

Evaluation, Verification and Measurement Report Residential Home Energy Savings Program California

PROGRAM YEARS 2019-2020

Prepared for:
Pacific Power

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Prepared by:



ENERGY RESEARCH
AND EVALUATION

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1 Executive Summary

ADM Associates, Inc. (ADM) is under contract with PacifiCorp to perform evaluation, measurement, and verification (EM&V) services to determine the energy savings (kWh) that resulted from Pacific Power's 2019-2020 Home Energy Savings Program in California. This report documents ADM's findings.

Program years 2019 and 2020 coincide with the respective calendar years. The purpose of this report is to present ADM's impact evaluation of the energy savings (kWh) that resulted from the program and ADM's process evaluation of the program, focusing on participant and program staff perspectives regarding the Program's implementation and ADM's observations about the program.

1.1 Description of Programs

The program provides financial incentives (discounts, rebates, and free products) for Pacific Power residential customers to purchase and install energy efficient products. The Program leverages relationships with manufacturers, distributors, and retailers to ensure effective program implementation and optimize participation. Products included in the program are reported in Table 1-1.

ADM determined the evaluated energy (kWh) savings achieved through Pacific Power's 2019-2020 Home Energy Savings Program in California. Pacific Power contracted with Guidehouse to assess program cost-effectiveness. The results of the cost-effectiveness assessment are also included in this report. For the process evaluation, ADM gained 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.

*Table 1-1: Quantities of Product Incentives
Delivered through Program by Measure Category*

Measure Category	2019	2020	2019-2020
Appliances	11	5	16
Clothes Washer - Electric DHW & Electric Dryer	9	2	11
Clothes Washer - Electric DHW & Gas Dryer	1	-	1
Heat Pump Clothes Dryer	-	3	3
Refrigerator CEE Tier 3	1	-	1
Building Shell (sq ft)	3,496	1,616	5,112
Attic Insulation	2,626	1,616	4,242
Wall Insulation	870	-	870
Energy Kits	404	863	1,267
Best Kit	341	554	895
LED Kit	63	309	372
HVAC	154	143	297
Central Air Conditioner	-	1	1
Duct Sealing and/or Insulation	6	2	8
Heat Pump - Air Source	18	9	27
Heat Pump - Ductless	130	129	259
Smart Thermostat	-	2	2
Lighting	1,321	1,832	3,153
LED	1,321	1,832	3,153
Water Heating	7	13	20
Heat Pump Water Heater	7	13	20
Whole Home	4	7	11
New Home - Performance Path	3	7	10
Whole Home - Ductless Heat Pump	1	-	1
Total	5,397	4,479	9,876

1.2 Impact Evaluation Results

Table 1-2 Table 1-4 present the impact evaluation results, including claimed savings, evaluated gross savings, realization rates, and evaluated net savings for each measure category across both program years. Net-to-gross ratios are presented at the measure level in the detailed impact evaluation section of the report.

Table 1-2: Total Program Savings 2019-2020

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)	% Program Savings
HVAC	844,869	837,770	0.99	462,803	65%
Energy Kits	359,163	333,542	0.93	189,400	27%
Lighting	32,052	33,365	1.04	27,596	4%
Whole Home	37,963	37,500	0.99	20,625	3%
Water Heating	16,758	17,559	1.05	9,657	1.4%
Appliances	3,426	3,630	1.06	1,997	0.3%
Building Shell	2,039	2,039	1.00	776	0.1%
Total	1,296,270	1,265,406	0.98	712,855	100%

Table 1-3: Total Program Savings 2019

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)	% Program Savings
HVAC	535,052	525,189	0.98	290,687	72%
Energy Kits	127,455	155,888	1.22	90,703	22%
Lighting	15,244	16,284	1.07	13,271	3%
Whole Home	8,192	11,300	1.38	6,215	2%
Water Heating	3,580	3,580	1.00	1,969	0%
Appliances	1,622	1,350	0.83	743	0%
Building Shell	1,752	1,752	1.00	618	0%
Total	692,897	715,344	1.03	404,206	100%

Table 1-4: Total Program Savings 2020

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)	% Program Savings
HVAC	309,817	312,581	1.01	172,117	56%
Energy Kits	231,708	177,654	0.77	98,696	32%
Whole Home	29,771	26,200	0.88	14,410	5%
Lighting	16,808	17,081	1.02	14,325	5%
Water Heating	13,178	13,979	1.06	7,688	2%
Appliances	1,804	2,280	1.26	1,254	0%
Building Shell	288	288	1.00	158	0%
Total	603,374	550,062	0.91	308,649	100%

In addition to completing an impact evaluation using Unit Energy Savings (UES) from applicable Technical Reference (TRL) source documentation for a census of measures included in the program, ADM also completed a supplemental billing analysis of homes that received incentives for the purchase and installation of heat pumps.

1.3 Process Evaluation Results

ADM made the following key findings during its process analysis.

- The following measure categories were removed from program offerings at or near the end of the evaluation period: heat pumps, starter kits, lighting.
- Pacific Power transitioned between implementation contractors during the evaluation period. Pacific Power engaged both contractors during an overlapping period to facilitate data and process transfer. The transition posed numerous data management challenges.
- The new implementation team provided synergies gained from previous work on the utility's commercial programs and provided enhanced web-based program interfaces for the Home Energy Savings program.
- The technical reference library (TRL) is a key program reference resource that documents ex ante savings values for all versions of all measures included in the program. Maintaining TRL version control, timeliness and completeness was a challenge complicated by the transition to a new implementation team. The new contractor has replaced the prior TRL with a new Measure Library with enhanced functionality. Full migration to the new system was completed on June 1, 2021.
- Program tracking data documents the measures and quantities of each that were installed in the service area as a result of the program. Pacific Power receives and maintains the program tracking dataset. Additional information, such as upstream sales details, downstream product model specifications, and new home model details, are maintained by the implementer.
- Data errors and omissions were found in some of the program tracking dataset. These are described in detail in section 4.1.3 Tracking and Reporting. The new implementer has added data controls to improve program delivery and data management.
- Verified hours of use for upstream lighting measures exceeded ex ante hours of use, resulting in realization rates that exceeded 100 percent. ADM used room locations collected in the general population survey to determine weighted average hours of use.
- Verified installation rates of starter kit components are generally equal or greater than ex ante ISRs, except for second bathroom aerators and all showerheads. Kits

were removed from the program in September 2020 to align with CPUC direction to utilize only current statewide DEER workpapers.

- Fifty-four percent of the general population survey respondents indicated that they heat their homes with fuel types other than electricity or natural gas. Wood (23 percent), oil (13 percent), and propane (11 percent) were the dominant alternative fuels.
- Thirty percent of general population survey respondents indicated that they were eligible for California Alternative Rates for Energy (CAREs).
- Thirty-seven percent of respondents indicated that they were living below the federal poverty level.

1.4 Cost Effectiveness Results

Guidehouse estimated the cost-effectiveness results for the California Home Energy Savings Program based on 2019 and 2020 costs and savings estimates provided by PacifiCorp. Cost-effectiveness was tested using the 2017 and 2019 IRP decrement. The program passed cost-effectiveness for the Participant Cost Test (PCT). Cost-effectiveness results are reported in Table 1-5 through Table 1-7.

Table 1-5: Program Cost-Effectiveness Results – 2019-2020

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1816	\$1,350,001	\$866,137	-\$483,865	0.64
Total Resource Cost Test (TRC) No Adder	\$0.1816	\$1,350,001	\$787,397	-\$562,604	0.58
Utility Cost Test (UCT)	\$0.1529	\$1,137,213	\$787,397	-\$349,816	0.69
Rate Impact Test (RIM)		\$2,106,030	\$787,397	-\$1,318,633	0.37
Participant Cost Test (PCT)		\$1,261,307	\$2,205,713	\$944,406	1.75
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000057619
Discounted Participant Payback (years)					10.68

Table 1-6: Program Cost-Effectiveness Results – 2019

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1864	\$796,007	\$500,306	-\$295,700	0.63
Total Resource Cost Test (TRC) No Adder	\$0.1864	\$796,007	\$454,824	-\$341,183	0.57
Utility Cost Test (UCT)	\$0.1497	\$639,325	\$454,824	-\$184,501	0.71
Rate Impact Test (RIM)		\$1,227,803	\$454,824	-\$772,979	0.37
Participant Cost Test (PCT)		\$716,762	\$1,283,014	\$566,252	1.79
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000063264
Discounted Participant Payback (years)					10.96

Table 1-7: Program Cost-Effectiveness Results – 2020

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1750	\$553,995	\$365,830	-\$188,164	0.66
Total Resource Cost Test (TRC) No Adder	\$0.1750	\$553,995	\$332,573	-\$221,422	0.60
Utility Cost Test (UCT)	\$0.1573	\$497,888	\$332,573	-\$165,315	0.67
Rate Impact Test (RIM)		\$878,227	\$332,573	-\$545,654	0.38
Participant Cost Test (PCT)		\$544,545	\$922,700	\$378,155	1.69
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000051154
Discounted Participant Payback (years)					10.36

1.5 Conclusions and Recommendations

ADM recommends that Pacific Power consider the following actions.

Screen for premises that are likely fuel switchers

If Pacific Power reintroduces heat pumps, ADM recommends that it considers screening for supplemental fuel usage to identify potential fuel switching premises.

Add data elements to tracking and reporting

Pacific Power relies on implementation partners to collect and store critical data that is required to evaluate the program and verify the resulting energy savings. ADM recommends that Pacific Power adds the following additional data elements to its internal program tracking datasets:

- Product manufacturer and model numbers, or minimally efficiency specifications

- Sales or distribution location for all upstream measures
- Baseline conditions (specifics varies by measure)

Add process controls to program implementation

ADM recommends that Pacific Power work with program implementers to revise program controls to reduce or eliminate data omissions and inaccuracies and ensure that program eligibility requirements are met for all measures.

Evaluate program on an annual basis

Annual evaluations would allow Pacific Power to monitor program controls and data collection throughout the program year, allowing the utility to respond to program performance midcycle. ADM recommends that Pacific Power implement annual rather than biannual program evaluations.

Upgrade leakage modeling methodology

If Pacific Power re-introduces a upstream delivery model,¹ ADM recommends that Pacific Power employ a geospatial modeling method to replace the RSTAT model used when the measure was available, to estimate upstream program leakage, such as the methodology documented in the Arkansas TRM V8.1 that relies on split drive time polygons that extend 60 minutes away from a retailer, accounting for nearly 100 percent of product sales. The RSAT model used when the measure was available, did not utilize drive time polygons and instead relies on zip code, retailer trade area, and census block overlap, which is less accurate than the drive time polygon method.

Continue efforts to collect customers' email addresses on program applications

ADM recommends the Pacific Power energy efficiency implementation team continues to support efforts to increase the customer include email addresses on file to increase the pool of program participants who can be invited to complete electronic participate surveys.

¹ Pacific Power removed lighting measures from the program in September 2020 to improve cost effectiveness of the portfolio.

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 energy savings (kWh) that resulted from Pacific Power's 2019-2020 Home Energy Savings Program in California. This report document's ADM's findings.

Program year 2019 (PY 2019) and program year 2020 (PY 2020) coincide with the respective calendar years. The purpose of this report is to present ADM's impact evaluation of the energy savings (kWh) that resulted from the program and ADM's process evaluation of the program, focusing on participant and program staff perspectives regarding the Program's implementation and ADM's observations about the program.

2.1 Description of Programs

The program provides financial incentives (discounts, rebates, and free products) for Pacific Power residential customers to purchase and install energy efficient products. The Program leverages relationships with manufacturers, distributors, and retailers to ensure effective program implementation and optimize participation. Products included in the program are reported in Table 2-1.

*Table 2-1: Quantities of Product Incentives
Delivered through Program by Measure Category*

Measure Category	2019	2020	2019-2020
Appliances	11	5	16
Clothes Washer - Electric DHW & Electric Dryer	9	2	11
Clothes Washer - Electric DHW & Gas Dryer	1	-	1
Heat Pump Clothes Dryer	-	3	3
Refrigerator CEE Tier 3	1	-	1
Building Shell	3,496	1,616	5,112
Attic Insulation	2,626	1,616	4,242
Wall Insulation	870	-	870
Energy Kits	404	863	1,267
Best Kit	341	554	895
LED Kit	63	309	372
HVAC	154	143	297
Central Air Conditioner	-	1	1
Duct Sealing and/or Insulation	6	2	8
Heat Pump - Air Source	18	9	27
Heat Pump – Ductless	130	129	259

Measure Category	2019	2020	2019-2020
Smart Thermostat	-	2	2
Lighting	1,321	1,832	3,153
LED	1,321	1,832	3,153
Water Heating	7	13	20
Heat Pump Water Heater	7	13	20
Whole Home	4	7	11
New Home - Performance Path	3	7	10
Whole Home - Ductless Heat Pump	1	-	1
Total	5,397	4,479	9,876

Table 2-2 reports the methods by which the Program provides incentives to customers for each measure category.

Table 2-2: Incentive Delivery Method

Measure Category	Incentive Delivery
HVAC	Post purchase rebate application
Energy Kits	Free kit requested online for mail delivery
Whole Home	Post installation rebate application
Lighting	Point-of-sale pricing
Water Heating	Post purchase rebate application
Appliances	Post purchase rebate application
Building Shell	Post purchase rebate application

Upstream lighting measures were offered at a discounted price at the point of sale. The Program paid the discount incentive to the manufacturer. These point-of-sale incentives did not require the consumer to apply for the financial benefit; it is an efficient and cost-effective means encourage customers to purchase relatively high-volume, low-cost measures such as LEDs. Higher value incentives for larger measures (appliances, HVAC, etc.) are processed through a post-purchase application form that is designed to verify that incentives are delivered only for eligible measures. And finally, Pacific Power offered customers the opportunity to request free Starter Kits comprised of energy saving lighting and water saving measures through an online application process.

2.2 Impact Evaluation Objectives

The primary objective of the impact evaluation is to determine the gross and net energy savings (kWh) that resulted from the Program. Gross energy savings reflect the estimated amount of energy savings resulting from the installation of measures that incentives were paid for. Net energy savings reflect gross savings multiplied by the deemed net-to-gross (NTG) ratio prescribed by the California Public Utilities Commission (CPUC) in the Database for Energy Efficiency Resources (DEER).

ADM completed the following steps to determine the evaluated gross and net energy savings (kWh) that resulted from the Program.

- Reviewed and reconciled program tracking data to the claimed participation counts and ex-ante savings in 2019 and 2020 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 variables.
- For determining net energy savings and calculating cost-effectiveness, California standards utilize the CPUC’s DEER NTG values. The NTG values for 2019 and 2020 presented in this report are sourced from DEER as prescribed by CPUC.
- 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 rates for lighting measures using geospatial analysis.
- Provided inputs for cost benefit analyses.
- Provided ongoing technical reviews and guidance throughout the evaluation cycle.
- ADM did not conduct on-site verification or equipment monitoring as part of this evaluation.

2.3 Process Evaluation Objectives

The purpose of the process evaluation is 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.

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

3 Impact Evaluation

The Home Energy Savings Program resulted in a net evaluated savings of 712,855 kWh during the evaluation period. Gross and net evaluated savings (kWh) are presented in Table 3-1 through Table 3-3. Detailed impact evaluation results and analysis methodology for each measure category are included in subsequent sections.

Table 3-1: Total Program Savings by Measure Category 2019-2020

Measure Category	Quantity	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
HVAC	297	844,869	837,770	64.92%	0.99	462,803
Heat Pump – Ductless	259	703,280	694,020	53.55%	0.99	381,711
Heat Pump - Air Source	27	131,539	133,891	10.33%	1.02	73,640
Duct Sealing and/or Insulation	8	8,826	8,826	0.97%	1.00	6,884
Smart Thermostat	2	1,204	1,033	0.08%	0.86	568
Central Air Conditioner	1	20	-	0.00%	-	-
Energy Kits	1,267	359,163	335,420	26.57%	0.93	189,400
Best Kit	895	356,473	330,618	26.20%	0.93	186,739
LED Kit	372	2,690	2,924	0.37%	1.09	2,661
Whole Home	11	37,963	37,500	3.87%	0.99	20,625
New Home - Performance Path	10	37,963	37,500	3.87%	0.99	20,625
Whole Home - Ductless Heat Pump	1	-	-	2.89%	-	-
Lighting	3,153	32,052	33,365	2.89%	1.04	27,596
LED	3,153	32,052	33,365	-	1.04	27,596
Water Heating	20	16,758	17,559	1.35%	1.05	9,657
Heat Pump Water Heater	20	16,758	17,559	1.35%	1.05	9,657
Appliances	16	3,426	3,630	0.28%	1.06	1,997
Clothes Washer - Electric DHW & Electric Dryer	11	1,683	1,530	0.12%	0.91	842
Heat Pump Clothes Dryer	3	1,498	1,974	0.15%	1.32	1,086
Refrigerator CEE Tier 3	1	161	42	0.00%	0.26	23
Clothes Washer - Electric DHW & Gas Dryer	1	84	84	0.01%	1.00	46
Building Shell	5,112	2,039	2,039	0.11%	1.00	776
Wall Insulation	870	1,279	1,279	0.05%	1.00	358
Attic Insulation	4,242	760	760	0.06%	1.00	418
Total	9,876	1,296,270	1,265,406	100.00%	0.98	712,855

Table 3-2: Total Program Savings by Measure Category 2019

Measure Category	Quantity	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
HVAC	154	535,052	525,189	71.92%	0.98	290,687
Heat Pump – Ductless	130	438,801	429,454	58.44%	0.98	236,200
Heat Pump - Air Source	18	88,283	87,767	11.94%	0.99	48,272
Duct Sealing and/or Insulation	6	7,968	7,968	1.54%	1.00	6,215
Energy Kits	404	127,455	155,888	22.44%	1.22	90,703
Best Kit	341	125,667	153,942	22.00%	1.22	88,932
LED Kit	63	1,788	1,946	0.44%	1.09	1,771
Lighting	1,321	15,244	16,284	3.28%	1.07	13,271
LED	1,321	15,244	16,284	3.28%	1.07	13,271
Whole Home	4	8,192	11,300	1.54%	1.38	6,215
New Home - Performance Path	3	8,192	11,300	1.54%	1.38	6,215
Whole Home - Ductless Heat Pump	1	-	-	0.00%	-	-
Water Heating	7	3,580	3,580	0.49%	1.00	1,969
Heat Pump Water Heater	7	3,580	3,580	0.49%	1.00	1,969
Building Shell	3,496	1,752	1,752	0.18%	1.00	618
Wall Insulation	870	1,279	1,279	0.17%	1.00	358
Attic Insulation	2,626	473	473	0.01%	1.00	260
Appliances	11	1,622	1,350	0.01%	0.83	743
Clothes Washer - Electric DHW & Electric Dryer	9	1,377	1,224	0.15%	0.89	673
Refrigerator CEE Tier 3	1	161	42	0.09%	0.26	23
Clothes Washer - Electric DHW & Gas Dryer	1	84	84	0.06%	1.00	46
Total	5,397	692,897	715,344	100.00%	103%	404,206

Table 3-3: Total Program Savings by Measure Category 2020

Measure Category	Quantity	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
HVAC	143	309,817	312,581	55.76%	1.01	172,117
Heat Pump – Ductless	129	264,479	264,566	47.14%	1.00	145,511
Heat Pump - Air Source	9	43,256	46,124	8.22%	1.07	25,368
Smart Thermostat	2	1,204	1,033	0.18%	0.86	568
Duct Sealing and/or Insulation	2	858	858	0.22%	1.00	669
Central Air Conditioner	1	20	-	0.00%	-	-
Energy Kits	863	231,708	177,654	31.98%	0.77	98,696
Best Kit	554	230,806	176,676	31.69%	0.77	97,807
LED Kit	309	902	978	0.29%	1.08	890
Whole Home	7	29,771	26,200	4.67%	0.88	14,410
New Home - Performance Path	7	29,771	26,200	4.67%	0.88	14,410
Lighting	1,832	16,808	17,081	4.64%	1.02	14,325
LED	1,832	16,808	17,081	4.64%	1.02	14,325
Water Heating	13	13,178	13,979	2.49%	1.06	7,688
Heat Pump Water Heater	13	13,178	13,979	2.49%	1.06	7,688
Appliances	5	1,804	2,280	0.41%	1.26	1,254
Heat Pump Clothes Dryer	3	1,498	1,974	0.35%	1.32	1,086
Clothes Washer - Electric DHW & Electric Dryer	2	306	306	0.05%	1.00	168
Building Shell	1,616	288	288	0.05%	1.00	158
Attic Insulation	1,616	288	288	0.05%	1.00	158
Total	4,479	603,374	550,062	100.00%	0.91	308,649

3.1 Impact Evaluation Approach

ADM's evaluated unit energy savings (UES) for each measure takes into consideration savings values presented in TRL reference files. TRL reference files generally rely on California Database for Energy Efficiency Resources (DEER) developed by the California Public Utilities Commission (CPUC) and the Regional Technical Forum (RTF) library of measure UESs maintained by Northwest Power and Conservation Council to verify and evaluate energy efficiency savings.

When applicable, ADM incorporated verified variables such as installation rates and hours in place of ex ante variables used in the calculation of DEER and RTF savings values.

When determining savings that resulted from heat pumps, in addition to reporting evaluated savings based on savings values sourced from TRL reference files, ADM completed a usage data analysis to provide insights to consider for future program design.

3.1.1 Data Collection and Measure Verification

During the evaluation period ADM reviewed and reconciled program tracking data to the participation counts and ex-ante savings indicated in the 2019 and 2020 annual reports. ADM reviewed a census of program tracking data, associated savings values, input 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 surveyed a representative sample of known participants and employed a general population survey for unknown participants (those who purchased upstream measures) to collect installation data.

ADM completed the following activities as part of the evaluation, measurement and verification process.

- Review of the program tracking database is an essential step for verifying data integrity. ADM reviewed a census of program tracking dataset for completeness, consistency, and compliance with the provided TRL files.
- Review of measure savings assumptions and calculations maintained in the Technical Reference Library (TRL). The TRL files 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 Program. ADM reviewed all TRL documentation and included in this report any errors, omissions, or inconsistencies

identified during ADM's review. Appendix A: Ex Ante Review of TRL includes a complete list of the TRL reference files that ADM used in this evaluation.

- ADM requested program tracking data, TRL reports and reference files, in addition to other program data and verification, as necessary.
- ADM collected primary data from Pacific Power customers through two online surveys; one to customers who received energy kits, and the other to the general customer population to collect data about upstream measures.

3.1.2 Sample Design

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 upstream lighting measures, for which participants are not known, ADM employed a General Population Survey where the sampling frame is the population of Pacific Power residential customers in California excluding known participants in any energy efficiency programs that Pacific Power implemented in 2019 or 2020. Four hundred one customers responded to the survey. These responses were used to collect data used in the impact analysis for lighting measures.

For starter kits, the sampling frame is the population of participants for whom the tracking dataset includes valid email addresses. Sixty-eight starter kit program participants completed an online survey.

A census of HVAC tracking data was reviewed in detail, and an alternative analysis was completed using a census of billing data from customers who received a heat pump incentive.

ADM included the following datasets in its evaluation:

- Census review of all measures in the program tracking dataset to ensure appropriate use of UES values sourced from TRL files.
- Census review of heat pump manufacturer model numbers and specifications to verify that heat pumps for which incentives were paid met efficiency criteria established in the TRL reference files.
- Census review of lighting measures by manufacturer and product model number to verify that lighting products for which incentives were paid met the efficiency criteria established in the TRL reference files.

- Census review of heat pump water heater and other appliance manufacturer model numbers and specifications to verify that measures for which incentives were paid met efficiency criteria established in the TRL reference files.
- A sample of program participants who received energy kits was surveyed for measure installation rates, installation location, and process evaluation responses.
- A sample of Pacific Power residential customers who were not known to have participated in any downstream or request-by-mail Home Energy Savings Program offering was surveyed using a general customer population survey to determine measure installation rates, installation location, and process evaluation responses for upstream lighting measures.

Table 3-4: Survey Sample Response Size

Survey	Number of Survey Invites Sent	Number of Completed Surveys	Response Rate
General Population Survey	4,000	401	10%
Energy Kits Survey	336	68	20%

3.1.3 Impact Evaluation Approach by Measure Category

Table 3-5 shows the methodology used to calculate evaluated savings for each measure category. ADM reviewed TRL UES values, their assumptions and calculations, modeling files, and additional information contained in the TRL reference files and underlying DEER and Regional Technical Forum (RTF) files. NTG values were sourced from the CPUC's DEER database.

Table 3-5: Impact Evaluation Methodology Approach by Measure

Measure Category	Impact Evaluation Methodologies	Inputs to Gross Evaluated Savings
HVAC	Unit Energy Savings Review Supplemental Billing Analysis	<ul style="list-style-type: none"> • TRL reference files • Verified savings values
Energy Kits	Unit Energy Savings Review	<ul style="list-style-type: none"> • TRL reference files • Verified savings values • Energy Kits Survey
Whole Homes	Unit Energy Savings Review	<ul style="list-style-type: none"> • Project files
Lighting	Unit Energy Savings Review	<ul style="list-style-type: none"> • TRL reference files • Verified savings values • General population survey
Water Heating	Unit Energy Savings Review	<ul style="list-style-type: none"> • TRL reference files • Verified savings values
Appliances	Unit Energy Savings Review	<ul style="list-style-type: none"> • TRL reference files • Verified savings values
Building Shell	Unit Energy Savings Review	<ul style="list-style-type: none"> • TRL reference files • Verified savings values

3.2 HVAC

Pacific Power offered customers financial incentives to install energy efficient HVAC measures in their homes during the evaluation period. HVAC measures resulted in 462,803 kWh savings, accounting for 65 percent of program savings during the evaluation period. HVAC measures included heat pumps, duct sealing, smart thermostats and a single central air conditioner. Ninety-nine percent of HVAC savings resulted from ductless heat pumps. HVAC program savings are reported in Table 3-6 through Table 3-8.

Table 3-6: HVAC Program Savings 2019-2020

Measure Category	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Heat Pump – Ductless	259	703,280	694,020	0.99	0.55	381,711
Heat Pump - Air Source	27	131,539	133,891	1.02	0.55	73,640
Duct Sealing and/or Insulation	8	8,826	8,826	1.00	0.78	6,884
Smart Thermostat	2	1,204	1,033	0.86	0.55	568
Central Air Conditioner	1	20	-	0.00	0.55	-
Total	297	844,869	837,770	0.99		462,803

Table 3-7: HVAC Program Savings 2019

Measure Category	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Heat Pump – Ductless	130	438,801	429,454	0.98	0.55	236,200
Heat Pump - Air Source	18	88,283	87,767	0.99	0.55	48,272
Duct Sealing and/or Insulation	6	7,968	7,968	1.00	0.78	6,215
Total	154	535,052	525,189	0.98		290,687

Table 3-8: HVAC Program Savings 2020

Measure Category	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Heat Pump – Ductless	129	264,479	264,566	1.00	0.55	145,511
Heat Pump - Air Source	9	43,256	46,124	1.07	0.55	25,368
Smart Thermostat	2	1,204	1,033	0.86	0.55	568
Duct Sealing and/or Insulation	2	858	858	1.00	0.78	669
Central Air Conditioner	1	20	-	0.00	0.55	-
Grand Total	143	309,817	312,581	1.01		172,117

3.2.1 Tracking Data Verification

ADM reviewed program tracking data to evaluate if:

- The tracking dataset included duplicate or erroneous data entries;
- Data entries in the program tracking dataset included all necessary fields for savings calculations;
- Claimed energy savings match the applicable TRL source documents and calculations;
- Verification of measure incentive requirements for a sample of HVAC measure items (e.g. model numbers or HSPF reported in implementer's tracking data.)

Through this review process, ADM found the following inconsistencies in the dataset:

- Baseline conditions were missing from 36 records;
- Rebate applications were missing from 21 records;
- The incorrect climate zone was indicated on 22 records.

3.2.2 Ex Ante Review

ADM evaluated the UES values claimed by Pacific Power to verify that they were supported by the applicable TRL documents. Savings values reported in the tracking data matched the values reported in reference files included in the TRL except for *Ductless Heat Pump - Multi-head* and *Ductless Heat Pump - Single-head* for which no reference files were provided to document the source for the claimed savings. There was no notable program design difference between the documented and undocumented heat pump savings, therefore ADM accepted the claimed savings for these measures.

3.2.3 Evaluated Savings

Evaluated savings were calculated using UES values included in the TRL reference files. See Table 3-9 through Table 3-11 for savings by measure for the evaluation period. No adjustments were made to the claimed savings when program tracking data accurately reflected installed measures. For the 22 tracking data records that referenced the incorrect climate zone, evaluated savings reflect the correct climate zone. When neither verifiable model number no efficiency rating were available (6 records), no evaluated savings were assigned. When model specifications did not meet measure definition efficiency rating (3 records), no evaluated savings were assigned.

Table 3-9: HVAC Program Savings by Measure 2019-2020

Measure - Version	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Central Air Conditioner	1	20	-	0.00	0.55	-
Central Air Conditioner Upgrade - SEER 15 - < 45k BTU - CZ01 - CA - 1	1	20	-	0.00	0.55	-
Duct Sealing and/or Insulation	8	8,826	8,826	1.00	0.78	6,884
Manufactured Home - Duct Sealing - Direct Install - < 35 and >= 25% to <=15% Total Leakage - CZ16 - CA - 1	1	858	858	1.00	0.78	669
Manufactured Home - Duct Sealing - Direct Install - >=35% to <=15% Total Leakage - CZ16 - CA - 1	4	7,968	7,968	1.00	0.78	6,215
Manufactured Home - Duct Sealing - Direct Install - Test Only - CA - 1	3	-	-	-	-	-
Heat Pump - Air Source	27	131,539	133,891	1.02	0.55	73,640
Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ16 - CA - 1	1	7,293	7,293	1.00	0.55	4,011
Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 - CA - 1	1	7,169	7,169	1.00	0.55	3,943
Heat Pump Conversion - Convert FAF w/out CAC to 9.0 HSPF ASHP - CZ16 - CA - 1	1	7,045	7,045	1.00	0.55	3,875
Heat Pump Conversion - Convert FAF w/out CAC to Federal Standard ASHP - CZ01 - CA - 1	1	5,146	5,146	1.00	0.55	2,830
Heat Pump Conversion - Tier 1 - CA - 3	5	31,855	31,855	1.00	0.55	17,520
Heat Pump Conversion - Tier 2 - CA - 2	9	60,525	60,525	1.00	0.55	33,289
Heat Pump Upgrade - 9.4 HSPF - 17 SEER - CZ16 - CA - 2	1	248	152	0.61	0.55	84
Heat Pump Upgrade - 9.7 HSPF - 18 SEER - CZ16 - CA - 1	1	833	833	1.00	0.55	458
Heat Pump Upgrade - Tier 1 - CA - 3	2	726	726	1.00	0.55	399
Heat Pump Upgrade - Tier 2 - CA - 2	2	(4,823)	(5,339)	1.11	0.55	(2,936)
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ01 - CA - 1	1	4,736	6,230	1.32	0.55	3,427
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ01 - CA - 1	1	4,658	6,128	1.32	0.55	3,370
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 - CA - 1	1	6,128	6,128	1.00	0.55	3,370

Measure - Version	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Heat Pump - Ductless	259	703,280	694,020	0.99	0.55	381,711
Ductless Heat Pump - Multi-head - CA - 3	48	238,560	233,590	0.98	0.55	128,475
Ductless Heat Pump - Single-head - CA - 3	59	153,636	148,428	0.97	0.55	81,635
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 - CA - 1	3	7,893	8,724	1.11	0.55	4,798
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 - CA - 1	1	3,462	3,462	1.00	0.55	1,904
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	8	18,104	18,104	1.00	0.55	9,957
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	2	3,440	3,983	1.16	0.55	2,191
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	1	1,120	1,473	1.32	0.55	810
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	8	11,784	11,784	1.00	0.55	6,481
New Homes - Ductless Heat Pump - CA CZ01 - 1	8	10,608	5,304	0.50	0.55	2,917
New Homes - Ductless Heat Pump - CA CZ01 - 1	1	1,326	1,326	1.00	0.55	729
New Homes Ductless Heat Pump - CA - 2	5	5,735	5,735	1.00	0.55	3,154
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 - CA - 1	6	13,176	14,564	1.11	0.55	8,010
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 - CA - 1	16	46,240	45,546	0.98	0.55	25,050
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	41	70,520	75,407	1.07	0.55	41,474
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	52	117,676	116,590	0.99	0.55	64,125
Smart Thermostat	2	1,204	1,033	0.86	0.55	568
Smart Thermostat - eFAF - CZ16 - CA - 1	1	492	492	1.00	0.55	271
Smart Thermostat - Heat Pump - CZ16 - CA - 1	1	712	541	0.76	0.55	298
Total	297	844,869	837,770	0.99		462,803

Table 3-10: HVAC Program Savings by Measure 2019

Measure - Version	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Duct Sealing and/or Insulation	6	7,968	7,968	1.00	0.78	6,215
Manufactured Home - Duct Sealing - Direct Install - >=35% to <=15% Total Leakage - CZ16 - CA - 1	4	7,968	7,968	1.00	0.78	6,215
Manufactured Home - Duct Sealing - Direct Install - Test Only - CA - 1	2	-	-	#DIV/0!	0.78	-
Heat Pump - Air Source	18	88,283	87,767	0.99	0.55	48,272
Heat Pump Conversion - Tier 1 - CA - 3	4	25,484	25,484	1.00	0.55	14,016
Heat Pump Conversion - Tier 2 - CA - 2	9	60,525	60,525	1.00	0.55	33,289
Heat Pump Upgrade - Tier 1 - CA - 3	2	726	726	1.00	0.55	399
Heat Pump Upgrade - Tier 2 - CA - 2	3	1,548	1,032	0.67	0.55	568
Heat Pump - Ductless	130	438,801	429,454	0.98	0.55	236,200
Ductless Heat Pump - Multi-head - CA - 3	47	233,590	228,620	0.98	0.55	125,741
Ductless Heat Pump - Single-head - CA - 3	57	148,428	143,220	0.96	0.55	78,771
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 - CA - 1	2	5,262	6,093	1.16	0.55	3,351
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 - CA - 1	1	3,462	3,462	1.00	0.55	1,904
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	1	2,263	2,263	1.00	0.55	1,245
New Homes Ductless Heat Pump - CA - 2	5	5,735	5,735	1.00	0.55	3,154
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 - CA - 1	6	17,340	17,340	1.00	0.55	9,537
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	4	6,880	6,880	1.00	0.55	3,784
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	7	15,841	15,841	1.00	0.55	8,713
Total	154	535,052	525,189	0.98		290,687

Table 3-11: HVAC Program Savings by Measure 2020

Measure - Version	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Central Air Conditioner	1	20	-	0.00	0.55	-
Central Air Conditioner Upgrade - SEER 15 - < 45k BTU - CZ01 - CA - 1	1	20	-	0.00	0.55	-
Duct Sealing and/or Insulation	2	858	858	1.00	0.78	669
Manufactured Home - Duct Sealing - Direct Install - < 35 and >= 25% to <=15% Total Leakage - CZ16 - CA - 1	1	858	858	1.00	0.78	669
Manufactured Home - Duct Sealing - Direct Install - Test Only - CA - 1	1	-	-	0.00	0.78	-
Heat Pump - Air Source	9	43,256	46,124	1.07	0.55	25,368
Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ16 - CA - 1	1	7,293	7,293	1.00	0.55	4,011
Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 - CA - 1	1	7,169	7,169	1.00	0.55	3,943
Heat Pump Conversion - Convert FAF w/out CAC to 9.0 HSPF ASHP - CZ16 - CA - 1	1	7,045	7,045	1.00	0.55	3,875
Heat Pump Conversion - Convert FAF w/out CAC to Federal Standard ASHP - CZ01 - CA - 1	1	5,146	5,146	1.00	0.55	2,830
Heat Pump Conversion - Tier 1 - CA - 3	1	6,371	6,371	1.00	0.55	3,504
Heat Pump Upgrade - 9.4 HSPF - 17 SEER - CZ16 - CA - 2	1	248	152	0.61	0.55	84
Heat Pump Upgrade - 9.7 HSPF - 18 SEER - CZ16 - CA - 1	1	833	833	1.00	0.55	458
Heat Pump Upgrade - Tier 2 - CA - 2	-1	(6,371)	(6,371)	1.00	0.55	(3,504)
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ01 - CA - 1	1	4,736	6,230	1.32	0.55	3,427
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ01 - CA - 1	1	4,658	6,128	1.32	0.55	3,370
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 - CA - 1	1	6,128	6,128	1.00	0.55	3,370
Heat Pump - Ductless	129	264,479	264,566	1.00	0.55	145,511
Ductless Heat Pump - Multi-head - CA - 3	1	4,970	4,970	1.00	0.55	2,734
Ductless Heat Pump - Single-head - CA - 3	2	5,208	5,208	1.00	0.55	2,864
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 - CA - 1	1	2,631	2,631	1.00	0.55	1,447
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	7	15,841	15,841	1.00	0.55	8,713
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	2	3,440	3,983	1.16	0.55	2,191

Measure - Version	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	1	1,120	1,473	1.32	0.55	810
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	8	11,784	11,784	1.00	0.55	6,481
New Homes - Ductless Heat Pump - CA CZ01 - 1	8	10,608	5,304	0.50	0.55	2,917
New Homes - Ductless Heat Pump - CA CZ01 - 1	1	1,326	1,326	1.00	0.55	729
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 - CA - 1	6	13,176	14,564	1.11	0.55	8,010
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 - CA - 1	10	28,900	28,206	0.98	0.55	15,513
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 - CA - 1	37	63,640	68,527	1.08	0.55	37,690
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 - CA - 1	45	101,835	100,749	0.99	0.55	55,412
Smart Thermostat	2	1,204	1,033	0.86	0.55	568
Smart Thermostat - eFAF - CZ16 - CA - 1	1	492	492	1.00	0.55	271
Smart Thermostat - Heat Pump - CZ16 - CA - 1	1	712	541	0.76	0.55	298
Total	143	309,817	312,581	1.01		172,117

3.2.4 Discussion of Realization Rates

Evaluated savings for the HVAC measure category resulted in 99 percent realization rate.

ADM supports Pacific Power transition from generically described ductless heat pumps to measure definitions that include baseline and climate zone conditions. While these measure naming conventions continue to generalize both baseline and efficient conditions, they improve the ability to estimate savings in the absence of detailed specific measure variables included in the tracking dataset.

Realization rates other than 100 percent resulted from the following factors:

Incorrect climate zones were indicated for 22 records in the tracking data. Evaluated savings reflect correct climate zones.

Efficiency rating threshold was not met for three records in the tracking data. Evaluated saving reflect no savings for those records.

Verifiable model specifications were not provided for six records. When neither verifiable model number nor efficiency rating were available to verify that efficiency threshold was met, no evaluated savings were assigned.

3.2.5 Net to Gross Ratio

The default deemed NTG ratio of .55 was applied to all HVAC measures except duct sealing which has a deemed NTG ratio of .78, as indicated in California's DEER.

3.2.6 Additional Analysis of Heat Pumps

To fulfill the M&V commitments outlined in the work plan, ADM completed a billing analysis using consumption data from homes that installed heat pumps during the evaluation period. The following sections outline the methodology and results of this analysis.

3.2.6.1 Data Collection and Review

ADM reviewed all program tracking data available for customers that received heat pumps through the program. The program data included the "Measure Effective Date" (presumed to be the date on which the new heat pump was installed), the "Measure Name", "Housing Type," and "Previous Heat Source". All program participant homes were classified as "Single Family" premises with the exception of one "Manufactured Home." For 60 of the 256 premises ADM received data specifying the home's baseline heating was electric, the remaining 196 had unknown or unreported baseline conditions.

ADM received billing data from early 2017 through early 2021 for 256 unique residential premises that installed ductless heat pumps discounted through the program. The data

received was reviewed and ADM removed premises from the analysis using the following criteria:

- 6 or more months of billing data both prior to installation of the heat pump as well as following installation required for inclusion in the model;
- No periods of zero energy consumption that might indicate the premise was not occupied;
- Not an outlier. Outliers were classified as premises with consumption records greater than 1.5 times the interquartile range of the average, per-premise daily consumption of the entire program population.

After completing these data review checks, 179 premises that had installed program-rebated heat pumps were available for use in ADM's regression model.

In addition to customer-specific data, ADM also acquired weather data from the National Oceanic and Atmospheric Administration database. Because the evaluation service territory spans a large area, premises are paired with their closest weather station by zip code.

3.2.6.2 Analysis Methodology

ADM utilized a difference-in-differences (post-only) methodology which involves the use of a linear regression model on premise energy consumption data with a dummy term (that is either 1 or 0) labeled as 'post' included to designate whether a data point occurs before or after installation. This has the effect of allowing the term to drop out of the regression for pre-period data points and assigns a coefficient value for post-period data points that describes how the energy consumption changes solely due to the intervention effect while controlling for other regression variables. The model equation is shown in Equation 1.

Equation 1: Ductless Heat Pump Linear Regression Model

$$AEC_{i,t} = \alpha_j + \beta_1 \times Post + \beta_2 \times Month + \beta_3 \times DD + \epsilon$$

Where:

$AEC_{i,t}$	is the average daily consumption of electricity for period, t , for a given customer (i).
$\alpha_{j[i]}$	is an intercept term unique to each account number where $j = 1, \dots, J$ and J is the number of premises.
$Post$	is a dummy variable that can be either 0 or 1 depending on whether or not a data point is before or after measure installation.

- Month* is a categorical variable controlling for changes in base consumption for each month of the year.
- DD* represents the degree day variable for each data point, used as a proxy for either heating or cooling usage, depending on the seasonal model².
- ϵ The error term.

3.2.6.3 Results

The results of the regression analysis are shown below in Table 3-12. ADM found that consumption increased by 0.64 kWh/day during summer months and by 4.5 kWh/day during the winter months. Overall, these results indicate a net increase in energy consumption following the installation of a heat pump of 1,286 kWh per premise, annually.

Table 3-12: Ductless Heat Pump Regression Analysis Results

Season	Daily Savings	Daily Error	Seasonal Savings [†]	Annual Savings	Premise Count	Data Points
Summer	-0.64	0.45	-59	-1,286	179	1,686
Winter	-4.50	0.34	-1,228		179	5,455

[†]ADM defined the “Summer Season” as July-September (92 days) and the “Winter Season” as October-June (273 days).

Regression statistics are provided in Table 3-13 below for each coefficient listed in Equation 1 as well as the standard error on those estimates and associated t-value and R-Squared values for each. T-value can be interpreted as the relative importance of the term in estimating the premise consumption. For example, the magnitude of the CDD and HDD terms (β_3) relative to the t-values of the other terms indicate their significant influence in determining the predicted consumption. Moreover, ADM considers the results to be statistically significant for the winter season because the absolute value of the t-value for β_1 , the coefficient used to determine savings, is greater than 1.645, the z-score which corresponds to the 90% confidence level. The R-Squared value can be interpreted as the linear regression fit, where a value of 1 indicates a perfect fit.

² ADM determined optimal cooling and heating degree day base temperatures to use in the regression by creating a list of possible degree day base temperatures (both cooling and heating) at whole number intervals and then iterating through the 2-dimensional set. Each iteration fit a linear regression model to energy consumption and a degree day set; the set which minimized the root mean squared error of the model was then used as the optimal degree day base temperatures. Based on the results of this analysis, ADM used a base temperature of 70°F for cooling and 55°F for heating.

Table 3-13: Ductless Heat Pump Regression Analysis Statistics

Season	Term	Estimate	Standard Error	t-value	R-Squared
Summer	$\alpha_{j[i]}$	23.13	2.46	9.41	0.73
	β_1	0.64	0.45	1.43	
	β_2	0.22	0.27	0.81	
	β_3	17.85	2.79	6.41	
Winter	$\alpha_{j[i]}$	24.67	1.28	19.32	0.66
	β_1	4.50	0.34	13.30	
	β_2	-0.12	0.05	-2.26	
	β_3	21.55	0.70	30.65	

3.2.6.4 Discussion of Additional Heat Pump Analysis

Since the winter season regression analysis indicates a net increase in consumption following the installation of a heat pump, it is likely that at least some program participants had non-electric baseline heating conditions in their homes. Baseline conditions may have included a variety of primary or secondary fuel types other than electric heat sources, such as wood, oil, propane, kerosene, white fuel, diesel, or natural gas, as indicated by the general population survey findings (see Table 4-4 in Section 4.2: General Population Survey). Moreover, considering that the summer season regression analysis also indicates a net increase in consumption following the installation of a heat pump, it is likely that some participants utilize their heat pumps for cooling their homes as well as heating.

The negative savings values found via the regression analysis suggest that the range of baseline conditions present in the customer population may not be fully represented in the TRL ex ante assumptions. Additional review of baseline heating fuels (both primary and secondary sources) for program applicants as well as revised ex ante baselines may be advisable for future program years, if heat pumps were added back into the program.

3.3 Starter Kits

Pacific Power supplied 1,267 energy saving kits, referred to as *Starter Kits* on the Pacific Power web site, at no charge to eligible customers in California who requested them. The kits resulted in 189,400 kWh of savings, accounting for 27 percent of total program savings during the evaluation period.

All kits contained four standard LED bulbs; customers who indicated that they had an electric water heater also received water saving aerators and low flow showerheads for up to two bathrooms. Pacific Power customer eligibility was determined through the web-based portal where customers ordered kits.

In May of 2020, Pacific Power increased the per-customer limit from one to two kits every ten years with the following parameters:

- Second kits would be lighting only if a water savings kit was previously provided.
- If a customer requested two kits, only one could be a bathroom kit.
- No two-bathroom kits should be given out for customers who receive a second kit that is a water savings kit.

Total starter kit savings(kWh) are presented in Table 3-14 Table 3-16. Pacific Power discontinued Starter Kits measures in September 2020.

Table 3-14: Starter Kit Program Savings 2019-2020

Measure - Version	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
Version 5					
Energy Savings Kit - Best - 1 Bathroom - CA - 5	111	26,758	41,332	154%	24,204
Energy Savings Kit - Best - 2 Bathrooms - CA - 5	210	90,670	106,667	118%	61,450
Energy Savings Kit - LED - CA - 5	52	1,756	1,914	109%	1,742
Version 6					
Energy Savings Kit - Best - 1 Bathroom - CA - 6	181	51,585	44,384	86%	24,617
Energy Savings Kit - Best - 2 Bathrooms - CA - 6	393	187,461	138,235	74%	76,467
Energy Savings Kit - LED - CA - 6	320	934	1,009	108%	919
Grand Total	1,267	359,163	333,542	93%	189,400

Table 3-15: Starter Kit Program Savings 2019

Measure - Version	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
Version 5					
Energy Savings Kit - Best - 1 Bathroom - CA - 5	110	26,517	40,960	154%	23,986
Energy Savings Kit - Best - 2 Bathrooms - CA - 5	210	90,670	106,667	118%	61,450
Energy Savings Kit - LED - CA - 5	52	1,756	1,914	109%	1,742
Version 6					
Energy Savings Kit - Best - 1 Bathroom - CA - 6	8	2,280	1,973	87%	1,094
Energy Savings Kit - Best - 2 Bathrooms - CA - 6	13	6,201	4,342	70%	2,402
Energy Savings Kit - LED - CA - 6	11	32	32	99%	29
Total	404	127,455	155,888	122%	90,703

Table 3-16: Starter Kit Program Savings 2020

Measure - Version	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
Version 5					
Energy Savings Kit - Best - 1 Bathroom - CA - 5	1	241	372	154%	218
Version 6					
Energy Savings Kit - Best - 1 Bathroom - CA - 6	173	49,305	42,411	86%	23,523
Energy Savings Kit - Best - 2 Bathrooms - CA - 6	380	181,260	133,893	74%	74,065
Energy Savings Kit - LED - CA - 6	309	902	978	108%	890
Total	863	231,708	177,654	77%	98,696

Net evaluated savings reflect the gross evaluated saving with applied deemed NTG ratios. NTG ratios were applied at the component level and are therefore not included at the kit level in Table 3-14 through Table 3-16.

3.3.1 Tracking Data Verification

ADM reviewed program tracking data to evaluate if:

- Tracking dataset included duplicate or erroneous data entries
- Data entries in the program tracking dataset included all necessary fields for savings calculations
- Claimed energy savings match the applicable TRL source documents and calculations

ADM found the following inconsistencies in the dataset.

- Nine customers received two starter kits before the 10-year per-customer limit was raised from one to two kits.
- Eleven customers received two starter kits with water saving measures.

3.3.2 Ex Ante Review

ADM completed an ex ante review of each kit version to verify that claimed savings in the tracking data reflected the ex ante values in the TRL reference documents. Reference files included additional embedded reference files for each kit component. These documents were used to identify ex ante assumptions for in service rates and the percentage of recipients with electric water heaters.

ADM identified the following errors in ex ante values included in TRL reference documents.

Version 5 Kit

- The ex ante component savings for Kitchen Aerator was assigned saving for a bathroom aerator (16.6 kWh). ADM used the kitchen aerator savings (151.14 kWh) to calculate evaluated savings (see Table 3-17, column *Adjusted Ex Ante UES*).

Version 6 Kit

- The ex ante savings values claimed for the showerhead (171.91), kitchen aerator (89.64), and bath aerator (20.5) were not supported by the TRL reference document. See **Error! Reference source not found.** for adjusted gross savings values from reference documents that were used to calculate evaluated savings.

3.3.3 Evaluated Savings

To calculate evaluated savings, ADM adjusted ISRs and percentage of recipients with electric water heaters from the assumptions documented in reference files to actual ISR and percentage electric water heaters calculated from participant survey responses. Respondents reported installation information for each component, allowing ADM to calculate ISRs for each kit component separately. Only customers who received water savings measures were considered when calculating percentage of participants with electric water heaters. Source reference files for adjusted savings for aerators and showerheads of version 6 kits are indicated in table notes. Savings for each configuration of each version of starter kits is included in Table 3-17 and Table 3-18.

Table 3-17: Unit Energy Savings - Version 5

Kit Component	Claimed UES (kWh)	Ex Ante ISR	Ex Ante % Electric DHW	Adjusted Ex Ante UES	Evaluated ISR	Evaluated % Electric DHW	Gross Evaluated UES (kWh)	Realization Rate	Deemed NTG	Net Evaluated Savings
Energy Savings Kit - Best - 1 Bathroom										
LED 1 (9.5 Watt)	8.44	84%		8.44	100%		10.05	119%	0.91	9.14
LED 2 (9.5 Watt)	8.44	84%		8.44	95%		9.57	113%	0.91	8.71
LED 3 (9.5 Watt)	8.44	84%		8.44	88%		8.86	105%	0.91	8.06
LED 4 (9.5 Watt)	8.44	84%		8.44	83%		8.34	99%	0.91	7.59
Aerator Kitchen (1.5 gph)	16.60	67%	84%	151.14	66%	93%	164.68	992%	0.55	90.57
Aerator Bath 1 (0.5 gpm)	34.70	67%	84%	34.70	66%	93%	37.81	109%	0.55	20.79
Showerhead 1 (1.5 gpm)	156.00	84%	84%	156.00	65%	93%	133.06	85%	0.55	73.18
TOTAL	241.06						372.36	154%		218.05
Energy Savings Kit - Best - 2 Bathrooms										
LED 1 (9.5 Watt)	8.44	84%		8.44	100%		10.05	119%	0.91	9.14
LED 2 (9.5 Watt)	8.44	84%		8.44	95%		9.57	113%	0.91	8.71
LED 3 (9.5 Watt)	8.44	84%		8.44	88%		8.86	105%	0.91	8.06
LED 4 (9.5 Watt)	8.44	84%		8.44	83%		8.34	99%	0.91	7.59
Aerator Kitchen (1.5 gph)	16.60	67%	84%	151.14	66%	93%	164.68	992%	0.55	90.57
Aerator Bath 1 (0.5 gpm)	34.70	67%	84%	34.7	66%	93%	37.81	109%	0.55	20.79
Aerator Bath 2 (0.5 gpm)	34.70	67%	84%	34.7	52%	93%	29.61	85%	0.55	16.29
Showerhead 1 (1.5 gpm)	156.00	84%	84%	156	65%	93%	133.06	85%	0.55	73.18
Showerhead 2 (1.5 gpm)	156.00	84%	84%	156	52%	93%	105.96	68%	0.55	58.28
TOTAL	431.76						507.94	118%		292.62
Energy Savings Kit – LED										
LED 1 (9.5 Watt)	8.44	84%		8.44	100%		10.05	119%	0.91	9.14
LED 2 (9.5 Watt)	8.44	84%		8.44	95%		9.57	113%	0.91	8.71
LED 3 (9.5 Watt)	8.44	84%		8.44	88%		8.86	105%	0.91	8.06
LED 4 (9.5 Watt)	8.44	84%		8.44	83%		8.34	99%	0.91	7.59
TOTAL	33.76						36.82	109%		33.50

SOURCES: (Evaluated ISR and % Electric DHW) Customer survey 2021; (LEDs) 2018.08.03_CA_HES_LEDs_Brief.xlsx / LED General Purpose: 9.5 watts - Mail By Request – CA; (Kitchen aerator) 2018.08.03_CA_HES_Faucet_Aerators_Brief.xlsx / Res-FaucetAerKit-Elec-1.5; (Bathroom aerator) 2018.08.03_CA_HES_Faucet_Aerators_Brief.xlsx / Bathroom Faucet Aerators 0.5 gpm Mail by Request Electric Only DHW; (Showerheads) 2018.08.03_CA_HES_Low_Flow_Showerheads_Brief.xlsx / Low Flow Showerheads - Mail by Request - Electric Only - 1.50 gpm (weighted by CZ); (Deemed NTG) READi SupportTable_NTG

Table 3-18: Unit Energy Savings - Version 6

Kit Component	Claimed UES (kWh)	Ex Ante ISR	Ex Ante % Electric DHW	Adjusted Ex Ante UES	Evaluated ISR	Evaluated % Electric DHW	Gross Evaluated UES (kWh)	Realization Rate	Deemed NTG	Net Evaluated Savings
Energy Savings Kit - Best - 1 Bathroom										
LED 1 (9.5 Watt)	0.73	84%		0.73	100%		0.87	119%	0.91	0.79
LED 2 (9.5 Watt)	0.73	84%		0.73	95%		0.83	113%	0.91	0.75
LED 3 (9.5 Watt)	0.73	84%		0.73	88%		0.77	105%	0.91	0.70
LED 4 (9.5 Watt)	0.73	84%		0.73	83%		0.72	99%	0.91	0.66
Aerator Kitchen (1.5 gph)	90.32	67%	84%	90.32	66%	93%	98.41	109%	0.55	54.13
Aerator Bath 1 (0.5 gpm)	20.65	67%	84%	11.07	66%	93%	12.07	58%	0.55	6.64
Showerhead 1 (1.5 gpm)	171.91	84%	84%	155.83	65%	93%	132.92	77%	0.55	73.10
TOTAL	285.80						246.58	86%		136.76
Energy Savings Kit - Best - 2 Bathrooms										
LED 1 (9.5 Watt)	0.73	84%		0.73	100%		0.87	119%	0.91	0.79
LED 2 (9.5 Watt)	0.73	84%		0.73	95%		0.83	113%	0.91	0.75
LED 3 (9.5 Watt)	0.73	84%		0.73	88%		0.77	105%	0.91	0.70
LED 4 (9.5 Watt)	0.73	84%		0.73	83%		0.72	99%	0.91	0.66
Aerator Kitchen (1.5 gph)	89.64	67%	84%	90.32	66%	93%	98.41	110%	0.55	54.13
Aerator Bath 1 (0.5 gpm)	20.50	67%	84%	11.07	66%	93%	12.07	59%	0.55	6.64
Aerator Bath 2 (0.5 gpm)	20.50	67%	84%	11.07	52%	93%	9.45	46%	0.55	5.20
Showerhead 1 (1.5 gpm)	171.91	84%	84%	155.83	65%	93%	132.92	77%	0.55	73.10
Showerhead 2 (1.5 gpm)	171.91	84%	84%	155.83	52%	93%	105.84	62%	0.55	58.21
TOTAL	477.38						361.87	76%		200.18
Energy Savings Kit – LED										
LED 1 (9.5 Watt)	0.73	84%		0.73	100%		0.87	119%	0.91	0.79
LED 2 (9.5 Watt)	0.73	84%		0.73	95%		0.83	113%	0.91	0.75
LED 3 (9.5 Watt)	0.73	84%		0.73	88%		0.77	105%	0.91	0.70
LED 4 (9.5 Watt)	0.73	84%		0.73	83%		0.72	99%	0.91	0.66
TOTAL	2.92						3.18	109%		2.90

SOURCES: (Evaluated ISR and % Electric DHW): Customer survey 2021; (LEDs) 2019.03.01_CA_HES_LEDs_Brief / LED - General Purpose A-Lamp: 60W Equiv. 100-120 LPW; (Aerators and showerheads) PGECODHW125 R7; (Ex ante ISRs for aerators and showerheads) PGECODHW125 R4 Showerheads and aerators.docx; (Deemed NTG) READi SupportTable_NTG; (Ex ante % electric DHW) PGECODHW125 R4 Showerheads and Aerators.doc.

3.3.4 Discussion of Realization Rates

LEDs

LED realization rates exceeded 100 percent because evaluated ISRs exceeded ex ante ISRs except for the last of the 4 bulbs in each kit. TRL reference documents for lighting components include an ex ante ISR of 84 percent. ADM used survey data to calculate ISRs for each light bulb in the kit; individual ISRs ranged from 100 to 83 percent. Realization rates over 100 percent reflect the higher ISRs.

Aerators and Showerheads

The ex ante savings values claimed for water saving measures in the version 6 kits were not supported by the TRL reference document. Corrected values were sourced from DEER reference files. See table notes.

Ex ante values for the percentage of measures installed in homes with electric water heaters was 84 percent for showerheads and aerators. Survey responses from customers who received water savings measures indicate that 93 percent had electric water heaters, resulting in an increased realization rate.

ISRs for water saving measures were calculated for each individual component. Evaluated ISRs were lower than ex ante ISRs, decreasing their realization rates.

Duplication of kits sent to customers

No evaluated savings were assigned to 15 kits that were distributed outside the lifetime per customer limit guidelines.

3.3.5 Net to Gross Ratio

The deemed NTG ratios indicated by California DEER are applied to each kit component individually and are included in Table 3-17 and Table 3-18.

3.4 Lighting

Pacific Power ran an upstream lighting program during the evaluation period which provided in-store discounts on LED lighting products in 14 participating retail stores in the service area. A total of 3,153 discounted LED lighting measures were sold through the program. Lighting measures resulted in 27,596 kWh savings during the evaluation period, representing 4 percent of program savings. Total program savings from lighting measures are reported in Table 3-19.

Table 3-19: Total Program Savings: Lighting

Program Year	Quantity	Ex Ante Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
2019	1,321	15,247	16,286	1.07	13,271
2020	1,832	16,809	17,081	1.02	14,325
2019-2020	3,153	32,056	33,366	1.04	27,596

3.4.1 Tracking Data Verification

ADM reviewed program tracking data to verify that upstream lighting measures were sold through retail stores in the service area. Retail locations were identified for all but 23 of the 3,153 lighting units sold through the program.

3.4.2 Ex Ante Review

ADM reviewed TRL reference documents to verify that the claimed savings matched the savings indicated in the TRL. ADM reviewed claimed savings included in tracking data and savings values reported in TRL reference files.

Tracking data included one measure for which the claimed savings did not equal the ex ante savings indicated in the TRL reference file. Claimed savings for *LED Specialty - Can Retrofit: >12 to 23 Watts - CA – 1* had a UES of 17.48 kWh in the tracking data. The correct UES in the TRL for the measure is 28.08 kWh.

3.4.3 Evaluated Savings

ADM calculated evaluated ISRs and HOU's to calculate gross evaluated savings. California's deemed NTG ratios and an evaluated leakage rate were applied to gross evaluated savings to calculate net evaluated savings. Evaluated UES for lighting measures are included in Table 3-20. Total gross and net evaluated program savings for lighting measures, by measure, are reported in Table 3-21 through Table 3-23.

Table 3-20: Unit Energy Savings (UES) Lighting Measures

Measure - Version	Claimed UES	Ex Ante ISR	Ex Ante HOU	Source	Evaluated ISR	Evaluated HOU	Evaluated UES
LED Downlight: 10 watts - Retail - CA - 2	13.79	0.84	541	1	0.72	674	14.73
LED Downlight: 11 watts - Retail - CA - 2	12.72	0.84	541	1	0.72	674	13.59
LED Downlight: 13 watts - Retail - CA - 2	16.74	0.84	541	1	0.72	674	17.88
LED Downlight: 14 watts - Retail - CA - 2	16.17	0.84	541	1	0.72	674	17.27
LED Downlight: 16 watts - Retail - CA - 2	18.96	0.84	541	1	0.72	674	20.25
LED Downlight: 23 watts - Retail - CA - 2	27.26	0.84	541	1	0.72	674	29.12
LED Downlight: 7 watts - Retail - CA - 2	9.31	0.84	541	1	0.72	674	9.94
LED Downlight: 8 watts - Retail - CA - 2	10.50	0.84	541	1	0.72	674	11.22
LED Downlight: 9 watts - Retail - CA - 2	11.58	0.84	541	1	0.72	674	12.37
LED General Purpose: 10 watts - Retail - CA - 2	9.27	0.84	541	1	0.75	604	9.23
LED General Purpose: 100W Equivalent - 110-120 LPW - Retail - CA - 1	1.38	0.84	541	3	0.75	604	1.37
LED General Purpose: 11 watts - Retail - CA - 2	9.76	0.84	541	1	0.75	604	9.72
LED General Purpose: 12 watts - Retail - CA - 2	10.66	0.84	541	1	0.75	604	10.61
LED General Purpose: 13 watts - Retail - CA - 2	11.56	0.84	541	1	0.75	604	11.51
LED General Purpose: 15 watts - Retail - CA - 2	13.32	0.84	541	1	0.75	604	13.26
LED General Purpose: 16 watts - Retail - CA - 2	14.22	0.84	541	1	0.75	604	14.16
LED General Purpose: 17 watts - Retail - CA - 2	15.12	0.84	541	1	0.75	604	15.05
LED General Purpose: 40W Equivalent - 100-120 LPW - Retail - CA - 1	0.59	0.84	541	3	0.75	604	0.59
LED General Purpose: 6 watts - Retail - CA - 2	5.33	0.84	541	1	0.75	604	5.31
LED General Purpose: 60W Equivalent - 100-120 LPW - Retail - CA - 1	0.73	0.84	541	3	0.75	604	0.73
LED General Purpose: 75W Equivalent - 110-120 LPW - Retail - CA - 1	0.98	0.84	541	3	0.77	595	0.98
LED Specialty - BR-R: <11 Watts - Retail - CA - 1	8.82	0.84	541	3	0.77	595	8.86
LED Specialty - BR-R: 11 to <14 Watts - Retail - CA - 1	11.59	0.84	541	2	0.77	595	11.64
LED Specialty - BR-R: 14 to <22 Watts - Retail - CA - 1	12.77	0.84	541	2	0.77	595	12.82
LED Specialty - Can Retrofit: >12 to 23 Watts - CA - 1	17.48	0.84	541	2	0.77	595	28.20
LED Specialty - Candelabra: 3 watts - Retail - CA - 2	8.62	0.84	541	1	0.77	595	8.66
LED Specialty - Candelabra: 4 watts - Retail - CA - 2	11.50	0.84	541	1	0.77	595	11.55
LED Specialty - Globe: 5 watts - Retail - CA - 2	8.93	0.84	541	1	0.77	595	8.97
LED Specialty - Globe: 6 watts - Retail - CA - 2	10.71	0.84	541	1	0.77	595	10.76

Sources: (1) 2018.08.03_CA_HES_LEDs_Brief.xlsx, (2) 2019.03.01_CA_HES_LEDs_Brief Nexant.xlsx, (3) 2019.03.01_CA_HES_LEDs_Brief.xlsx, Evaluated ISRs and HOUs calculated from 2020 general population survey sent to Pacific Power customers (see Appendix B) and *Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates*; DNV KEMA Energy and Sustainability, Pacific Northwest National Laboratory; December 2012.

Table 3-21: Total Claimed and Evaluated Savings 2019-2020

Measure - Version	Quantity	Ex Ante Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG Ratio	Leakage	Net Evaluated Savings (kWh)
LED Downlight: 10 watts - Retail - CA - 2	40	552	589	1.07	0.91	0.0784	494
LED Downlight: 11 watts - Retail - CA - 2	93	1,183	1,264	1.07	0.91	0.0784	1,060
LED Downlight: 13 watts - Retail - CA - 2	128	2,143	2,289	1.07	0.91	0.0784	1,920
LED Downlight: 14 watts - Retail - CA - 2	10	162	173	1.07	0.91	0.0784	145
LED Downlight: 16 watts - Retail - CA - 2	19	360	385	1.07	0.91	0.0784	323
LED Downlight: 23 watts - Retail - CA - 2	18	491	524	1.07	0.91	0.0784	439
LED Downlight: 7 watts - Retail - CA - 2	104	968	1,034	1.07	0.91	0.0784	867
LED Downlight: 8 watts - Retail - CA - 2	181	1,901	2,030	1.07	0.91	0.0784	1,702
LED Downlight: 9 watts - Retail - CA - 2	198	2,293	2,449	1.07	0.91	0.0784	2,054
LED General Purpose: 10 watts - Retail - CA - 2	10	93	92	0.99	0.91	0.0784	77
LED General Purpose: 100W Equivalent - 110-120 LPW - Retail - CA - 1	24	33	33	1.00	0.91	0.0784	28
LED General Purpose: 11 watts - Retail - CA - 2	24	234	233	1.00	0.91	0.0784	195
LED General Purpose: 12 watts - Retail - CA - 2	34	362	361	1.00	0.91	0.0784	303
LED General Purpose: 13 watts - Retail - CA - 2	3	35	35	1.00	0.91	0.0784	29
LED General Purpose: 15 watts - Retail - CA - 2	8	107	106	0.99	0.91	0.0784	89
LED General Purpose: 16 watts - Retail - CA - 2	17	242	241	1.00	0.91	0.0784	202
LED General Purpose: 17 watts - Retail - CA - 2	25	378	376	0.99	0.91	0.0784	315
LED General Purpose: 40W Equivalent - 100-120 LPW - Retail - CA - 1	20	12	12	1.00	0.91	0.0784	10
LED General Purpose: 6 watts - Retail - CA - 2	107	570	568	1.00	0.91	0.0784	476
LED General Purpose: 60W Equivalent - 100-120 LPW - Retail - CA - 1	87	64	63	0.98	0.91	0.0784	53
LED General Purpose: 75W Equivalent - 110-120 LPW - Retail - CA - 1	15	15	15	1.00	0.91	0.0784	13
LED Specialty - BR-R: <11 Watts - Retail - CA - 1	1,234	10,884	10,930	1.00	0.91	0.0784	9,167
LED Specialty - BR-R: 11 to <14 Watts - Retail - CA - 1	485	5,621	5,645	1.00	0.91	0.0784	4,734
LED Specialty - Can Retrofit: >12 to 23 Watts - CA - 1	52	909	1,466	1.61	0.91	0.0784	1,229
LED Specialty - Candelabra: 3 watts - Retail - CA - 2	1	9	9	1.00	0.60	0.0784	5
LED Specialty - Candelabra: 4 watts - Retail - CA - 2	37	426	427	1.00	0.60	0.0784	236
LED Specialty - Globe: 5 watts - Retail - CA - 2	48	429	430	1.00	0.60	0.0784	238
LED Specialty - Globe: 6 watts - Retail - CA - 2	45	482	484	1.00	0.60	0.0784	268
LED Specialty - BR-R: 14 to <22 Watts - Retail - CA - 1	86	1,098	1,103	1.00	0.91	0.0784	925
Grand Total	3,153	32,056	33,366	1.04			27,596

Table 3-22: Total Claimed and Evaluated Savings 2019

Measure - Version	Quantity	Ex Ante Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG Ratio	Leakage	Net Evaluated Savings (kWh)
LED Downlight: 10 watts - Retail - CA - 2	40	552	589	1.07	0.91	0.0784	494
LED Downlight: 11 watts - Retail - CA - 2	93	1,183	1,264	1.07	0.91	0.0784	1,060
LED Downlight: 13 watts - Retail - CA - 2	128	2,143	2,289	1.07	0.91	0.0784	1,920
LED Downlight: 14 watts - Retail - CA - 2	10	162	173	1.07	0.91	0.0784	145
LED Downlight: 16 watts - Retail - CA - 2	19	360	385	1.07	0.91	0.0784	323
LED Downlight: 23 watts - Retail - CA - 2	18	491	524	1.07	0.91	0.0784	439
LED Downlight: 7 watts - Retail - CA - 2	104	968	1,034	1.07	0.91	0.0784	867
LED Downlight: 8 watts - Retail - CA - 2	181	1,901	2,030	1.07	0.91	0.0784	1,702
LED Downlight: 9 watts - Retail - CA - 2	198	2,293	2,449	1.07	0.91	0.0784	2,054
LED General Purpose: 10 watts - Retail - CA - 2	10	93	92	0.99	0.91	0.0784	77
LED General Purpose: 11 watts - Retail - CA - 2	24	234	233	1.00	0.91	0.0784	195
LED General Purpose: 12 watts - Retail - CA - 2	34	362	361	1.00	0.91	0.0784	303
LED General Purpose: 13 watts - Retail - CA - 2	3	35	35	1.00	0.91	0.0784	29
LED General Purpose: 15 watts - Retail - CA - 2	8	107	106	0.99	0.91	0.0784	89
LED General Purpose: 16 watts - Retail - CA - 2	17	242	241	1.00	0.91	0.0784	202
LED General Purpose: 17 watts - Retail - CA - 2	25	378	376	0.99	0.91	0.0784	315
LED General Purpose: 6 watts - Retail - CA - 2	107	570	568	1.00	0.91	0.0784	476
LED Specialty - BR-R: <11 Watts - Retail - CA - 1	126	1,111	1,116	1.00	0.91	0.0784	936
LED Specialty - BR-R: 11 to <14 Watts - Retail - CA - 1	12	139	140	1.01	0.91	0.0784	117
LED Specialty - Can Retrofit: >12 to 23 Watts - CA - 1	33	577	931	1.61	0.91	0.0784	781
LED Specialty - Candelabra: 3 watts - Retail - CA - 2	1	9	9	1.00	0.60	0.0784	5
LED Specialty - Candelabra: 4 watts - Retail - CA - 2	37	426	427	1.00	0.60	0.0784	236
LED Specialty - Globe: 5 watts - Retail - CA - 2	48	429	430	1.00	0.60	0.0784	238
LED Specialty - Globe: 6 watts - Retail - CA - 2	45	482	484	1.00	0.60	0.0784	268
Grand Total	1,321	15,247	16,286	1.07			13,271

Table 3-23: Total Claimed and Evaluated Savings 2020

Measure - Version	Quantity	Ex Ante Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG Ratio	Leakage	Net Evaluated Savings (kWh)
LED General Purpose: 100W Equivalent - 110-120 LPW - Retail - CA - 1	24	33	33	1.00	0.91	0.0784	28
LED General Purpose: 40W Equivalent - 100-120 LPW - Retail - CA - 1	20	12	12	1.00	0.91	0.0784	10
LED General Purpose: 60W Equivalent - 100-120 LPW - Retail - CA - 1	87	64	63	0.98	0.91	0.0784	53
LED General Purpose: 75W Equivalent - 110-120 LPW - Retail - CA - 1	15	15	15	1.00	0.91	0.0784	13
LED Specialty - BR-R: <11 Watts - Retail - CA - 1	1,108	9,773	9,814	1.00	0.91	0.0784	8,230
LED Specialty - BR-R: 11 to <14 Watts - Retail - CA - 1	473	5,482	5,505	1.00	0.91	0.0784	4,617
LED Specialty - BR-R: 14 to <22 Watts - Retail - CA - 1	86	1,098	1,103	1.00	0.91	0.0784	925
LED Specialty - Can Retrofit: >12 to 23 Watts - CA - 1	19	332	536	1.61	0.91	0.0784	449
Grand Total	1,832	16,809	17,081	1.02			14,325

3.4.4 Discussion of Realization Rates

Realization rates primarily ranged from 100 to 107 percent, resulting from evaluated ISRs and HOUs that differed from ex ante values for these variables. The ex ante ISR for all lighting measures was 84 percent; the ex ante HOUs for all measures was 541 hours. Evaluated ISRs and HOU were calculated from general population survey responses collected in 2020 and are presented in Table 3-20. Both ISR and HOU were calculated separately for general purpose bulbs, specialty bulbs, and downlights.

The realization rate for *LED Specialty - Can Retrofit: >12 to 23 Watts* was 161 percent because the incorrect TRL ex ante savings value was used in the tracking data (the claimed savings was a TRL value from a similar bulb).

3.4.5 Leakage analysis

Leakage is an estimate of the percentage of measures sold through the program that were purchased by residents who live outside Pacific Power's service area. ADM assessed leakage by using geo-mapping data of participating and non-participating retailers combined with general population survey responses.

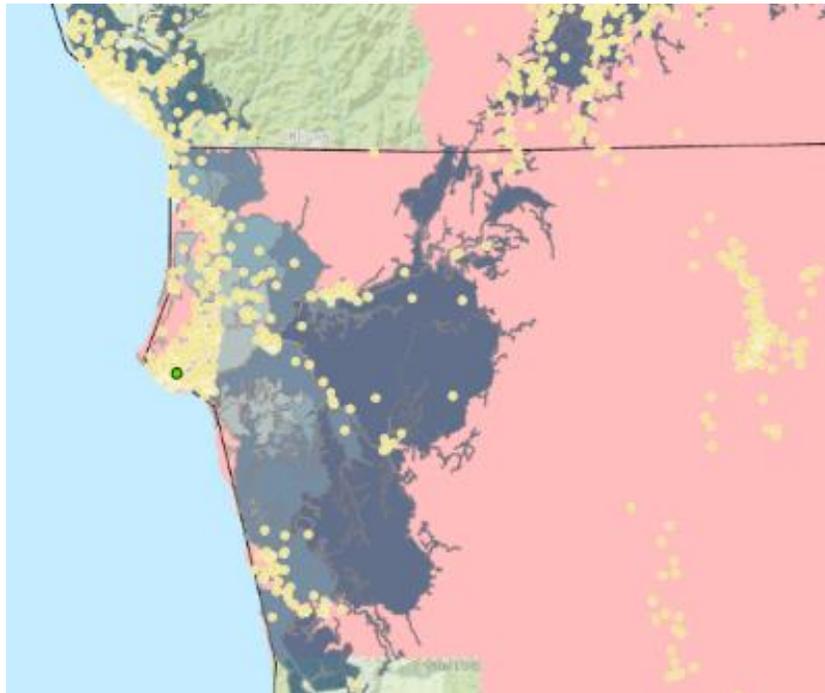
First, ADM mapped 60-minute drive-time areas surrounding both participating and non-participating (competing) retailers³ (see Figure 3-1 on the following page). If retailers had overlapping areas, ADM assumed that customers purchased measures from the closest store and modified retailers' drive-time areas.

Second, ADM determined the total population in each retailer's drive time area and the percentage of the population in each area that are Pacific Power customers.⁴

³ 2020 data. Safe Graph Data: <https://marketplace.arcgis.com/listing.html?id=3425348e4bee4059af2b353e52df43c2>.

⁴ 2010 Census block data from Environmental System Research Institute (ESRI).

Figure 3-1: Sample Leakage Analysis Map



Retailer (green dot), Drive time areas (blue), Pacific Power service area (pink), census block population (yellow).

Third, ADM modified drive-time areas established in step one using general population survey⁵ responses to define drive-time range categories to assess how many consumers were willing to drive and shop at each participating retail store. Drive-time behavior survey results are included in **Error! Reference source not found.** Within each drive-time category, ADM calculated the percentage of the population that lives in Pacific Power’s service area.

Table 3-24: Drive Time Results from General Population Survey

Retail Type	0-5	5-10	10-15	15-20	20-25	25-30	30-40	40-50	50-60	60+
DIY	8%	17%	14%	7%	6%	1%	8%	6%	2%	31%
Big Box	9%	16%	14%	11%	6%	3%	18%	7%	2%	14%
Member	16%	2%	2%	2%	2%	0%	3%	5%	3%	65%
Discount	9%	25%	24%	12%	9%	2%	11%	3%	0%	5%

Fourth, for each drive-time category indicated in Table 3-24 for each retailer, ADM calculated the predicted population that was willing to drive to and shop at the retailer, and what percentage of that population is Pacific Power customers.

⁵ ADM conducted the general population survey in 2020.

The resulting leakage percentage is the share of residents who are willing to drive to participating retailers who are not Pacific Power customers. ADM calculated lighting program leakage by weighting each store's leakage by its ex post savings (kWh).

ADM estimated that 7.84 percent of the upstream lighting measures sold at participating retailers were purchased by residents living outside of Pacific Power's service area.

3.4.6 Net to Gross Ratio

The deemed NTG ratios for lighting measures, as indicated in California's DEER, are included in Table 3-21 through Table 3-23.

3.5 Whole Homes

Pacific Power offered financial incentives to build homes that exceeded building code efficiency standards. Incentives were paid for ten homes through the program. New Homes measures resulted in 20,625 kWh of savings, accounting for 3 percent of total program savings as reported in Table 3-25.

Table 3-25: Whole Homes Program Savings

Measure Category	Quantity	Claimed Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate (%)	NTG	Evaluated Net Savings (kWh)
2019 Whole Homes Whole Home Performance Path	3	8,192	11,300	138%	55%	6,215
2020 Whole Homes Whole Home Performance Path	7	29,771	26,200	88%	55%	14,410
Total	10	37,963	37,500	99%		20,625

3.5.1 Tracking Data Verification

ADM reviewed program tracking data to evaluate if:

- Tracking dataset included duplicate or erroneous data entries
- Data entries in the program tracking dataset included all necessary fields for savings calculations
- Claimed energy savings match the applicable TRL source documents and calculations

3.5.2 Ex Ante Review

ADM verified that the UES values 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 completed in 2019 and 2020.

3.5.3 Evaluated Savings

Ex ante savings estimates for the New Homes program were developed using energy models for each of the home types built in the program. A distinct energy savings model was developed for each home in the program, ranging from 1- to 4-bedroom homes. Baseline and efficient annual energy consumption were calculated per square foot and the difference used to calculate final energy savings.

ADM evaluated the model outputs for each of the energy models applied to the program homes to ensure that they were appropriate and accurate. ADM also verified that the appropriate energy savings model was applied to each home in the program and adjusted the applied model where necessary.

3.5.4 Discussion of Realization Rates

Of the 10 homes constructed through the program, ADM found that six had the appropriate model applied, one had a model applied that was smaller than indicated in the project documentation, and three had models applied that were larger than indicated in the project documentation. ADM calculated an overall realization rate of 99 percent for the measure category.

3.5.5 Net to Gross Ratio

The default deemed NTG ratio of .55 was applied to new homes as indicated in California DEER.

3.6 Water Heating

Pacific Power offered rebates to verified customers who installed energy efficient heat pump water heaters in their homes during the evaluation period. Pacific Power provided incentives for twenty heat pump water heaters, resulting in 9,657 kWh savings, accounting for 1.4 percent of total program savings, as reported in Table 3-26.

Table 3-26: Water Heating Program Savings 2019-2020

Year	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
2019	7	3,580	3,580	1.00	0.55	1,969
2020	13	13,178	13,979	1.06	0.55	7,688
Total	20	16,758	17,559	1.05	0.55	9,657

3.6.1 Tracking Data Verification

ADM reviewed the program tracking data to:

- Verify that measure incentive requirements were met for all appliances (e.g. model numbers)
- Verify that the program tracking dataset did not include duplicate or erroneous data entries
- Verify that all energy savings are claimed in accordance with the applicable TRL source documents and calculations

3.6.2 Ex Ante Review

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 2019 and 2020.

3.6.3 Evaluated savings

Heat pump water heater saving are indicated by three variables in the reference files: capacity, efficiency rating, and climate zone. ADM reviewed the manufacture model specifications for each heat pump water heater reported in the program tracking data to verify each model's capacity and efficiency rating. ADM also reviewed that climate zone indicated for each customer address that received a water heater rebate.

Where any of the three variables used to identify a specific measure category, and therefore indicate energy savings, did not match the data provided, ADM assigned the correct savings (kWh) from the reference files as the evaluated savings.

ADM assumed an ISR of 1.0 for water heating measures. Total gross and net evaluated program savings for water heating, by measure, are reported in Table 3-27 Table 3-29.

Table 3-27: Water Heating Program Savings by Measure 2019-2020

Measure - Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - CA - 1	1	115	678	5.90	0.55	373
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA - 1	1	115	678	5.90	0.55	373
Heat Pump Water Heater > 55 Gallon - 3.5 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA - 1	2	612	573	0.94	0.55	315
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ01 - Self-Installed - CA - 1	1	1,730	1,730	1.00	0.55	952
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA - 1	1	1,490	1,490	1.00	0.55	820
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ01 - CA - 1	1	1,880	1,490	0.79	0.55	820
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA - 1	4	6,480	6,480	1.00	0.55	3,564
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ01 - Self Install - CA - 1	2	1,356	1,356	1.00	0.55	746
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - CA - 1	1	504	504	1.00	0.55	277
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - Self Install - CA - 1	3	1,512	1,512	1.00	0.55	832
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ01 - Self Install - CA - 1	2	712	712	1.00	0.55	392
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ16 - CA - 1	1	252	356	1.41	0.55	196
Total	20	16,758	17,559	1.05		8,238

Table 3-28: Water Heating Program Savings by Measure 2019

Measure - Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ01 - Self Install - CA - 1	2	1,356	1,356	1.00	0.55	746
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - CA - 1	1	504	504	1.00	0.55	277
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - Self Install - CA - 1	2	1,008	1,008	1.00	0.55	554
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ01 - Self Install - CA - 1	2	712	712	1.00	0.55	392
Total	7	3,580	3,580	1.00		1,969

Table 3-29: Water Heating Program Savings by Measure 2020

Measure-Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - CA - 1	1	115	678	5.90	0.55	373
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA - 1	1	115	678	5.90	0.55	373
Heat Pump Water Heater > 55 Gallon - 3.5 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA - 1	2	612	573	0.94	0.55	315
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ01 - Self-Installed - CA - 1	1	1,730	1,730	1.00	0.55	952
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA - 1	1	1,490	1,490	1.00	0.55	820
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ01 - CA - 1	1	1,880	1,490	0.79	0.55	820
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA - 1	4	6,480	6,480	1.00	0.55	3,564
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - Self Install - CA - 1	1	504	504	1.00	0.55	277
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ16 - CA - 1	1	252	356	1.41	0.55	196
Total	13	13,178	13,979	1.06		7,688

Sources: 2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx; 2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx

3.6.4 Discussion of Realization Rates

Heat pump water heater savings are indicated by three variables in the reference files: capacity, efficiency rating, and climate zone. Five records in the program tracking designated the incorrect measure and therefore the incorrect savings: three records indicated the incorrect climate zone, and two records indicated the incorrect capacity. ADM applied savings for the correct measures as indicated in the reference files to calculate evaluated savings. Realization rates reflect these differences.

3.6.5 Net to Gross Ratio

The default deemed NTG ratio of .55 was applied to heat pump water heaters as indicated in California DEER.

3.7 Appliances

Pacific Power offered rebates to verified customers on qualified energy efficient home appliances during the evaluation period. Rebates were issued on 16 appliance measures resulting in 1,997 kWh savings, accounting for .3 percent of program savings as reported in Table 3-30.

Table 3-30: Appliance Program Savings 2019-2020

Year	Quantity	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
2019	11	1,622	1,350	0.83	.55	743
2020	5	1,804	2,280	1.26	.55	1,254
Total	16	3,426	3,630	1.06	.55	1,997

3.7.1 Tracking Data Verification

ADM reviewed the program tracking data to:

- Verify that measure incentive requirements were met for all appliances (e.g. model numbers).
- Verify that the program tracking dataset did not include duplicate or erroneous data entries.
- Verify that all energy savings are claimed in accordance with the applicable TRL source documents and calculations.

3.7.2 Ex Ante Review

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 2019 and 2020.

3.7.3 Evaluated Savings

ADM reviewed manufacture model specifications to determine correct savings as indicated by TRL reference documents and assumed an ISR of 1.0 for appliances. Savings by measure are reported in Table 3-31.

Table 3-31: Appliance Program Savings by Measure 2021-2020

Appliance Measure - Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Clothes Dryer - Ventless_UCEF 3.80 to 4.19 - CZ01 - CA - 1	1	331	605	1.83	0.55	333
Clothes Dryer - Ventless_UCEF 5.30 to 6.09 - CZ01 - CA - 1	1	460	662	1.44	0.55	364
Clothes Dryer - Ventless_UCEF 7.20 to 8.00 - CZ16 - CA - 1	1	707	707	1.00	0.55	389
Clothes Washer - Electric DHW & Gas Dryer - CA - 4	1	84	84	1.00	0.55	46
Clothes Washer - Electric DHW & Electric Dryer - CA - 4	11	1,683	1,530	0.91	0.55	842
Refrigerator - CEE Tier 3 - Any Style - CA - 3	1	161	42	0.26	0.55	23
Total	16	3,426	3,630	1.06		1,997

Sources: (Ventless Clothes Dryers) 2019.03.01_CA_HES_AnyRes_Heat_Pump_Clothes_Dryer_Brief / RTF ResClothesDryers_v3.1; (Clothes Washers) 2018.09.06_CA_HES_Clothes_Washers_Brief.xlsx; (Refrigerator) 2018.09.06_CA_HES_Refrigerator_Brief.xlsx

Table 3-32: Appliance Program Savings by Measure 2019

Appliance Measure - Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Clothes Washer - Electric DHW & Gas Dryer - CA - 4	1	84	84	1.00	0.55	46
Clothes Washer - Electric DHW & Electric Dryer - CA - 4	9	1,377	1,224	0.89	0.55	673
Refrigerator - CEE Tier 3 - Any Style - CA - 3	1	161	42	0.26	0.55	23
Total	11	1,622	1,350	0.83		743

Table 3-33: Appliance Program Savings by Measure 2020

Appliance Measure - Version	Quantity	Claimed UES kWh/yr	Ex Post Gross UES kWh/yr	Realization Rate	Deemed NTG	Evaluated Net UES kWh/yr
Clothes Dryer - Ventless_UCEF 3.80 to 4.19 - CZ01 - CA - 1	1	331	605	1.83	0.55	333
Clothes Dryer - Ventless_UCEF 5.30 to 6.09 - CZ01 - CA - 1	1	460	662	1.44	0.55	364
Clothes Dryer - Ventless_UCEF 7.20 to 8.00 - CZ16 - CA - 1	1	707	707	1.00	0.55	389
Clothes Washer - Electric DHW & Electric Dryer - CA - 4	2	306	306	1.00	0.55	168
Total	5	1,804	2,280	1.26		1,254

3.7.4 Discussion of Realization Rates

The following adjustments were made to the claimed savings which impacted realization rates of individual measures.

Clothes Dryer – Ventless

Two units had higher efficiency ratings than the assigned measures, evaluated savings reflect higher efficiency measures, as indicated in the reference files.

Clothes Washer - Electric DHW & Electric Dryer - CA – 4

One unit did not meet the integrated modified energy factor (IMEF) efficiency requirements, evaluated savings for that unit were 0, reducing the realization rate.

Refrigerator - CEE Tier 3 - Any Style - CA – 3

The refrigerator in the tracking data is a tier 1, not tier 3 energy efficient model. Evaluated savings reflect a tier 1 unit, as indicated in the reference files.

3.7.5 Net to Gross Ratio

The default deemed NTG ratio of .55 was applied to appliances included in the program as indicated in California DEER.

3.8 Building Shell

Pacific Power offered rebates to verified customers who installed insulation in their homes during the evaluation period. Pacific Power provided incentives for 5,112 square feet of wall and attic insulation installed in four homes during the evaluation period, resulting in savings of 776 kWh, accounting for .1 percent of total program savings, as reported in Table 3-34.

Table 3-34: Building Shell Program Savings 2019-2020

Year	Quantity (sq ft)	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Evaluated Net UES (kWh)
2019	3,496	1,752	1,752	1.00	618
2020	1,616	288	288	1.00	158
Total	5,112	2,039	2,039	1.00	776

3.8.1 Tracking Data Verification

ADM reviewed the program tracking data to:

- Verify that the program tracking dataset did not include duplicate data entries.

3.8.2 Ex Ante Review

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 2019 and 2020.

3.8.3 Evaluated Savings

ADM used an ISR of 1.0 for home insulation measures. Because of the small percentage of program savings that resulted from home insulation, ADM did not survey program participants or verify R ratings or heating fuel. ADM used TRL reference documents to determine evaluated savings. Savings by measure are included in Table 3-35 through Table 3-37.

Table 3-35: Building Shell Program Savings by Measure 2019-2020

Insulation Measure - Version	Quantity (sq ft)	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Insulation - Attic - <= R19 to R44 - CZ16 - CA - 1	960	38	38	1.00	0.55	21
Insulation - Attic - Add R-19 - Electric Heat - CA - 2	2626	473	473	1.00	0.55	260
Insulation - Attic - Add R-30 - Electric Heat - CA - 2	656	249	249	1.00	0.55	137
Insulation - Wall - Electric Heat - CA - 2	870	1,279	1,279	1.00	0.28	358
Total	5,112	2,039	2,039	1.00		776

Table 3-36: Building Shell Program Savings by Measure 2019

Insulation Measure - Version	Quantity (sq ft)	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Insulation - Attic - Add R-19 - Electric Heat - CA - 2	2626	473	473	1.00	0.55	260
Insulation - Wall - Electric Heat - CA - 2	870	1,279	1,279	1.00	0.28	358
Total	3,496	1,752	1,752	1.00		618

Table 3-37: Building Shell Program Savings by Measure 2020

Insulation Measure - Version	Quantity (sq ft)	Claimed UES (kWh)	Ex Post Gross UES (kWh)	Realization Rate	Deemed NTG	Evaluated Net UES (kWh)
Insulation - Attic - <= R19 to R44 - CZ16 - CA - 1	960	38	38	1.00	0.55	21
Insulation - Attic - Add R-30 - Electric Heat - CA - 2	656	249	249	1.00	0.55	137
Total	1,616	288	288	1.00		158

Sources: (Version 1 insulation measures) 2018.08.03_CA_HES_Insulation_Brief.xlsx; (Version 2 insulation measures) 2019.03.01_CA_HES_SF_MF_Insulation_Brief.xlsx

3.8.4 Net to Gross Ratio

The deemed NTG ratios indicated by California DEER are included in Table 3-35 through Table 3-37.

4 Process Evaluation

4.1 Review of Program Materials and In-Depth Interviews

ADM completed a process analysis of the program which included in depth interviews and conversations with key staff at Pacific Power and Nexant, the program implementer. Additional information was gathered from a general customer survey, a starter kit participant survey, and a review of program materials.

4.1.1 Roles and Responsibilities

The Pacific Power program manager is responsible for the Wattsmart Home Energy Savings programs in California and Washington, including oversight of the regulatory process, assessing cost effectiveness of the program, regulatory recovery, review and approving marketing campaigns, program participation and procedures, and design and implementation of procedures.

Pacific Power transition from CLEAResult to Nexant as the delivery partner during the evaluation period. Delivery partner responsibilities included program implementation, contract management, client management, and overseeing day-to-day operations. In making the transition, Pacific Power sought to take advantage of synergies derived from Nexant's experience delivering their business customer program. Nexant provided an enhanced public user interface with online application processing with the capacity to tie into Pacific Power's program tracking system.

4.1.2 Program Design and Goals

The primary purpose of the program is to achieve conservation targets established through the integrated resource planning process and identified in a multi-year application filed with the CPUC. . An important secondary goal of the program is delivering high quality customer service and customer satisfaction to insure continued customer engagement in the program.

Declining DEER UESs was the primary challenge Pacific Power faced in achieving its program objective. In addition, the COVID pandemic occurred during the last ten months of the evaluation period (March through December 2020).

4.1.3 Tracking and Reporting

Pacific Power savings documentation is comprised of the technical reference library (TRL) and its associated files and the program tracking dataset.

4.1.3.1 Technical Reference Library (TRL)

Ex ante program savings, as well as other measure specifications, are documented in Pacific Power's Technical Reference Library (TRL). The TRL is comprised of a listing of all program measures and all versions of each measure. Measure specifications are updated as required by changing regulatory and market conditions. The TRL file is maintained jointly by Pacific Power and its contracted program implementer. Each measure listed includes specifications for the measure and version number, including reference files that documented UES savings values or savings calculation methodologies.

TRL reference files are frequently briefs that summarize relevant measures included in California DEER or RTF reference files that include the basis for unit energy savings values. RTF and DEER reference documents are frequently updated, and therefore keeping the TRL current is a challenge.

Because the TRL includes multiple versions of specific measures for which the savings values can vary, the accuracy of TRL necessitates that a specific reference file is indicated for each version of each measure.

The new implementation contractor has replaced the prior TRL with a new Measure Library with enhanced functionality. Full migration to the new system was completed on June 1, 2021.

4.1.3.2 Program Tracking Dataset

Pacific Power maintains a program tracking dataset that includes:

- Measure name and corresponding data that ties to TRL
- Record or application status and relevant dates
- Customer and account information for downstream measures

The program implementer collects and retains the following data elements that are not included in Pacific Power's dataset:

- Product manufacturer and model numbers
- Retail sales location for upstream measures
- Baseline conditions

ADM found that key program tracking data elements are retained with program implementer and are not integrated into Pacific Power's program tracking database. The transition to a new implementer mid evaluation cycle introduced additional data collection and retrieval challenges.

Program data provided by Pacific Power and the implementer included the follow data errors and omissions.

HVAC

- 22 (7 percent) of 297 records included HVAC measures with the incorrect climate zone indicated
- 6 records did not include either a model number or an efficiency rating to verify that the installed measure met the qualifications
- 3 measures did not meet efficiency threshold rating
- 21 records were missing a customer application

Starter kits

- 20 (2 percent) of 1,267 kits were sent to customers who had already received one. Program guidelines specified one kit/customer in ten year period.
- 1,219 (62 percent) of kit records did not include email address
- **New homes**
- 4 (40 percent) of 10 homes had claimed savings that did not match the correct model home

Lighting

- 23 (.7 percent) of 3,153 lighting units did not have retail location indicated in the implementer's data.

Water Heating

- 3 (15 percent) of 20 records designated measures with the incorrect climate zone
- 2 records (10 percent) designated measures with the incorrect capacity based on model numbers provided

Appliances

- 3 (19 percent) of 16 records designated the incorrect efficiency rating based on model numbers provided
- 1 record designated a model number that did not meet efficiency threshold

4.1.4 Communication

Pacific Power transitioned to a new implementation contractor in mid-2019. The two contractors overlapped to manage the transition.

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.

4.2 General Population Survey

This section presents key findings from the general population survey administered online by ADM and completed by 401 customers. ADM sent customers email invitations to complete the questionnaire through an online survey platform and offered monetary incentives (\$5 electronic gift card) to complete the survey. The survey collected data for both the process evaluation and impact analyses. Customers who participated in Home Energy Savings Programs other than upstream lighting were not invited to complete the survey. In this way, the customer database acted as a sample of the general population.

4.2.1 LED Lighting Measures

Participants indicated if they purchased LED lighting products during the evaluation period. All survey respondents indicated they purchased LED measures (n = 400). Most of the respondents purchased standard LED bulbs (87 percent), specialty LED bulbs (33 percent), and LED downlights (13 percent).

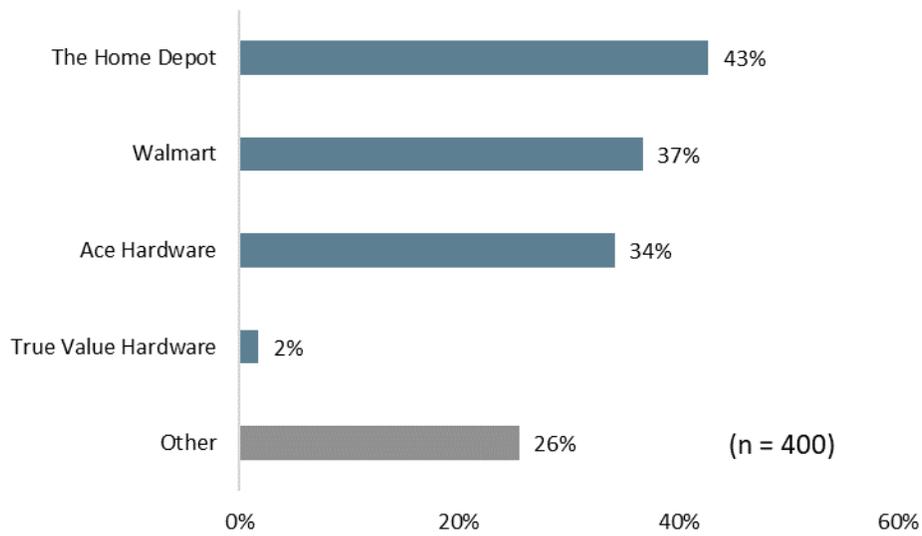
Table 4-1 What type of ENERGY STAR® LED lighting products did you buy?

LED Types	Percentage
Standard LED bulb(s)	87%
Specialty LED bulb(s)	33%
LED downlight(s)	13%
I don't know	5%

*Multiple response questions- percentage exceeds 100%.

Customers who bought LED measures were asked if they purchased their measures from retail stores participating in the upstream lighting program. The top retail stores among the survey respondents were The Home Depot (43 percent), Walmart (37 percent), and Ace Hardware (34 percent) as show in Figure 4-1.

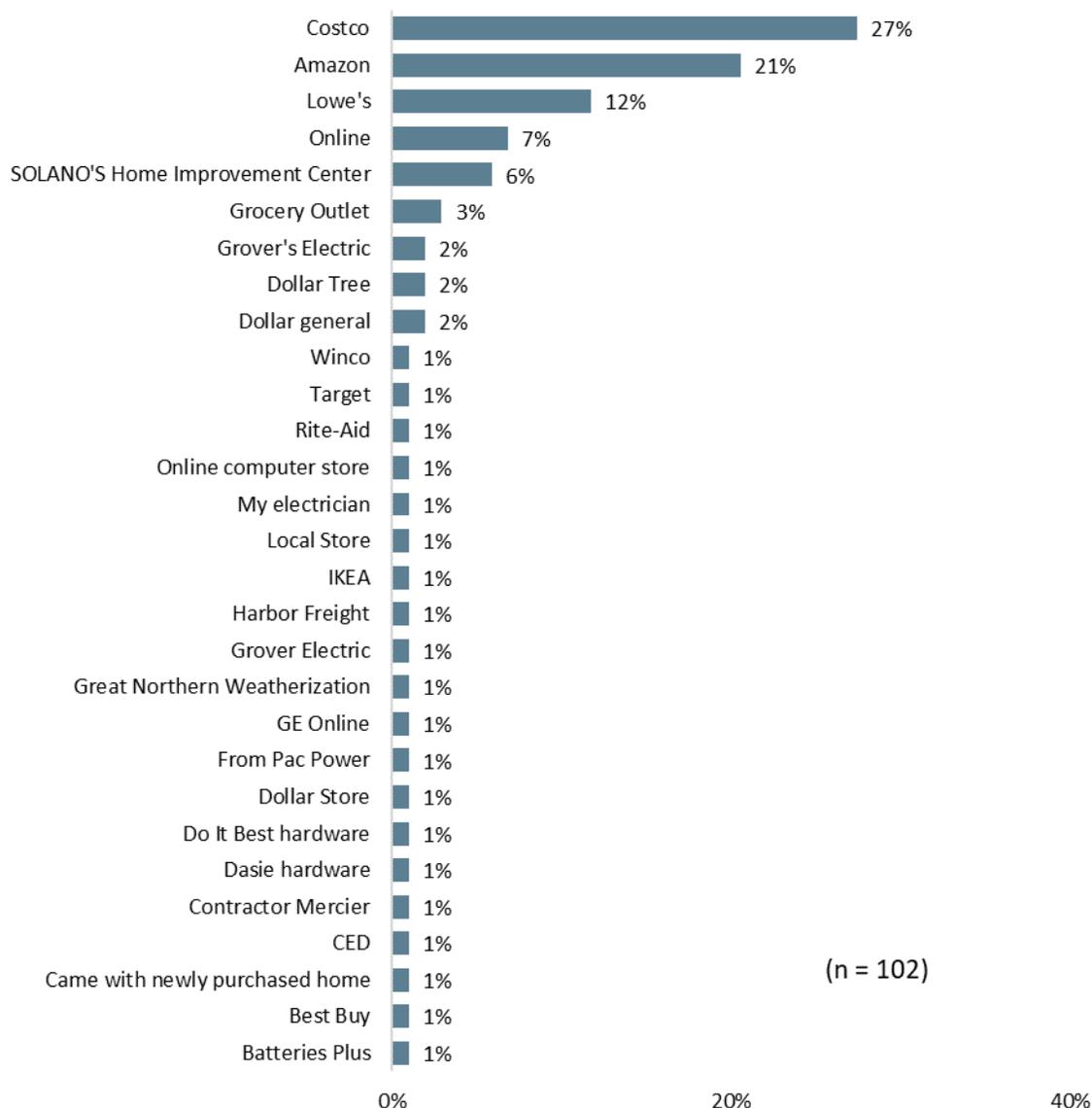
Figure 4-1 Which stores did you buy your ENERGY STAR® LED lighting from?



*Multiple response questions- percentage exceeds 100%.

Of the 400 respondents, 26 percent indicated they purchased their LEDs from other sources. Of the respondents who obtained their LEDs from another store, 27 percent indicated they bought their lights from Costco, 21 percent obtained them from Amazon.com, and 12 percent indicated they bought the measures from Lowe's. See Figure 4-2 for more details.

Figure 4-2 Which other non-participating stores did you buy your ENERGY STAR® LED lighting from?



*Multiple response questions- percentage exceeds 100%.

Furthermore, 76 percent of respondents purchased their standard LEDs during 2020 compared to 72 percent who purchased theirs in 2019. People who purchased specialty LED bulbs and LED downlights also bought more in 2020 than in 2019 (see Table 4-2; many of the participants bought their lights during both years).

Table 4-2 When did you buy the ENERGY STAR® LED bulbs?

LED Types	2019	2020
Standard LED bulb(s) (n = 292)	72%	76%
Specialty LED bulb(s) (n = 110)	48%	70%
LED downlight(s) (n = 42)	48%	67%

*Multiple response questions- percentage exceeds 100%.

4.2.2 Participant Motivations for Purchasing LEDs

The most common response to why respondents purchased LEDs was to replace burned-out bulbs (64 percent), followed by those who wanted to replace their working bulbs with ones that consumed less energy (49 percent). Another 20 percent indicated they had added a new light fixture in their home, and six percent wanted to take advantage of the discount pricing. Just one percent of the respondents could not recall.

Table 4-3 Why did you purchase the ENERGY STAR® LED lighting?

Response	Percent (n = 333)
To replace burned out bulbs	64%
To replace working bulbs to lower energy use	49%
To add new light fixture(s) in my home	20%
To take advantage of discounted pricing	6%
I do not know	1%

*Multiple response questions- percentage exceeds 100%.

Regarding the discount pricing (n = 291), 15 percent of respondents indicated they recalled that the standard LEDs had been discounted, compared to 48 percent who stated the measures were not discounted, and 36 percent did not recall. Of the people who recalled the discount (n = 45), 25 percent remembered seeing a label or sign indicating Pacific Power provided the discount compared to the 63 percent who did not see a label and 13 percent who could not recall.

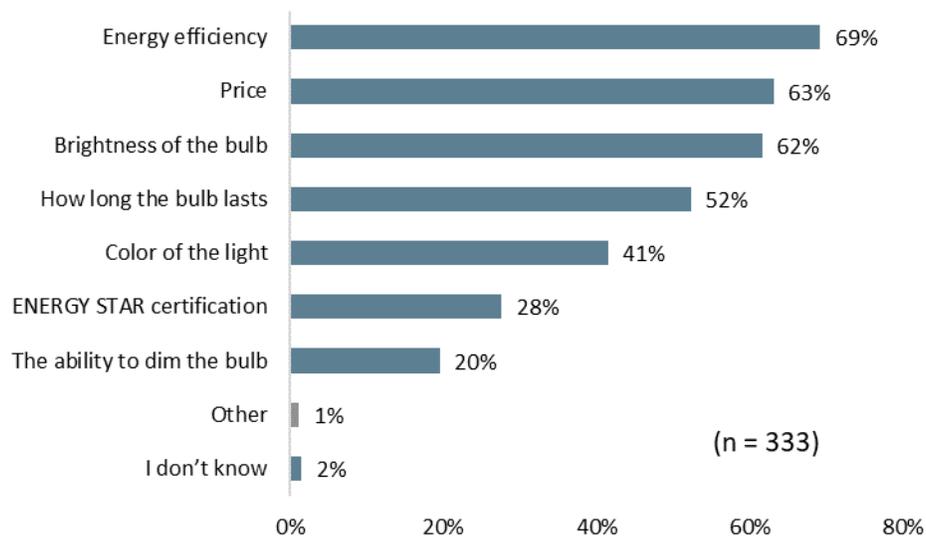
Of the 109 people who bought specialty LED, eight percent knew the measures were discounted, 52 percent did not know if they were, and 39 percent could not recall at the time of the survey. Of the seven people who knew about the discount, none remember

seeing a label indicating the discount was provided by Pacific Power or did not recall.

Of the 42 people who bought LED downlights, 17 percent knew the measures were discounted, 50 percent did not know if they were, and 33 percent could not recall at the time of the survey. Of the nine people who knew about the discount, two remember seeing a label indicating the discount was provided by Pacific Power, 57 percent did not see any discount signage, and 14 percent did not recall.

Although pricing was a significant factor when considering the purchase, it was not the only important to many respondents. The figure below illustrates the top characteristics customers considered when purchasing LED lighting such as energy efficiency (69 percent), the brightness of the light bulb (62 percent), and how long the bulb lasts (52 percent).

Figure 4-3 Which characteristic do you consider when purchasing light bulbs?



*Multiple response questions- percentage exceeds 100%.

4.2.3 Home Characteristics and Demographics

Participants' home characteristics are summarized in Table 4-4. Participants reported living in single-family homes (69 percent) and most owned their homes (73 percent). The majority of survey participants' homes were built before 2000 (72 percent).

Forty-two percent of respondents reported that electricity was their primary home heating fuel. Twenty-three percent indicated that their home was heated by wood or wood pellets.

Seventy-three percent of home sizes are about 2,000 square feet or smaller, and 85 percent of the respondents indicated that up to three people lived in their household.

Thirty percent of respondents indicated that they were eligible for California Alternative Rates for Energy (CAREs). And 2 percent indicated that English was not the primary

language spoken at home.

The survey included questions about the number of residents in the household and asked if the household income was over or under the thresholds included that corresponds to the federal poverty level for the number of residents per household. Thirty-seven percent of respondents indicated that they were living below the federal poverty level.

Table 4-4: Home Characteristics

Home Characteristics	Percentage of Respondents (n = 401)
Single-family home	69%
Manufactured or mobile home	18%
Apartment or condominium	6%
Duplex or townhouse	4%
Other	2%
DK	0%
Year Built	Percentage of Respondents (n = 401)
Before 1960	26%
1960 to 1979	21%
1980 to 1999	25%
2000 to 2009	14%
2010 or later	6%
Do not recall/Prefer not to answer	8%
Own or Rent	Percentage of Respondents (n = 400)
Own	73%
Rent	25%
Do not recall/Prefer not to answer	2%

What is the main fuel used for heating your home?	Percentage of Respondents (n = 401)
Electricity	45%
Wood	23%
Oil	13%
Propane	11%
Kerosene/white fuel/diesel	7%
Natural gas	4%
Don't heat home	<1%
How large is your home?	Percentage of Respondents (n = 399)
Less than 1,000 square feet	14%
1,000-2,000 square feet	59%
2,000-3,000 square feet	16%
3,000-4,000 square feet	4%
Greater than 4,000 square feet	1%
Do not recall/Prefer not to answer	7%
Is English the primary language spoken in your household?	Percentage of Respondents (n = 398)
Yes	98%
No	2%

Is your household eligible for California Alternative Rates for Energy (CAREs)?	Percentage of Respondents (n = 401)
Yes	30%
No	33%
Do not recall/Prefer not to answer	37%
Including yourself, how many people are living in your household?	Percentage of Respondents (n = 392)
1	24%
2	47%
3	14%
4	8%
5	5%
6	2%
7	1%
8	0%
9	0%
10	0%
Do not recall/Prefer not to answer	0%

4.3 Starter Kits Program Participant Survey

A total of 68 customers who participated in the Starter Kits program in 2019 or 2020 completed an online survey about their experience with the Starter Kits program. The survey gathered data related to program awareness, measures installed, in-service rates, customer experience, and various aspects of the customers' satisfaction. The survey collected data for both the process evaluation and impact analyses.

4.3.1 Program Awareness and Enrollment Experience

Participants provided information and feedback regarding how they learned about the Starter Kits program. Almost half of participants reported hearing about the program either through their utility bills insert (41 percent) or a message printed on their bill (32 percent). Another 32 percent learning about the program from the utility's website, and 7 percent learned about it from Pacific Power's newsletter. A summary of survey responses appears in Table 4-5.

Table 4-5: How did respondents learn about the program?

How did you hear about these kits?	Percent of Responses (n = 68)
Utility bills insert	41%
My bill	32%
Pacific Power website	32%
Pacific Power newsletter	7%
Word of mouth (friend, relative, coworker, etc.)	4%
Other	1%
I don't know	7%
<i>*Percentage exceeds 100%. Participants could choose more than one option.</i>	

4.3.2 Customer Experience and Installation of Measures

Survey respondents provided feedback about their experience installing kit components. Respondents were asked if their home had an electric water heater. Eighty-six percent of all the participants (n = 68) reported they used an electric water heater. In contrast, 93 percent of participants who received one of the bath kits (n = 56) stated they had an electric water heater. See the two tables below for more details.

Table 4-6 What fuel does your main water heater use?

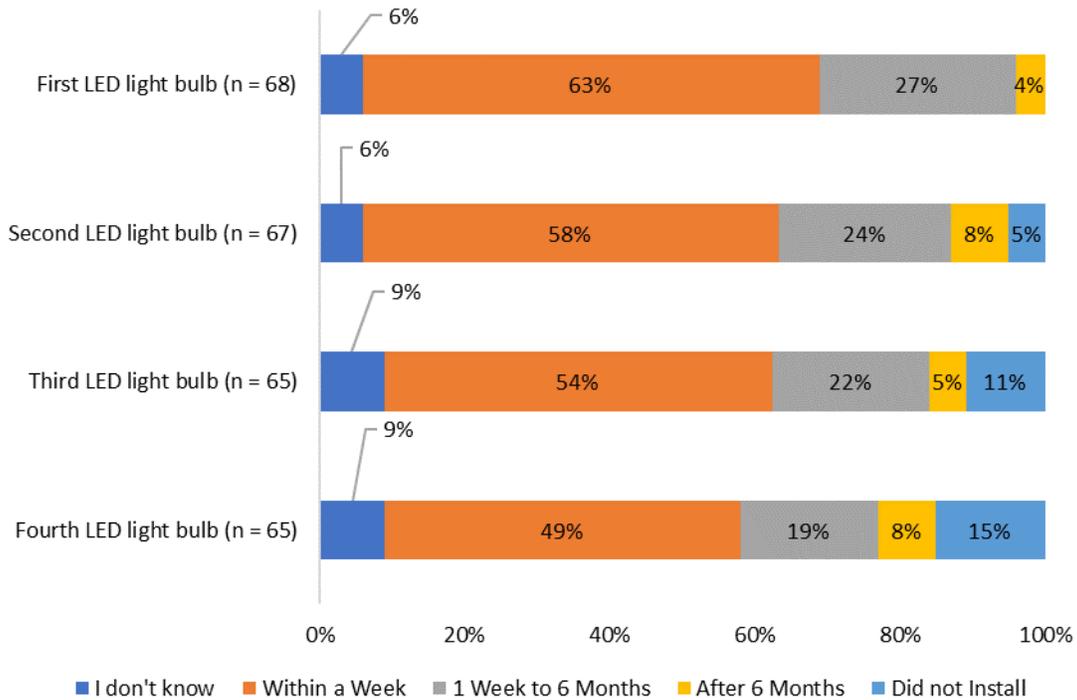
What fuel does your main water heater use?	Percent of All Kit Recipients (n = 68)
Electricity	86%
Natural gas	2%
Propane	8%
Other	3%
I don't know	1%

Table 4-7 What fuel does your main water heater use?

What fuel does your main water heater use?	Percent of Bath-1 and Bath-2 Kit Recipients (n = 56)
Electricity	93%
Natural gas	2%
Propane	4%
Other	1%

Respondents indicated they installed their LED lightbulbs within a week of receiving the kits. See Figure 4-4 for more details. Kit recipients who had not installed the LEDs at the time of the survey stated they were waiting for their bulbs to burn out (n = 9), disliked the color of the LEDs in the kit (n = 1). One person indicated there were some missing measures but did not elaborate on their comment.

Figure 4-4 How long after receiving your kit did you install the LEDs?

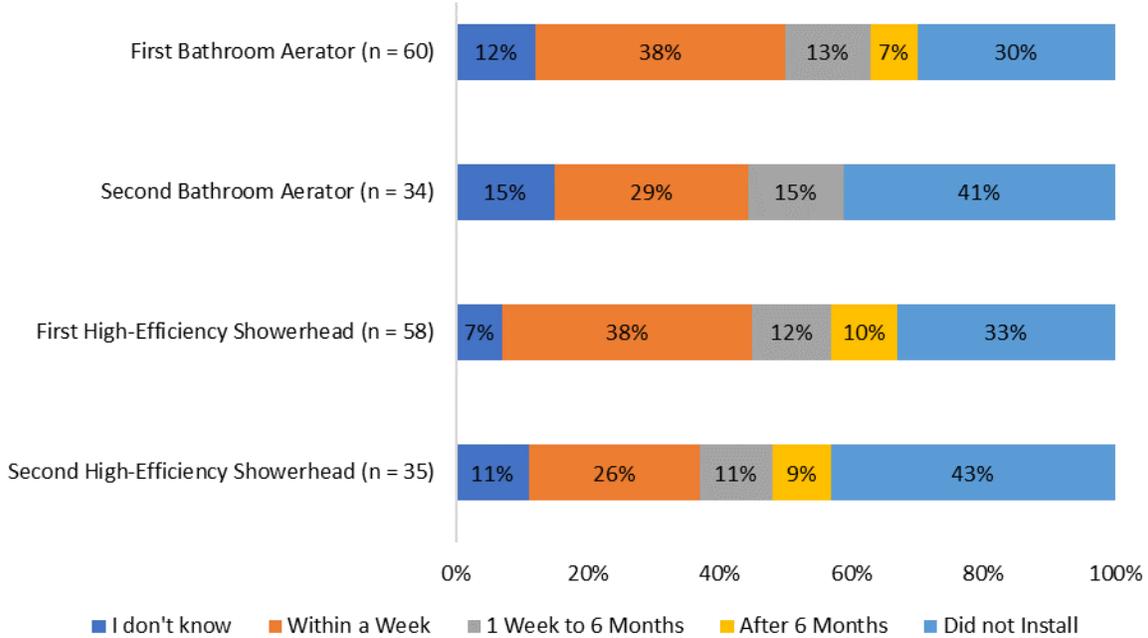


For participants who also received showerheads or bathroom aerators, customers either installed them within a week or currently have not installed them (see Figure 4-5). The same responses were true for people who installed kitchen aerators: 36 percent stated they installed them within a week, and 30 percent had not installed them.⁶

Reasons for not using the showerheads included they already had high-efficiency measures installed (41 percent), the showerhead in the kit did not integrate well with current plumbing (26 percent), they disliked the showerhead’s water pressure (19 percent), the customers disliked the way it looked (four percent), or other (11 percent). People who decided not to install the aerators stated they already had an aerator installed (40 percent), the measure did not integrate well with current plumbing (27 percent), they disliked the aerator’s water pressure (10 percent), they disliked the way the aerator looked (seven percent), or other (17 percent).

⁶ Note that installation rates used in the impact analysis do not include *I Don't Know* responses. Installation rates used in impact analysis equal total installed quantity divided by total installed plus not install. $ISR = \frac{\text{Total Installed Qty}}{\text{Total Installed Qty} + \text{Not Installed Qty}}$ That is why the sum of installed percentages reported here do not match the ISRs used in impact analysis.

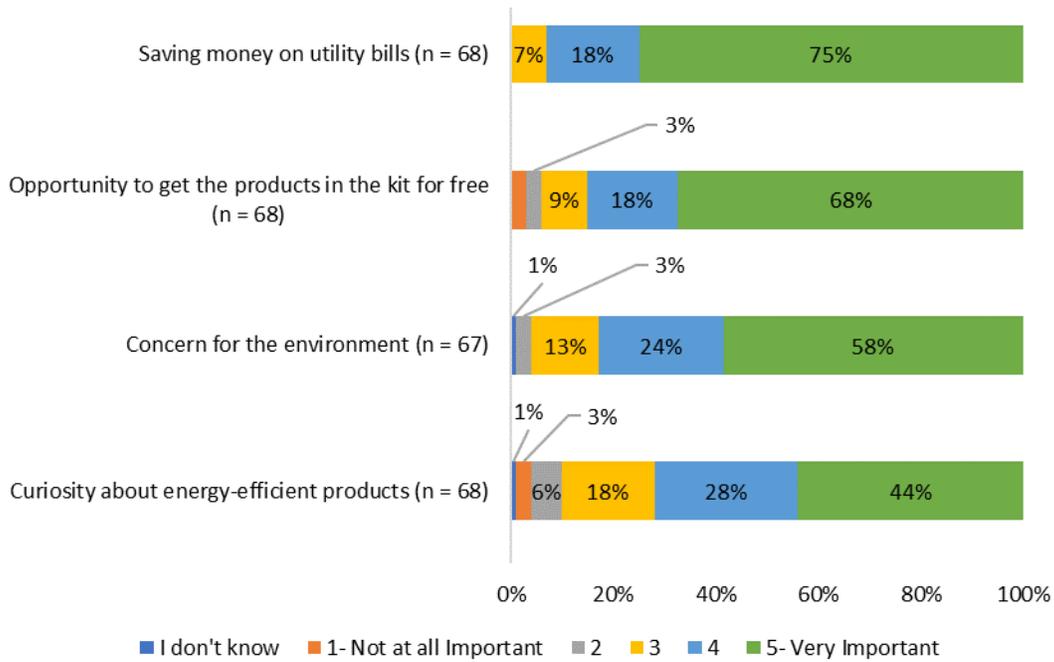
Figure 4-5 How long after receiving your kit did you install the bathroom measures?



4.3.3 Participant Motivations

Respondents provided feedback regarding what influenced them to request the Starter Kit. Seventy-five percent of respondents ranked “saving money on utility bills” as their strongest motivation to request a kit, followed by the fact of receiving a free energy kit from the program (68 percent). Fifty-eight percent stated they were motivated by their concerns about the environment, and 44 percent expressed curiosity for energy-efficiency products.

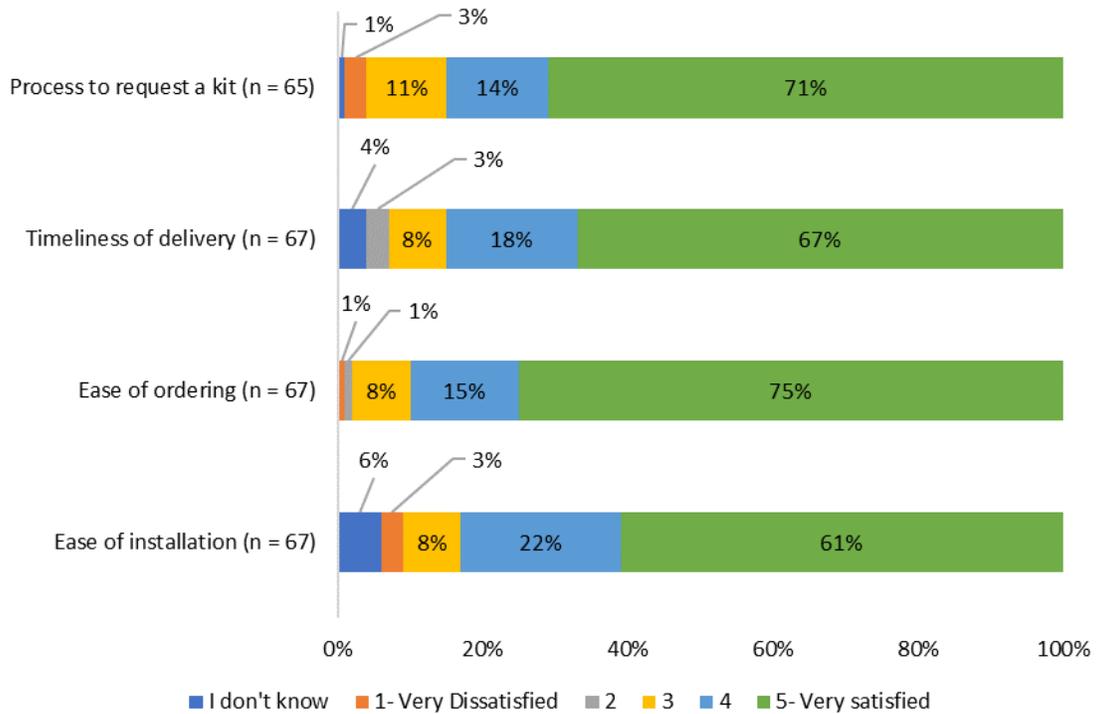
Figure 4-6: Survey respondents' Ranking of Reasons for Requesting a Starter Kit



4.3.4 Customer Satisfaction

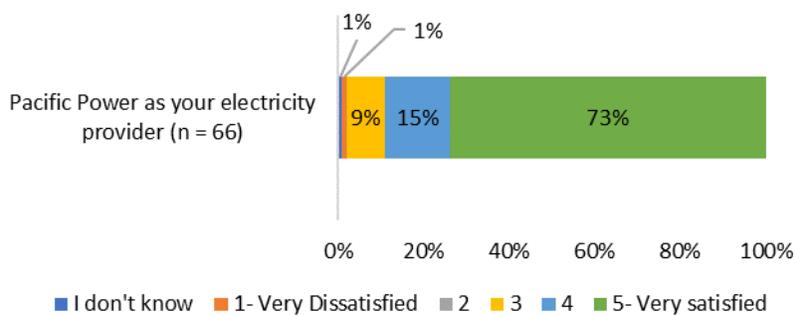
Participants provided feedback regarding their level of satisfaction with specific aspects of the program and their overall experience with the Starter Kits program. Participants indicated they were satisfied with the process to request a kit (85 percent), the timeliness of delivery (85 percent), ease of ordering (90 percent), and ease of installation (83 percent). See Figure 1-4 for more details. Respondents also expressed satisfaction with the kits' content and the quality of the measures (79 percent for each aspect).

Figure 4-7: Customer Satisfaction with Starter Kit Program



Fifty-five percent of respondents indicated they were satisfied or very satisfied with the amount of energy savings they perceived from installing the measures. Overall satisfaction with the Pacific Power as their utility company was 88 percent (see Figure 4-8).

Figure 4-8 Customer Satisfaction with Pacific Power



4.3.5 Key Kit Survey Findings

The following are key findings to the Starter Kits Program.

- **Participants provided information and feedback regarding how they learned about the Starter Kits program.** Most of participants reported hearing about the program through either their utility bills insert, a message printed on their bill, or through the utility's website. When asked about the measures, most participants indicated they installed them within a week of receiving the kits. Customers who indicated not installing any of the LEDs stated they were waiting for their light bulbs to burnout. The most common response for not installing the showerheads or aerators was they already had energy-efficient measures installed.
- **Saving money on utility bills was the strongest motivator for customers.** Another factor that influenced participation rates were receiving free measures and having concerns about the environment. Overall, participants indicated they were satisfied or very satisfied with the process to request a kit, the timeliness of delivery, ease of ordering, and ease of installation. Customers also expressed great satisfaction with Pacific Power as their utility company.

4.4 Process evaluation key findings

ADM made the following key findings during its process analysis.

- The following measure categories were removed from program offerings at or near the end of the evaluation period: heat pumps, starter kits, lighting.
- Pacific Power transitioned to implementation contractors during the evaluation period. Pacific Power engaged both contractors during an overlapping period to facilitate data and process transfer. The transition posed numerous data management challenges.
- The new implementation team provided synergies gained from previous work on the utility's commercial programs and provided enhanced web based program interfaces for the Home Energy Savings program.
- The technical reference library (TRL) is a key program reference resource that documents ex ante savings values for all versions of all measures included in the program. Maintaining TRL version control, timeliness and completeness is a challenge complicated by the transition to a new implementation team. The new contractor has replaced the prior TRL with a new Measure Library with enhanced functionality. Full migration to the new system was completed on June 1, 2021.
- Program tracking data documents the measures and quantities of each that were installed in the service area as a result of the program. Pacific Power receives and maintains the program tracking dataset. Additional information, such as upstream sales details, downstream product model specifications, and new home model details, are maintained by the implementer.
- Data errors and omissions were found in some of the program tracking dataset. The new implementer has added data controls to improve program delivery and data management.
- Pacific Power customer awareness that the utility provided LED discounts was low.
- Verified hours of use for upstream lighting measures exceeded ex ante hours of use, resulting in realization rates that exceeded 100 percent.
- Verified installation rates of starter kit components are generally equal or greater than ex ante ISRs, except for second bathroom aerators and all showerheads.
- Fifty-four percent of the general population survey respondents indicated that they heat their homes with fuel types other than electricity or natural gas. Wood (23 percent), oil (13 percent), and propane (11 percent) were the dominant alternative fuels.
- Thirty percent of general population survey respondents indicated that they were eligible for California Alternative Rates for Energy (CAREs).

- Thirty-seven percent of respondents indicated that they were living below the federal poverty level.

5 Cost-Effectiveness

Guidehouse estimated program cost-effectiveness results based on 2019 and 2020 costs and savings estimates provided by Pacific Power. Cost-effectiveness was tested using the 2017 and 2019 IRP decrement. The program passed cost-effectiveness for the Participant Cost Test (PCT). Program inputs used in the cost effectiveness analysis are included in Table 5-1.

Table 5-1: Program Inputs

Parameter	2019	2020
Discount Rate	6.57%	6.92%
Residential Line Loss	11.43%	8.78%
Residential Energy Rate (\$/kWh) ¹	\$0.1285	\$0.1116
Inflation Rate	2.20%	2.28%

¹ Future rates determined using a 2.20% and 2.28% annual escalator.

Table 5-2 through Table 5-7 include total program cost effectiveness results.

Table 5-2: Program Costs by Year

Year	Engineering Costs	Utility Admin	Program Delivery	Program Dev.	Incentives	Total Utility Costs	Gross Customer Costs
2019	\$0	\$26,010	\$371,163	\$1,760	\$240,392	\$639,325	\$716,762
2020	\$0	\$25,566	\$225,598	\$999	\$245,725	\$497,888	\$544,545
2019-2020	\$0	\$51,576	\$596,761	\$2,759	\$486,117	\$1,137,213	\$1,261,307

Table 5-3: Program Savings by Year

Year	Gross kWh Savings	Realization Rate	Adjusted Gross kWh Savings	Net to Gross Ratio	Net kWh Savings	Measure Life
2019	692,897	103%	715,344	57%	404,206	15
2020	603,374	91%	550,062	56%	308,649	14
2019-2020	1,296,270	98%	1,265,406	56%	712,855	15

Table 5-4: Program Benefit/Cost Ratios by Year

Year	PTRC	TRC	UCT	RIM	PCT
2019	0.63	0.57	0.71	0.37	1.79
2020	0.66	0.60	0.67	0.38	1.69
2019-2020	0.64	0.58	0.69	0.37	1.75

Table 5-5: Program Cost-Effectiveness Results – 2019-2020

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1816	\$1,350,001	\$866,137	-\$483,865	0.64
Total Resource Cost Test (TRC) No Adder	\$0.1816	\$1,350,001	\$787,397	-\$562,604	0.58
Utility Cost Test (UCT)	\$0.1529	\$1,137,213	\$787,397	-\$349,816	0.69
Rate Impact Test (RIM)		\$2,106,030	\$787,397	-\$1,318,633	0.37
Participant Cost Test (PCT)		\$1,261,307	\$2,205,713	\$944,406	1.75
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000057619				
Discounted Participant Payback (years)	10.68				

Table 5-6: Program Cost-Effectiveness Results – 2019

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1864	\$796,007	\$500,306	-\$295,700	0.63
Total Resource Cost Test (TRC) No Adder	\$0.1864	\$796,007	\$454,824	-\$341,183	0.57
Utility Cost Test (UCT)	\$0.1497	\$639,325	\$454,824	-\$184,501	0.71
Rate Impact Test (RIM)		\$1,227,803	\$454,824	-\$772,979	0.37
Participant Cost Test (PCT)		\$716,762	\$1,283,014	\$566,252	1.79
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000063264				
Discounted Participant Payback (years)	10.96				

Table 5-7: Program Cost-Effectiveness Results – 2020

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1750	\$553,995	\$365,830	-\$188,164	0.66
Total Resource Cost Test (TRC) No Adder	\$0.1750	\$553,995	\$332,573	-\$221,422	0.60
Utility Cost Test (UCT)	\$0.1573	\$497,888	\$332,573	-\$165,315	0.67
Rate Impact Test (RIM)		\$878,227	\$332,573	-\$545,654	0.38
Participant Cost Test (PCT)		\$544,545	\$922,700	\$378,155	1.69
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000051154				
Discounted Participant Payback (years)	10.36				

6 Conclusions and Recommendations

6.1 Conclusions

Pacific Power's 2019-2020 Home Energy Savings program resulted in a savings of 712,855 kWh reflecting a realization rate of 98 percent.

Table 6-1: Total Program Savings by Year

Program Year	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
2019	692,897	715,344	1.03	404,206
2020	603,374	550,062	0.91	308,649
Total	1,296,270	1,265,406	0.98	712,855

HVAC measures accounted for 66 percent of program savings (99 percent of which is the result of heat pumps), energy kits represent 27 percent of program savings, and lighting represents 4 percent of program savings. The remaining measure categories account for 4.5 percent of program savings. This shift in distribution of program savings from the previous evaluation cycle is the result of declining savings available from lighting and water savings measures, and strongly reflects a transformation of the lighting market (see Table 6-2).

Table 6-2: Total Program Savings by Measure Category 2019-2020

Measure Category	Claimed Saving	Evaluated Savings	Realization Rate	Net Evaluated Savings	% Program Savings	% Program Savings 2017-2018
HVAC	844,869	837,770	0.99	462,803	65%	30%
Energy Kits	359,163	333,542	0.93	189,400	27%	43%
Lighting	32,052	33,365	1.04	27,596	4%	24%
Whole Home	37,963	37,500	0.99	20,625	3%	1%
Water Heating	16,758	17,559	1.05	9,657	1%	1%
Appliances	3,426	3,630	1.06	1,997	0.28%	.2%
Building Shell	2,039	2,039	1.00	776	0.11%	.1%
Total	1,296,270	1,265,406	0.98	712,855		

The following measure categories were removed from program offerings at or near the end of the evaluation period: heat pumps, starter kits, lighting.

6.2 Recommendations

ADM recommends that Pacific Power consider the following actions.

Screen for premises that are likely fuel switchers measures

If Pacific Power reintroduces heat pumps, ADM recommends that it considers screening for supplemental fuel usage to identify potential fuel switching premises.

Add data elements to tracking and reporting

Pacific Power relies on implementation partners to collect and store critical data that is required to evaluate the program and verify the resulting energy savings. ADM recommends that Pacific Power adds the following additional data elements to its internal program tracking datasets:

- Product manufacturer and model numbers, or minimally efficiency specifications
- Sales or distribution location for all upstream measures
- Baseline conditions (specifics varies by measure)

Add process controls to program implementation

ADM recommends that Pacific Power work with program implementers to revise program controls to reduce or eliminate data omissions and inaccuracies and ensure that program eligibility requirements are met for all measures.

Evaluate program on an annual basis

Annual evaluations would allow Pacific Power to monitor program controls and data collection throughout the program year, allowing the utility to respond to program performance midcycle. ADM recommends that Pacific Power implement annual rather than biannual program evaluations.

Add climate zone to customer data

Climate zone is referenced in numerous measure definitions because savings are determined by these climate specifications. As such, ADM recommends that Pacific Power add climate zone to its customer database to simplify a process to verify which climate zone the customer lives in, and therefore increase the accuracy of measure specification during data entry.

Upgrade leakage modeling methodology

ADM recommends that Pacific Power employ a geospatial modeling method to replace the RSTAT model currently used to estimate upstream program leakage, such as the methodology documented in the Arkansas TRM V8.1 that relies on split drive time polygons that extend 60 minutes away from a retailer, accounting for nearly 100 percent of product sales. The RSAT model does not utilize drive time polygons and instead

relies on zip code, retailer trade area, and census block overlap, which is less accurate than the drive time polygon method.

Continue efforts to collect customers' email addresses on program applications

ADM recommends the Pacific Power energy efficiency implementation team continues to support efforts to increase the customer include email addresses on file to increase the pool of program participants who can be invited to complete electronic participate surveys.

7 Appendix A – TRL Reference Documents

This appendix documents the TRL reference files used to complete this evaluation. ADM’s review of these documents included verifying savings values accurately reflected the underlying technical files on which they are based, usually RFT files.

Measure Name	ADM verified reference doc
Appliances	
Clothes Dryer - Ventless_UCEF 3.80 to 4.19 - CZ01 – CA	2019.03.01_CA_HES_AnyRes_Heat_Pump_Clothes_Dryer_Brief.xlsx
Clothes Dryer - Ventless_UCEF 5.30 to 6.09 - CZ01 – CA	2019.03.01_CA_HES_AnyRes_Heat_Pump_Clothes_Dryer_Brief.xlsx
Clothes Dryer - Ventless_UCEF 7.20 to 8.00 - CZ16 – CA	2019.03.01_CA_HES_AnyRes_Heat_Pump_Clothes_Dryer_Brief.xlsx
Clothes Washer - Electric DHW & Gas Dryer – CA	2018.09.06_CA_HES_Clothes_Washers_Brief.xlsx
Clothes Washer - Electric DHW & Electric Dryer – CA	2018.09.06_CA_HES_Clothes_Washers_Brief.xlsx
Refrigerator - CEE Tier 3 - Any Style – CA	2018.09.06_CA_HES_Refrigerator_Brief.xlsx
Building Shell	
Insulation - Attic - <= R19 to R44 - CZ16 – CA	2019.03.01_CA_HES_SF_MF_Insulation_Brief.xlsx
Insulation - Attic - Add R-19 - Electric Heat – CA	2018.08.03_CA_HES_Insulation_Brief.xlsx
Insulation - Attic - Add R-30 - Electric Heat – CA	2018.08.03_CA_HES_Insulation_Brief.xlsx
Insulation - Wall - Electric Heat – CA	2018.08.03_CA_HES_Insulation_Brief.xlsx
Energy Kits	
Energy Savings Kit - Best - 1 Bathroom – CA	2019.03.01_CA_HES_Kits_Brief Nexant.xlsx
Energy Savings Kit - Best - 2 Bathrooms – CA	2019.03.01_CA_HES_Kits_Brief Nexant.xlsx
Energy Savings Kit - LED – CA	2019.03.01_CA_HES_Kits_Brief Nexant.xlsx
Energy Savings Kit - Best - 1 Bathroom – CA	2018.09.05_CA_HES_Kits_Brief.xlsx
Energy Savings Kit - Best - 2 Bathrooms – CA	2018.09.05_CA_HES_Kits_Brief.xlsx
Energy Savings Kit - LED – CA	2018.09.05_CA_HES_Kits_Brief.xlsx
HVAC	
Central Air Conditioner Upgrade - SEER 15 - < 45k BTU - CZ01 – CA	2019.03.01_CA_HES_CAC_Brief.xlsx
Ductless Heat Pump - Multi-head – CA	None provided
Ductless Heat Pump - Single-head – CA	None provided
Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ16 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Heat Pump Conversion - Convert FAF w/out CAC to 9.0 HSPF ASHP - CZ16 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx

Measure Name	ADM verified reference doc
Heat Pump Conversion - Convert FAF w/out CAC to Federal Standard ASHP - CZ01 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Heat Pump Conversion - Tier 1 – CA	2018.08.03_CA_HES_HP_Conversion_Brief.xlsx
Heat Pump Conversion - Tier 2 – CA	2018.08.03_CA_HES_HP_Conversion_Brief.xlsx
Heat Pump Upgrade - 9.4 HSPF - 17 SEER - CZ16 – CA	2019.04.15_CA_HES_SF_MH_HPUUpgrade_Brief DEER2020 Nexant.xlsx
Heat Pump Upgrade - 9.7 HSPF - 18 SEER - CZ16 – CA	2019.03.01_CA_HES_SF_MH_HPUUpgrade_Brief
Heat Pump Upgrade - Tier 1 – CA	2018.08.03_CA_HES_HP_Upgrade_Brief.xlsx
Heat Pump Upgrade - Tier 2 – CA	2018.08.03_CA_HES_HP_Upgrade_Brief.xlsx
Manufactured Home - Duct Sealing - Direct Install - < 35 and >= 25% to <=15% Total Leakage - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_DuctSealing_Brief.xlsx
Manufactured Home - Duct Sealing - Direct Install - >=35% to <=15% Total Leakage - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_DuctSealing_Brief.xlsx
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Manufactured Home - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Manufactured Home - Ductless Heat Pump 9.0 HSPF Zonal ER- CZ01 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to 9.0 HSPF ASHP - CZ01 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ01 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Manufactured Homes - Heat Pump Conversion - Convert FAF w/CAC to Federal Standard ASHP - CZ16 – CA	2019.03.01_CA_HES_SF_MH_HPConversion_Brief.xlsx
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Multifamily - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
New Homes - Ductless Heat Pump - CA CZ01	2019.03.01_CA_HES_New_Homes_DHP_Brief.xlsx
New Homes - Ductless Heat Pump - CA CZ01	2019.03.01_CA_HES_New_Homes_DHP_Brief.xlsx
New Homes Ductless Heat Pump – CA	2019.03.01_CA_HES_New_Homes_DHP_Brief.xlsx
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ01 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Single Family - Ductless Heat Pump 9.0 HSPF eFAF - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ01 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Single Family - Ductless Heat Pump 9.0 HSPF Zonal ER - CZ16 – CA	2019.03.01_CA_HES_SF_MH_MF_Ductless_Heat_Pump_Brief.xlsx
Smart Thermostat - eFAF - CZ16 – CA	2019.03.01_CA_HES_Smart_Thermostat_Brief.xlsx
Smart Thermostat - Heat Pump - CZ16 – CA	2019.03.01_CA_HES_Smart_Thermostat_Brief.xlsx

Lighting	
LED Downlight: 10 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 11 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 13 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 14 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 16 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 23 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 7 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 8 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Downlight: 9 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 10 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 100W Equivalent - 110-120 LPW - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 11 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 12 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 13 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 15 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 16 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 17 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 40W Equivalent - 100-120 LPW - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 6 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 60W Equivalent - 100-120 LPW - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED General Purpose: 75W Equivalent - 110-120 LPW - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED Specialty - BR-R: ?11 Watts - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED Specialty - BR-R: <11 Watts - Retail – CA	2019.03.01_CA_HES_LEDs_Brief.xlsx
LED Specialty - BR-R: 11 to ?14 Watts - Retail – CA	2019.03.01_CA_HES_LEDs_Brief Nexant.xlsx
LED Specialty - BR-R: 11 to <14 Watts - Retail – CA	2019.03.01_CA_HES_LEDs_Brief Nexant.xlsx
LED Specialty - BR-R: 14 to ?22 Watts - Retail – CA	2019.03.01_CA_HES_LEDs_Brief Nexant.xlsx
LED Specialty - Can Retrofit: >12 to 23 Watts – CA	2019.03.01_CA_HES_LEDs_Brief Nexant.xlsx
LED Specialty - Candelabra: 3 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Specialty - Candelabra: 4 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Specialty - Globe: 5 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx
LED Specialty - Globe: 6 watts - Retail – CA	2018.08.03_CA_HES_LEDs_Brief.xlsx

Water Heating	
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater > 55 Gallon - 3.17 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater > 55 Gallon - 3.5 EF - 65 Gallon replacing 60 Gallon - CZ01 - Self-Installed - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ01 - Self-Installed - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater 0-55 Gallon - 3.24 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ01 - CA	2019.03.01_CA_HES_Heat_Pump_Water_Heater_Brief.xlsx
Heat Pump Water Heater 0-55 Gallon - 3.5 EF - 50 Gallon replacing 50 Gallon - CZ16 - Self-Installed - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ01 - Self Install - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Heat Pump Water Heaters 55 Gallon and Less (Over 2.0 EF) - CZ16 - Self Install - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ01 - Self Install - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Heat Pump Water Heaters Over 55 Gallon (Over 2.2 EF) - CZ16 - CA	2018.08.03_CA_HES_Heat_Pump_Water_Heaters_Brief.xlsx
Whole Home	
New Homes Whole Home Performance Path - 15 to 29.99% Better than Code - CA	N/A
Whole Home Upgrade Package - Large - Ductless Heat Pump - Single Head - CA	N/A

8 Appendix B – General Population Survey

Client	PacifiCorp
Program	Wattsmart Home
Group	Pacific Power customers in California
Purpose	Collect ISR, NTG, leakage and process data for upstream measures Collect non-participant spillover data for all residential EE programs

Identify Participants

1. Did you or anyone else in your home buy any LED lighting products in 2019 or 2020?
 - Yes
 - No
 - I don't recall
2. Which stores did you buy your ENERGY STAR LED lighting from (consider only in-store purchases, not online purchases)? Select all that apply.
 - Ace Hardware
 - Eller's Fort Dick Market
 - The Home Depot
 - True Value Hardware
 - Walmart
 - Other (Please specify)
 - I don't know
3. What type of ENERGY STAR LED lighting products did you buy? Select all that apply.
 - Standard LED bulb(s)
 - Specialty LED bulb(s)
 - LED downlight(s)
 - I don't know

Standard LED bulbs

4. When did you buy the ENERGY STAR standard LED bulbs? Select all that apply.
 - 2019
 - 2020

5. How many ENERGY STAR standard LED bulbs did you buy during 2019-2020?
 - [numeric]
 - I don't know
6. Of the [LEDStandardQtyBought] bulbs you bought; how many are currently:
 - Installed [numeric]
 - In storage [numeric]
 - Discarded or given away [numeric]
7. Of the [LEDStandardQtyInstalled] *bulbs that you have installed*, how many replaced LEDs and how many replaced bulbs that were not LEDs?
 - Number of replaced LED bulbs [numeric]
 - Number of replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.) [numeric]
 - Number installed in new lamps or fixtures.
 - I don't know
8. Do you recall if the ENERGY STAR standard LED bulbs you bought were discounted?
 - Yes, there were discounted
 - No, they were not discounted
 - I don't remember
9. Do remember seeing a label or sign letting customers know that the discount was provided by Pacific Power?
 - Yes
 - No
 - I don't remember
10. Were any of the ENERGY STAR standard LED bulbs you purchased in 2019 or 2020 installed in a business or commercial building?
 - Yes
 - No
 - I don't know
11. Approximately how many of the ENERGY STAR standard LED bulbs you purchased were installed in a business or commercial building?

- Quantity: [numeric]

12. How many of the [LEDStandardQtyInstalled] installed standard LED bulbs are in each of the following locations?

Bathroom	[numeric]
Bedroom	
Dining room	
Exterior	
Garage	
Hallway	
Kitchen	
Living room	
Office	
Other room	
Installed at building other than home	
Don't know	

Specialty LED bulbs

13. When did you buy the ENERGY STAR specialty LED bulbs? Select all that apply. [allow multiple selection]

- 2019
- 2020

14. How many ENERGY STAR specialty LED bulbs did you buy during 2019-2020?

- [numeric]
- I don't know

15. Of the [LEDSpecialtyQtyBought] bulbs you bought; how many are currently:

- Installed [numeric]
- In storage [numeric]
- Discarded or given away [numeric]

16. Of the [LEDSpecialtyQtyInstalled] *bulbs that you have installed*, how many replaced LEDs, and how many replaced bulbs that were not LEDs?

- Number of replaced LED bulbs [numeric]
- Number of replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.) [numeric]
- Number installed in new lamps or fixtures [numeric]

- I don't know

17. Do you recall if the ENERGY STAR specialty LED bulbs you bought were discounted?

- Yes, there were discounted
- No, they were not discounted
- I don't remember

18. Do remember seeing a label or sign letting customers know that the discount was provided by Pacific Power?

- Yes
- No
- I don't remember

19. Were any of the ENERGY STAR specialty LED bulbs you purchased in 2019 or 2020 installed in a business or commercial building?

- Yes
- No
- I don't know

20. Approximately how many of the ENERGY STAR specialty LED bulbs you purchased were installed in a business or commercial building?

- Quantity: ____
- I don't know

21. How many of the [LEDSpecialtyQtyInstalled] specialty LED bulbs that are installed are in your home are in each of the following locations?

Bathroom	[numeric]
Bedroom	
Dining room	
Exterior	
Garage	
Hallway	
Kitchen	
Living room	
Office	
Other room	
Installed at building other than home	
Don't know	

LED downlight

22. When did you buy the ENERGY STAR LED downlight? Select all that apply.

- 2019
- 2020

23. How many ENERGY STAR LED downlights did you buy during 2019-2020?

- [numeric]
- I don't know

24. Of the [LEDDownlightQtyBought] bulbs you bought; how many are currently:

- Installed [numeric]
- In storage [numeric]
- Discarded or given away [numeric]

25. Of the [LEDDownlightQtyInstalled] *LED downlights that you have installed*, how many replaced LEDs, how many replaced bulbs that were not LEDs, and how many went in new fixtures?

- Number of replaced bulbs that were LEDs [numeric]
[LEDDownlightReplacedLEDs]
- Number of replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.) [numeric] [LEDDownlightReplacedNonLEDs]
- Number installed in new fixtures
- I don't know

26. Do you recall if the ENERGY STAR LED downlights you bought were discounted?

- Yes, there were discounted
- No, they were not discounted
- I don't remember

27. Do remember seeing a label or sign letting customers know that the discount was provided by Pacific Power?

- Yes
- No
- I don't remember

28. Were any of the ENERGY STAR LED downlights you purchased in 2019 or 2020 installed in a business or commercial building?

- Yes
- No
- I don't know

29. Approximately how many of the LED downlights you purchased were installed in a business or commercial building?

- Quantity: ____
- I don't know

30. How many of the [LEDDownlightQtyInstalled] LED downlights that are installed in each of the following locations?

Bathroom	[numeric]
Bedroom	
Dining room	
Exterior	
Garage	
Hallway	
Kitchen	
Living room	
Office	
Other room	
Installed at building other than home	
Don't know	

LED Lighting Process Questions

31. Which characteristic do you consider when purchasing light bulbs? Select all that apply.

- Price
- Energy efficiency
- ENERGY STAR certification
- Brightness of the bulb
- How long the bulb lasts
- The ability to dim the bulb
- Color of the light
- Other (please specify)
- I don't know

32. Why did you purchase the ENERGY STAR LED lighting? Select all that apply.

- To replace burned out bulbs
- To replace working bulbs to lower energy use
- To add new light fixture(s) in my home
- To take advantage discounted pricing
- Other (please specify)
- I don't know

Leakage

33. How long you would drive in minutes to reach each of the following retail location types.

	Length in minutes	Don't know
Grocery	[numeric]	98
Do-It-Yourself or DIY retailer (e.g., Home Depot, Lowe's etc.)		98
Mass merchant (e.g., Walmart, Target)		98
Warehouse Club (e.g., Costco, Sam's Club)		98

Home Demographics

34. Which of the following best describes your home?

- Manufactured or mobile home
- Single-family home
- Duplex or townhouse
- Apartment or condominium
- Other (please specify)
- I don't know

35. Do you own or rent your home?

- Own
- Rent
- Prefer not to answer

36. When was your home built?

- Before 1960
- 1960-1979
- 1980-1999
- 2000-2009
- 2010 or later
- I don't know

37. How large is your home?

- Less than 1,000 square feet
- 1,000-2,000 square feet
- 2,000-3,000 square feet
- 3,000-4,000 square feet
- Greater than 4,000 square feet
- I don't know

38. What is the main fuel used for heating your home?

- Electricity
- Natural Gas
- Propane
- Oil
- Don't heat home
- Other (Please specify)
- I don't know

39. Is English the primary language spoken in your household?

- Yes
- No

40. Is your household eligible for California Alternative Rates for Energy (CAREs)?
(Select one)

- Yes

- No
- I don't know

41. Including yourself, how many people are living in your household?

[DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

42. Is your annual household income over or under [FPL CUTOFF INCOME HOUSEHOLD SIZE]?

- Over
- Under
- I don't know
- Prefer not to answer

43. Thank you

- Thank you for your valuable feedback. In exchange for your time, we'd like to send you a \$5 electronic gift card that you can use at one of dozens of retailers. We will email your gift card to:
- [Email]

44. If you would like us to send it to a different email address, enter it here:

- On behalf of Pacific Power, thank you for your time and feedback! If you have any questions regarding this survey or the status of your gift card, email adm-surveys@pacificorp.com. Have a great day!

9 Appendix C – Starter Kits Customer Survey

SCREENING

1. Our records indicate that you received a Pacific Power Home Energy Savings Program Starter Kit in 2019. Starter Kits contain four LED light bulbs, and customers with electric water heating also receive high-performance showerheads and kitchen and bathroom faucet aerators. Did you receive a Home Energy Savings Program Starter Kit in the mail?
 - Yes
 - No [TERMINATE]
 - I don't know [TERMINATE]

2. What fuel does your main water heater use?
 - Electricity
 - Natural gas
 - Propane
 - Other (Please specify)
 - I don't know

3. How satisfied were you with the following aspects of your Home Energy Savings Program Starter Kit? **[INSERT 1-5 SCALE; 1 = VERY DISSATISFIED, 5 = VERY SATISFIED, WITH 98 = I DON'T KNOW]**
 - Ease of ordering
 - Ease of installation
 - Quality of components
 - Timeliness of delivery
 - Process to request a kit
 - Kit contents
 - Energy savings that resulted from install kit
 - Pacific Power as your electricity provider

[DISPLAY Q4 IF ANY Q3 < 3]

4. Why were you dissatisfied?
 - [OPEN-ENDED]

5. How important were each the following reasons for requesting a kit? [INSERT 1-5 SCALE; 1 = NOT AT ALL IMPORTANT, 5 = VERY IMPORTANT, WITH 98 = I DON'T KNOW]

- Saving money on utility bills
- Concern for the environment
- Curiosity about energy-efficient products
- Opportunity to get the products in the kit for free

6. How did you hear about the Starter Kits? **[MULTI-SELECT]**

- Newspaper/magazine/print media
- Utility bill insert
- My bill
- Pacific Power website
- Word of mouth (friend, relative, coworker, etc.)
- Contractor or plumber
- TV ad
- Pacific Power representative
- Pacific Power newsletter
- Retailer/store
- Community event
- Social media such as Facebook or Twitter
- Home Energy Report
- Other (Please specify)
- I don't know

7. How long after receiving your kit did you install its contents? [INSERT OPTIONS DEFINED AS 1 = WITHIN 1 WEEK, 2 = 1 WEEK TO 6 MONTHS, 3 = AFTER 6 MONTHS, 4 = DID NOT INSTALL, AND 98 = I DON'T KNOW]

- First LED light bulb
- Second LED light bulb
- Third LED light bulb
- Fourth LED light bulb

[SHOW IF KIT - 2 BATH >0, OR KIT - 1 BATH >0] KITCHEN AERATOR

[SHOW IF KIT - 2 BATH >0, OR KIT - 1 BATH >0] BATHROOM AERATOR

[SHOW IF KIT - 2 BATH >0] SECOND BATHROOM AERATOR

[SHOW IF KIT - 2 BATH >0, OR KIT - 1 BATH >0] HIGH-EFFICIENCY SHOWERHEAD

SHOW IF KIT - 2 BATH >0] SECOND HIGH-EFFICIENCY SHOWERHEAD

[DISPLAY Q8 IF Q7(□), Q7(□), Q7(□), OR Q7(□) = 4]

8. Why did you decide not to use all the LEDs yet? [SELECT ALL THAT APPLY]

- Waiting for current lights to burn out
- Not the correct wattage
- Disliked the color tone/quality of the emitted light
- Did not fit into my fixtures
- Other (Please specify)

[DISPLAY Q9 IF Q7(0), Q7(0) OR Q7(0) = 4]

9. Why did you decide not to use the faucet aerator(s) that came in your kit?
[SELECT ALL THAT APPLY]

- Faucet aerators were already installed on all faucets
- Did not integrate well with current plumbing
- Disliked the pressure/water volume
- Disliked the way it looked
- Other (Please specify)

[DISPLAY Q10 IF Q7(0) OR Q7(0) = 4]

10. Why did you decide not to use the high-efficiency shower head(s) included in the kit? [SELECT ALL THAT APPLY]

- High-efficiency showerheads were already installed in all showers
- Did not integrate well with current plumbing
- Disliked the pressure/water volume
- Disliked the way it looked
- Other (Please specify)

HOME DEMOGRAPHICS

11. Which of the following best describes your home?

- Manufactured or mobile home
- Single-family home
- Duplex or townhouse
- Apartment or condominium
- Other (please specify)
- Don't know

12. When was your home built?

- Before 1960

- 1960-1979
- 1980-1999
- 2000-2009
- 2010 or later
- Don't know

13. Do you own or rent your home?

- Own
- Rent
- Prefer not to answer

14. What is the main fuel used to heat your home?

- Electricity
- Natural gas
- Propane
- Oil
- Other (Please specify)
- Don't heat home
- Don't know

15. What fuel does your main water heater use?

- Electricity
- Natural gas
- Propane
- Other (Please specify)
- Don't know

16. Including yourself, how many people are living in your household?

- [DROP DOWN BOX – 1-12, 13 or more, 99. Prefer not to answer]

17. Is your annual household income over or under [FPL CUTOFF INCOME HOUSEHOLD SIZE]?

- Over
- Under
- Don't know
- Prefer not to answer

18. We appreciate your time and would like to send you a \$5 electronic gift card to thank you. We will send it to [EMAIL]. If you would like us to send your gift card to a different address, please enter the new address below. You should receive an email with the link to your gift card within 10 days.

- Please send my gift card to the above email address.
- Please send my electronic gift card to the following email address: ____
- I do not wish to receive a gift card

19. If you have questions regarding this survey or would like to know the status of your gift card, you can send an email to adm-surveys@admenergy.com. On behalf of Pacific Power, thank you for participating. Have a great day!