14 watts - Retail - CA	14	43	29	0.71	2.00	0.88	13.21
CFL Specialty - Daylight: 19 watts - Retail - CA	19	53	34	0.71	2.00	0.88	15.48
CFL Specialty - Daylight: 23 watts - Retail - CA	23	72	49	0.71	2.00	0.88	22.31
CFL Specialty - Daylight: 9 watts - Retail - CA	9	40	31	0.71	2.00	0.88	14.12
CFL Specialty - Reflector: 15 watts - Retail - CA	15	65	50	0.71	2.00	0.88	22.77
LED Downlight: 10 watts - Retail - CA	10	65	55	1.00	2.00	0.88	35.28
LED Downlight: 11 watts - Retail - CA	11	75	64	1.00	2.00	0.88	41.05
LED Downlight: 12 watts - Retail - CA	12	65	53	1.00	2.00	0.88	33.99
LED Downlight: 13 watts - Retail - CA	13	65	52	1.00	2.00	0.88	33.35
LED Downlight: 14 watts - Retail - CA	14	65	51	1.00	2.00	0.88	32.71
LED Downlight: 15 watts - Retail - CA	15	65	50	1.00	2.00	0.88	32.07
LED Downlight: 16 watts - Retail - CA	16	75	59	1.00	2.00	0.88	37.84
LED Downlight: 17 watts - Retail - CA	17	75	58	1.00	2.00	0.88	37.20
LED Downlight: 18 watts - Retail - CA	18	75	57	1.00	2.00	0.88	36.56
LED Downlight: 5 watts - Retail - CA	5	75	70	1.00	2.00	0.88	44.90
LED Downlight: 6 watts - Retail - CA	6	75	69	1.00	2.00	0.88	44.26
LED Downlight: 7 watts - Retail - CA	7	30	23	1.00	2.00	0.88	14.75
LED Downlight: 8 watts - Retail - CA	8	45	37	1.00	2.00	0.88	23.73
LED Downlight: 9 watts - Retail - CA	9	65	56	1.00	2.00	0.88	35.92
LED General Purpose: 10 watts - Retail - CA	10	43	33	1.00	2.00	0.88	21.17
LED General Purpose: 11 watts - Retail - CA	11	43	32	1.00	2.00	0.88	20.52
LED General Purpose: 12 watts - Retail - CA	12	43	31	1.00	2.00	0.88	19.88
LED General Purpose: 14 watts - Retail - CA	14	43	29	1.00	2.00	0.88	18.60
LED General Purpose: 15 watts - Retail - CA	15	43	28	1.00	2.00	0.88	17.96
LED General Purpose: 16 watts - Retail - CA	16	53	37	1.00	2.00	0.88	23.73
LED General Purpose: 17 watts - Retail - CA	17	53	36	1.00	2.00	0.88	23.09
LED General Purpose: 18 watts - Retail - CA	18	72	54	1.00	2.00	0.88	34.63
LED General Purpose: 6 watts - Retail - CA	6	29	23	1.00	2.00	0.88	14.75
LED General Purpose: 7 watts - Retail - CA	7	29	22	1.00	2.00	0.88	14.11
LED General Purpose: 8 watts - Retail - CA	8	29	21	1.00	2.00	0.88	13.47
LED General Purpose: 9 watts - Retail - CA	9	29	20	1.00	2.00	0.88	12.83
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	8	60	52	1.00	2.00	0.88	33.35
LED Specialty - Candelabra: 3 watts - Retail - CA	3	25	22	1.00	2.00	0.88	14.11
LED Specialty - Candelabra: 4 watts - Retail - CA	4	25	21	1.00	2.00	0.88	13.47
LED Specialty - Candelabra: 5 watts - Retail - CA	5	40	35	1.00	2.00	0.88	22.45
LED Specialty - Candelabra: 7 watts - Retail - CA	7	40	33	1.00	2.00	0.88	21.17
LED Specialty - Globe: 4 watts - Retail - CA	4	20	16	1.00	2.00	0.88	10.26
LED Specialty - Globe: 5 watts - Retail - CA	5	40	35	1.00	2.00	0.88	22.45
LED Specialty - Globe: 6 watts - Retail - CA	6	40	34	1.00	2.00	0.88	21.81
LED Specialty - Globe: 7 watts - Retail - CA	7	40	33	1.00	2.00	0.88	21.17

Table 7-2: 2017 California Homes Energy Savings Program Claimed and Evaluated Gross Lighting Savings

Lighting Measures	Claimed Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
CFL Specialty - Daylight: 14 watts - Retail - CA	1,267	1,206	95.2%
CFL Specialty - Daylight: 19 watts - Retail - CA	31	29	95.2%
CFL Specialty - Daylight: 23 watts - Retail - CA	89	85	95.2%
CFL Specialty - Daylight: 9 watts - Retail - CA	85	81	95.2%
CFL Specialty - Reflector: 15 watts - Retail - CA	410	390	95.2%
LED Downlight: 10 watts - Retail - CA	8,707	5,884	67.6%
LED Downlight: 11 watts - Retail - CA	40,733	27,527	67.6%
LED Downlight: 12 watts - Retail - CA	815	551	67.6%
LED Downlight: 13 watts - Retail - CA	6,533	4,415	67.6%
LED Downlight: 14 watts - Retail - CA	9,317	6,296	67.6%
LED Downlight: 15 watts - Retail - CA	10,961	7,407	67.6%
LED Downlight: 16 watts - Retail - CA	189	128	67.6%
LED Downlight: 17 watts - Retail - CA	2,602	1,759	67.6%
LED Downlight: 18 watts - Retail - CA	2,849	1,926	67.6%
LED Downlight: 5 watts - Retail - CA	269	182	67.6%
LED Downlight: 6 watts - Retail - CA	3,759	2,540	67.6%
LED Downlight: 7 watts - Retail - CA	12,219	8,259	67.6%
LED Downlight: 8 watts - Retail - CA	20,983	14,183	67.6%
LED Downlight: 9 watts - Retail - CA	6,460	4,366	67.6%
LED Fixture - ENERGY STAR - CA	66,430	57,322	86.3%
LED General Purpose: 10 watts - Retail - CA	286,244	193,448	67.6%
LED General Purpose: 11 watts - Retail - CA	14,788	9,993	67.6%
LED General Purpose: 12 watts - Retail - CA	6,021	4,068	67.6%
LED General Purpose: 14 watts - Retail - CA	335	226	67.6%
LED General Purpose: 15 watts - Retail - CA	11,703	7,907	67.6%
LED General Purpose: 16 watts - Retail - CA	5,548	3,750	67.6%
LED General Purpose: 17 watts - Retail - CA	715	483	67.6%
LED General Purpose: 18 watts - Retail - CA	1,211	819	67.6%
LED General Purpose: 6 watts - Retail - CA	36,319	24,547	67.6%
LED General Purpose: 7 watts - Retail - CA	7,388	4,993	67.6%
LED General Purpose: 8 watts - Retail - CA	377	255	67.6%
LED General Purpose: 9 watts - Retail - CA	235,503	159,134	67.6%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	2,700	1,824	67.6%
LED Specialty - Candelabra: 3 watts - Retail - CA	508	343	67.6%
LED Specialty - Candelabra: 4 watts - Retail - CA	10,095	6,822	67.6%
LED Specialty - Candelabra: 5 watts - Retail - CA	17,361	11,734	67.6%
LED Specialty - Candelabra: 7 watts - Retail - CA	7,487	5,060	67.6%
LED Specialty - Globe: 4 watts - Retail - CA	226	152	67.5%
LED Specialty - Globe: 5 watts - Retail - CA	11,708	7,913	67.6%
LED Specialty - Globe: 6 watts - Retail - CA	1,939	1,311	67.6%
LED Specialty - Globe: 7 watts - Retail - CA	360	243	67.6%
2017 TOTAL	853,244	589,561	69.1%

Table 7-3: 2018 California Homes Energy Savings Program Claimed and Evaluated Gross Lighting Savings, pre TRL change

Lighting Measures	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
LED Downlight: 10 watts - Retail - CA	423	286	67.6%
LED Downlight: 11 watts - Retail - CA	1,723	1,164	67.6%
LED Downlight: 13 watts - Retail - CA	67	45	67.6%
LED Downlight: 14 watts - Retail - CA	850	574	67.6%
LED Downlight: 15 watts - Retail - CA	192	130	67.6%
LED Downlight: 16 watts - Retail - CA	151	102	67.6%
LED Downlight: 18 watts - Retail - CA	219	148	67.6%
LED Downlight: 6 watts - Retail - CA	44	30	67.6%
LED Downlight: 7 watts - Retail - CA	398	269	67.6%
LED Downlight: 8 watts - Retail - CA	95	64	67.6%
LED Downlight: 9 watts - Retail - CA	108	73	67.6%
LED Fixture - ENERGY STAR - CA	828	715	86.3%
LED General Purpose: 10 watts - Retail - CA	7,783	5,260	67.6%
LED General Purpose: 12 watts - Retail - CA	735	497	67.6%
LED General Purpose: 15 watts - Retail - CA	431	291	67.6%
LED General Purpose: 16 watts - Retail - CA	95	64	67.6%
LED General Purpose: 6 watts - Retail - CA	1,194	807	67.6%
LED General Purpose: 7 watts - Retail - CA	508	343	67.6%
LED General Purpose: 8 watts - Retail - CA	215	146	67.6%
LED General Purpose: 9 watts - Retail - CA	8,782	5,934	67.6%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	33	23	67.6%
LED Specialty - Candelabra: 4 watts - Retail - CA	781	528	67.6%
LED Specialty - Candelabra: 5 watts - Retail - CA	538	364	67.6%
LED Specialty - Candelabra: 7 watts - Retail - CA	85	57	67.6%
LED Specialty - Globe: 5 watts - Retail - CA	763	515	67.6%
LED Specialty - Globe: 6 watts - Retail - CA	392	265	67.6%
2018 (v1) TOTAL	27,433	18,693	68.1%

Table 7-4: 2018 California Homes Energy Savings Program Claimed and Evaluated Gross Lighting Savings, post TRL change

Lighting Measures	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
LED Downlight: 10 watts - Retail - CA	414	341	82.5%
LED Downlight: 11 watts - Retail - CA	11,473	9,461	82.5%
LED Downlight: 13 watts - Retail - CA	7,500	6,184	82.5%
LED Downlight: 14 watts - Retail - CA	3,283	2,707	82.5%
LED Downlight: 15 watts - Retail - CA	1,421	1,171	82.5%
LED Downlight: 16 watts - Retail - CA	550	453	82.5%
LED Downlight: 17 watts - Retail - CA	61	50	82.5%
LED Downlight: 18 watts - Retail - CA	469	387	82.5%
LED Downlight: 6 watts - Retail - CA	164	135	82.5%
LED Downlight: 7 watts - Retail - CA	10,250	8,452	82.5%
LED Downlight: 8 watts - Retail - CA	987	814	82.5%
LED Downlight: 9 watts - Retail - CA	4,007	3,304	82.5%
LED Fixture - ENERGY STAR - CA	7,363	7,564	102.7%
LED General Purpose: 10 watts - Retail - CA	19,004	15,670	82.5%
LED General Purpose: 11 watts - Retail - CA	244	201	82.5%
LED General Purpose: 12 watts - Retail - CA	1,226	1,011	82.5%
LED General Purpose: 15 watts - Retail - CA	2,584	2,131	82.5%
LED General Purpose: 16 watts - Retail - CA	1,522	1,255	82.5%
LED General Purpose: 17 watts - Retail - CA	60	50	82.5%
LED General Purpose: 6 watts - Retail - CA	1,578	1,301	82.5%
LED General Purpose: 7 watts - Retail - CA	2,395	1,975	82.5%
LED General Purpose: 8 watts - Retail - CA	2,673	2,204	82.5%
LED General Purpose: 9 watts - Retail - CA	32,616	26,894	82.5%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	28	23	82.5%
LED Specialty - Candelabra: 4 watts - Retail - CA	2,657	2,190	82.5%
LED Specialty - Candelabra: 5 watts - Retail - CA	604	498	82.5%
LED Specialty - Candelabra: 7 watts - Retail - CA	645	532	82.5%
LED Specialty - Globe: 4 watts - Retail - CA	16	13	82.5%
LED Specialty - Globe: 5 watts - Retail - CA	384	317	82.5%
LED Specialty - Globe: 6 watts - Retail - CA	760	627	82.5%
2018 (v2) TOTAL	116,936	97,914	83.7%

Table 7-5: 2017 California Home Energy Savings Program Net Lighting Savings and NTG

Lighting Measures	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
CFL Specialty - Daylight: 14 watts - Retail - CA	1,206	1,025	85.0%
CFL Specialty - Daylight: 19 watts - Retail - CA	29	25	85.0%
CFL Specialty - Daylight: 23 watts - Retail - CA	85	72	85.0%
CFL Specialty - Daylight: 9 watts - Retail - CA	81	68	85.0%
CFL Specialty - Reflector: 15 watts - Retail - CA	390	331	85.0%
LED Downlight: 10 watts - Retail - CA	5,884	3,530	60.0%
LED Downlight: 11 watts - Retail - CA	27,527	16,516	60.0%
LED Downlight: 12 watts - Retail - CA	551	331	60.0%
LED Downlight: 13 watts - Retail - CA	4,415	2,649	60.0%
LED Downlight: 14 watts - Retail - CA	6,296	3,777	60.0%
LED Downlight: 15 watts - Retail - CA	7,407	4,444	60.0%
LED Downlight: 16 watts - Retail - CA	128	77	60.0%
LED Downlight: 17 watts - Retail - CA	1,759	1,055	60.0%
LED Downlight: 18 watts - Retail - CA	1,926	1,155	60.0%
LED Downlight: 5 watts - Retail - CA	182	109	60.0%
LED Downlight: 6 watts - Retail - CA	2,540	1,524	60.0%
LED Downlight: 7 watts - Retail - CA	8,259	4,955	60.0%
LED Downlight: 8 watts - Retail - CA	14,183	8,510	60.0%
LED Downlight: 9 watts - Retail - CA	4,366	2,620	60.0%
LED Fixture - ENERGY STAR - CA	57,322	31,527	55.0%
LED General Purpose: 10 watts - Retail - CA	193,448	116,069	60.0%
LED General Purpose: 11 watts - Retail - CA	9,993	5,996	60.0%
LED General Purpose: 12 watts - Retail - CA	4,068	2,441	60.0%
LED General Purpose: 14 watts - Retail - CA	226	136	60.0%
LED General Purpose: 15 watts - Retail - CA	7,907	4,744	60.0%
LED General Purpose: 16 watts - Retail - CA	3,750	2,250	60.0%
LED General Purpose: 17 watts - Retail - CA	483	290	60.0%
LED General Purpose: 18 watts - Retail - CA	819	491	60.0%
LED General Purpose: 6 watts - Retail - CA	24,547	14,728	60.0%
LED General Purpose: 7 watts - Retail - CA	4,993	2,996	60.0%
LED General Purpose: 8 watts - Retail - CA	255	153	60.0%
LED General Purpose: 9 watts - Retail - CA	159,134	95,481	60.0%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	1,824	1,095	60.0%
LED Specialty - Candelabra: 3 watts - Retail - CA	343	206	60.0%
LED Specialty - Candelabra: 4 watts - Retail - CA	6,822	4,093	60.0%
LED Specialty - Candelabra: 5 watts - Retail - CA	11,734	7,040	60.0%
LED Specialty - Candelabra: 7 watts - Retail - CA	5,060	3,036	60.0%
LED Specialty - Globe: 4 watts - Retail - CA	152	91	60.0%
LED Specialty - Globe: 5 watts - Retail - CA	7,913	4,748	60.0%
LED Specialty - Globe: 6 watts - Retail - CA	1,311	786	60.0%
LED Specialty - Globe: 7 watts - Retail - CA	243	146	60.0%
2017 TOTAL	589,561	351,318	59.6%

Table 7-6: 2018 California Home Energy Savings Program Net Lighting Savings and NTG, pre TRL change

Lighting Measures	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
LED Downlight: 10 watts - Retail - CA	286	172	60.0%
LED Downlight: 11 watts - Retail - CA	1,164	699	60.0%
LED Downlight: 13 watts - Retail - CA	45	27	60.0%
LED Downlight: 14 watts - Retail - CA	574	345	60.0%
LED Downlight: 15 watts - Retail - CA	130	78	60.0%
LED Downlight: 16 watts - Retail - CA	102	61	60.0%
LED Downlight: 18 watts - Retail - CA	148	89	60.0%
LED Downlight: 6 watts - Retail - CA	30	18	60.0%
LED Downlight: 7 watts - Retail - CA	269	161	60.0%
LED Downlight: 8 watts - Retail - CA	64	38	60.0%
LED Downlight: 9 watts - Retail - CA	73	44	60.0%
LED Fixture - ENERGY STAR - CA	715	393	55.0%
LED General Purpose: 10 watts - Retail - CA	5,260	4,787	91.0%
LED General Purpose: 12 watts - Retail - CA	497	452	91.0%
LED General Purpose: 15 watts - Retail - CA	291	265	91.0%
LED General Purpose: 16 watts - Retail - CA	64	58	91.0%
LED General Purpose: 6 watts - Retail - CA	807	734	91.0%
LED General Purpose: 7 watts - Retail - CA	343	312	91.0%
LED General Purpose: 8 watts - Retail - CA	146	132	91.0%
LED General Purpose: 9 watts - Retail - CA	5,934	5,400	91.0%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	23	14	60.0%
LED Specialty - Candelabra: 4 watts - Retail - CA	528	317	60.0%
LED Specialty - Candelabra: 5 watts - Retail - CA	364	218	60.0%
LED Specialty - Candelabra: 7 watts - Retail - CA	57	34	60.0%
LED Specialty - Globe: 5 watts - Retail - CA	515	309	60.0%
LED Specialty - Globe: 6 watts - Retail - CA	265	159	60.0%
2018 (v1) TOTAL	18,693	15,316	81.9%

Table 7-7: 2018 California Home Energy Savings Program Net Lighting Savings and NTG, post TRL change

Lighting Measures	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
LED Downlight: 10 watts - Retail - CA	341	205	60.0%
LED Downlight: 11 watts - Retail - CA	9,461	5,676	60.0%
LED Downlight: 13 watts - Retail - CA	6,184	3,710	60.0%
LED Downlight: 14 watts - Retail - CA	2,707	1,624	60.0%
LED Downlight: 15 watts - Retail - CA	1,171	703	60.0%
LED Downlight: 16 watts - Retail - CA	453	272	60.0%
LED Downlight: 17 watts - Retail - CA	50	30	60.0%
LED Downlight: 18 watts - Retail - CA	387	232	60.0%
LED Downlight: 6 watts - Retail - CA	135	81	60.0%
LED Downlight: 7 watts - Retail - CA	8,452	5,071	60.0%
LED Downlight: 8 watts - Retail - CA	814	488	60.0%
LED Downlight: 9 watts - Retail - CA	3,304	1,982	60.0%
LED Fixture - ENERGY STAR - CA	7,564	4,160	55.0%
LED General Purpose: 10 watts - Retail - CA	15,670	14,259	91.0%
LED General Purpose: 11 watts - Retail - CA	201	183	91.0%
LED General Purpose: 12 watts - Retail - CA	1,011	920	91.0%
LED General Purpose: 15 watts - Retail - CA	2,131	1,939	91.0%
LED General Purpose: 16 watts - Retail - CA	1,255	1,142	91.0%
LED General Purpose: 17 watts - Retail - CA	50	45	91.0%
LED General Purpose: 6 watts - Retail - CA	1,301	1,184	91.0%
LED General Purpose: 7 watts - Retail - CA	1,975	1,797	91.0%
LED General Purpose: 8 watts - Retail - CA	2,204	2,006	91.0%
LED General Purpose: 9 watts - Retail - CA	26,894	24,474	91.0%
LED Specialty - 3-Way: 3,8,18 watts - Retail - CA	23	14	60.0%
LED Specialty - Candelabra: 4 watts - Retail - CA	2,190	1,314	60.0%
LED Specialty - Candelabra: 5 watts - Retail - CA	498	299	60.0%
LED Specialty - Candelabra: 7 watts - Retail - CA	532	319	60.0%
LED Specialty - Globe: 4 watts - Retail - CA	13	8	60.0%
LED Specialty - Globe: 5 watts - Retail - CA	317	190	60.0%
LED Specialty - Globe: 6 watts - Retail - CA	627	376	60.0%
2018 (v2) TOTAL	97,914	74,705	76.3%

7.2 Appendix B: Energy Kits Individual Component Savings Calculations

Table 7-8: Energy Kits Individual Component Savings Calculation Inputs, Aerators

Energy Kit Component	Input to Savings Calculation	Assumed Input Value to Savings Calculation ¹	Input Value for Evaluated Savings	Source for Evaluated Savings Calculation
Kitchen Aerator	In-Service Rate (%)	60.2%	67%	ADM Energy Kits Survey
	Average Baseline Flow Rate (GPM)	2.2	2.2	Federal rated max flow rate
	Average Post Measure Flow Rate (GPM)	1.5	1.5	Program materials
	Average time of hot water usage per person per day (minutes)	4.5	1.8073	Aerators_v1_1
	Average number of persons per household (state-specific values)	2.4	2.59	Aerators_v1_1
	Average temperature differential between hot and cold water (degrees)	28.23	75	Aerators_v1_1
	Unit Conversion (BTU/gallon)	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3,412.14	3,412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	95.1%	48.7%	Aerators_v1_1
	Efficiency of Electric Water Heaters (%)	98%	100%	Aerators_v1_1
	Average number of faucets in the home	1	1.08	Aerators_v1_1
Bathroom Aerator	In-Service Rate (%)	61.3%	67%	ADM Energy Kits Survey
	Average Baseline Flow Rate (GPM)	2.2	2.2	Federal rated max flow rate
	Average Post Measure Flow Rate (GPM)	0.5	0.5	Program materials
	Average time of hot water usage per person per day (minutes)	1.6	1.2936	Aerators_v1_1
	Average number of persons per household (state-specific values)	2.4	2.59	Aerators_v1_1
	Average temperature differential between hot and cold water (degrees)	21.23	75	Aerators_v1_1
	Unit Conversion (BTU/gallon)	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3,412.14	3,412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	95.1%	48.7%	Aerators_v1_1
	Efficiency of Electric Water Heaters (%)	98%	100%	Aerators_v1_1
	Average number of faucets in the home	2.11	2.56	Aerators_v1_1

¹ All inputs to the UES values for the aerator energy kit component are not specified in the TRL files or associated savings source documents, and thus ADM was not able to reverse engineer the claimed savings values for aerators.

Table 7-9: Energy Kits Individual Component Savings Calculation Inputs, Showerheads

Energy Kit Component	Input to Savings Calculation	Assumed Input Value to Savings Calculation ¹	Input Value for Evaluated Savings	Source for Evaluated Savings Calculation
Showerhead	In-Service Rate (%)	63.4%	52.1%	ADM Energy Kits surveys
	Average Baseline Flow Rate (GPM)	2.5	2.2	ResShowerheads_v3.0
	Average Post Measure Flow Rate (GPM)	1.5	1.35	Program materials
	Average gallons of hot water usage per person per day	11.70	7.76	ResShowerheads_v3.0
	Average number of persons per household (state-specific values)	2.4	2.37	ResShowerheads_v3.0
	Average temperature differential between hot and cold water	36.23	75	ResShowerheads_v3.0
	Unit Conversion (BTU/gallon)	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3412.14	3412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	95.1%	62%	ResShowerheads_v3.0
	Efficiency of Electric Water Heaters	98%	100.0%	ResShowerheads_v3.0
	Average number of showers in the home	1.71	1.78	ResShowerheads_v3.0

¹ All inputs to the UES values for the showerhead energy kit component are not specified in the TRL files or associated savings source documents, and thus ADM was not able to reverse engineer the exact claimed savings values for showerheads. ADM's ex-ante calculated savings were within 2% of the ex-ante claimed savings values.

7.3 Appendix C: Measure Category Cost-Effectiveness Results

The following tables show the cost-effectiveness results for each measure category in the Program for each program year, based on gross savings evaluated by ADM and NTG values mainly sourced from the CPUC's DEER database. The 2017 cost-effectiveness was tested using the 2015 IRP west residential whole house 49%, west residential lighting 48%, west residential heating 17%, and west water heating 53% decrements. The 2018 cost-effectiveness was tested using the 2017 IRP decrement for all measure categories.

Table 7-10: 2017 CA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.3688	\$6,613	\$1,459	-\$5,155	0.22
Total Resource Cost Test (TRC) No Adder	\$0.3688	\$6,613	\$1,326	-\$5,287	0.20
Utility Cost Test (UCT)	\$0.3334	\$5,978	\$1,326	-\$4,652	0.22
Rate Impact Test (RIM)		\$8,643	\$1,326	-\$7,317	0.15
Participant Cost Test (PCT)		\$9,003	\$10,664	\$1,660	1.18
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000006727				
Discounted Participant Payback (years)	n/a				

Table 7-11: 2017 CA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2558	\$4,344	\$1,712	-\$2,632	0.39
Total Resource Cost Test (TRC) No Adder	\$0.2558	\$4,344	\$1,557	-\$2,787	0.36
Utility Cost Test (UCT)	\$0.3078	\$5,227	\$1,557	-\$3,670	0.30
Rate Impact Test (RIM)		\$7,757	\$1,557	-\$6,200	0.20
Participant Cost Test (PCT)		\$4,154	\$11,081	\$6,927	2.67
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003973				
Discounted Participant Payback (years)	15.16				

Table 7-12: 2017 CA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0185	\$75,604	\$322,298	\$246,695	4.26
Total Resource Cost Test (TRC) No Adder	\$0.0185	\$75,604	\$292,998	\$217,395	3.88
Utility Cost Test (UCT)	\$0.0187	\$76,350	\$292,998	\$216,649	3.84
Rate Impact Test (RIM)		\$683,821	\$292,998	-\$390,823	0.43
Participant Cost Test (PCT)		\$14,598	\$654,783	\$640,185	44.85
Lifecycle Revenue Impacts (\$/kWh)				\$0.0000457966	
Discounted Participant Payback (years)					n/a

Table 7-13: 2017 CA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0254	\$2,057	\$6,342	\$4,284	3.08
Total Resource Cost Test (TRC) No Adder	\$0.0254	\$2,057	\$5,765	\$3,708	2.80
Utility Cost Test (UCT)	\$0.0259	\$2,096	\$5,765	\$3,669	2.75
Rate Impact Test (RIM)		\$14,125	\$5,765	-\$8,360	0.41
Participant Cost Test (PCT)		\$754	\$13,431	\$12,677	17.81
Lifecycle Revenue Impacts (\$/kWh)				\$0.0000008976	
Discounted Participant Payback (years)					n/a

Table 7-14: 2017 CA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1820	\$609,982	\$337,072	-\$272,910	0.55
Total Resource Cost Test (TRC) No Adder	\$0.1820	\$609,982	\$306,430	-\$303,553	0.50
Utility Cost Test (UCT)	\$0.1548	\$518,773	\$306,430	-\$212,343	0.59
Rate Impact Test (RIM)		\$1,017,930	\$306,430	-\$711,501	0.30
Participant Cost Test (PCT)		\$508,263	\$1,095,944	\$587,682	2.16
Lifecycle Revenue Impacts (\$/kWh)				\$0.0000480203	
Discounted Participant Payback (years)					10.20

Table 7-15: 2017 CA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0656	\$206,919	\$247,237	\$40,318	1.19
Total Resource Cost Test (TRC) No Adder	\$0.0656	\$206,919	\$224,761	\$17,842	1.09
Utility Cost Test (UCT)	\$0.0441	\$139,209	\$224,761	\$85,552	1.61
Rate Impact Test (RIM)		\$608,183	\$224,761	-\$383,422	0.37
Participant Cost Test (PCT)		\$245,077	\$865,335	\$620,257	3.53
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000411671				
Discounted Participant Payback (years)	3.57				

Table 7-16: 2017 CA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1992	\$17,308	\$7,105	-\$10,203	0.41
Total Resource Cost Test (TRC) No Adder	\$0.1992	\$17,308	\$6,459	-\$10,849	0.37
Utility Cost Test (UCT)	\$0.1794	\$15,590	\$6,459	-\$9,131	0.41
Rate Impact Test (RIM)		\$28,514	\$6,459	-\$22,056	0.23
Participant Cost Test (PCT)		\$13,305	\$29,099	\$15,794	2.19
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000018912				
Discounted Participant Payback (years)	7.68				

Table 7-17: 2017 CA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1415	\$51,223	\$25,984	-\$25,239	0.51
Total Resource Cost Test (TRC) No Adder	\$0.1415	\$51,223	\$23,622	-\$27,601	0.46
Utility Cost Test (UCT)	\$0.2018	\$73,031	\$23,622	-\$49,409	0.32
Rate Impact Test (RIM)		\$127,054	\$23,622	-\$103,432	0.19
Participant Cost Test (PCT)		\$40,000	\$142,032	\$102,032	3.55
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000048961				
Discounted Participant Payback (years)	n/a				

Table 7-18: 2018 CA Home Energy Savings Program Appliances Measure
Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2899	\$1,397	\$561	-\$836	0.40
Total Resource Cost Test (TRC) No Adder	\$0.2899	\$1,397	\$510	-\$887	0.37
Utility Cost Test (UCT)	\$0.2900	\$1,398	\$510	-\$887	0.37
Rate Impact Test (RIM)		\$2,079	\$510	-\$1,569	0.25
Participant Cost Test (PCT)		\$1,773	\$2,749	\$976	1.55
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000001439				
Discounted Participant Payback (years)	n/a				

Table 7-19: 2018 CA Home Energy Savings Program Building Shell Measure
Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1719	\$5,460	\$3,219	-\$2,241	0.59
Total Resource Cost Test (TRC) No Adder	\$0.1719	\$5,460	\$2,927	-\$2,534	0.54
Utility Cost Test (UCT)	\$0.1668	\$5,297	\$2,927	-\$2,371	0.55
Rate Impact Test (RIM)		\$9,816	\$2,927	-\$6,890	0.30
Participant Cost Test (PCT)		\$6,342	\$17,752	\$11,410	2.80
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000002660				
Discounted Participant Payback (years)	n/a				

Table 7-20: 2018 CA Home Energy Savings Program Energy Kits - DHW
Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0198	\$47,268	\$270,437	\$223,169	5.72
Total Resource Cost Test (TRC) No Adder	\$0.0198	\$47,268	\$245,852	\$198,584	5.20
Utility Cost Test (UCT)	\$0.0225	\$53,782	\$245,852	\$192,070	4.57
Rate Impact Test (RIM)		\$391,320	\$245,852	-\$145,468	0.63
Participant Cost Test (PCT)		\$14,475	\$628,181	\$613,706	43.40
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000170184				
Discounted Participant Payback (years)	n/a				

Table 7-21: 2018 CA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0162	\$1,544	\$11,338	\$9,793	7.34
Total Resource Cost Test (TRC) No Adder	\$0.0162	\$1,544	\$10,307	\$8,763	6.67
Utility Cost Test (UCT)	\$0.0170	\$1,621	\$10,307	\$8,686	6.36
Rate Impact Test (RIM)		\$15,105	\$10,307	-\$4,799	0.68
Participant Cost Test (PCT)		\$853	\$15,671	\$14,818	18.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000004745				
Discounted Participant Payback (years)	n/a				

Table 7-22: 2018 CA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1928	\$619,449	\$359,687	-\$259,762	0.58
Total Resource Cost Test (TRC) No Adder	\$0.1928	\$619,449	\$326,989	-\$292,460	0.53
Utility Cost Test (UCT)	\$0.1494	\$479,804	\$326,989	-\$152,816	0.68
Rate Impact Test (RIM)		\$934,466	\$326,989	-\$607,477	0.35
Participant Cost Test (PCT)		\$599,218	\$1,016,832	\$417,614	1.70
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000486829				
Discounted Participant Payback (years)	13.84				

Table 7-23: 2018 CA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0752	\$73,357	\$111,730	\$38,372	1.52
Total Resource Cost Test (TRC) No Adder	\$0.0752	\$73,357	\$101,572	\$28,215	1.38
Utility Cost Test (UCT)	\$0.0546	\$53,255	\$101,572	\$48,317	1.91
Rate Impact Test (RIM)		\$191,269	\$101,572	-\$89,697	0.53
Participant Cost Test (PCT)		\$44,187	\$192,786	\$148,598	4.36
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000076738				
Discounted Participant Payback (years)	2.58				

Table 7-24: 2018 CA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1816	\$6,350	\$4,000	-\$2,350	0.63
Total Resource Cost Test (TRC) No Adder	\$0.1816	\$6,350	\$3,636	-\$2,714	0.57
Utility Cost Test (UCT)	\$0.2144	\$7,497	\$3,636	-\$3,861	0.49
Rate Impact Test (RIM)		\$12,443	\$3,636	-\$8,807	0.29
Participant Cost Test (PCT)		\$5,551	\$13,193	\$7,642	2.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000007535				
Discounted Participant Payback (years)	3.26				