

2021-2022
Washington Home Energy Savings Program
Evaluation, Measurement & Verification Report

Prepared for:
Pacific Power

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Acronyms & Glossary of Terms

The following acronyms and terms are used throughout this report.

AHRI – Air-conditioning, Heating, and Refrigeration Institute

ASHP – Air source heat pump

CAC – Central air-conditioning

Claimed savings – Energy savings calculated based on forecasts rather than actual results; used for program and portfolio planning purposes; energy savings included in Pacific Power’s annual reports. Used interchangeably with ex-ante savings.

Deemed savings – An estimate of energy savings for an adopted efficiency measure or practice developed from a set of assumptions that reflects an average installation scenario.

Downstream programs – Programs that offer customers financial incentives to purchase energy efficient products, for example, by submitting a rebate application. The incentive is paid at the end point, or downstream, in the distribution channel.

EM&V – Evaluation, Measurement and Verification

Evaluated savings – Savings estimates that are based on verified program results rather than forecasts. Used interchangeably with ex-post savings.

Ex-ante savings – Energy savings calculated based on forecasts rather than actual results; used for program and portfolio planning purposes; energy savings included in Pacific Power’s annual reports. Used interchangeably with claimed savings.

Ex-post savings – Savings estimates that are based on verified program results rather than forecasts. Used interchangeably with evaluated savings.

HVAC – Heating, Ventilation and Air Conditioning

ISR – In-service rate

kWh – Kilowatt hours

ML – Measure Library

NPV – Net present value

Realization rate – The ratio of evaluated savings to claimed savings (ex-post savings divided by ex-ante savings).

RTF – Regional Technical Forum

Upstream programs – Programs that offer discounts on energy efficient products or services by paying incentives to retailers, distributors, or manufacturers who pass incentives on to customers. The incentive is paid at the beginning, or upstream, point in the distribution channel.

UES – unit energy savings

1 Executive Summary

ADM Associates, Inc. (ADM) is under contract with PacifiCorp to perform evaluation, measurement, and verification (EM&V) services to determine kilowatt hours (kWh) of energy savings that resulted from Pacific Power's 2021-2022 Home Energy Savings Program in Washington. This report documents ADM's findings.

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 that considers program operations.

The program provides financial incentives (discounts, rebates, and free products) to Pacific Power residential customers who purchase and install energy efficient products. The program leverages relationships with manufacturers, distributors, and retailers to ensure effective program implementation and optimize participation.

1.1 Impact Analysis Results

Table 1-1 through Table 1-3 present impact evaluation results including claimed savings, evaluated savings and realization rates for each measure category across both program years.

Table 1-1: Total Program Savings 2021-2022

Measure Category	Quantity	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	3,819	4,593,709	4,308,555	94%	83%
Lighting	219,474	723,970	617,610	85%	12%
Whole Home	29	90,880	83,786	92%	2%
Water Heating	54	71,018	71,420	101%	1%
Building Shell	202,578	69,806	63,392	91%	1%
Appliances	157	29,589	31,861	108%	1%
Energy Kits	25	3,800	3,306	87%	0.1%
Total	426,136	5,582,772	5,179,931	93%	100%

Table 1-2: Total Program Savings 2021

Measure Category	Quantity	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	1,469	2,182,438	2,079,626	95%	76%
Lighting	169,766	608,301	511,172	84%	19%
Whole Home	22	65,926	65,926	100%	2%
Building Shell	106,925	44,161	38,874	88%	1%
Water Heating	29	36,459	36,360	100%	1%
Appliances	89	16,307	16,891	104%	1%
Energy Kits	25	3,800	3,306	87%	0.1%
Total	278,325	2,957,392	2,752,156	93%	100%

Table 1-3: Total Program Savings 2022

Measure Category	Quantity	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	2,350	2,411,270	2,228,929	92%	92%
Lighting	49,708	115,669	106,438	92%	4%
Water Heating	25	34,559	35,060	101%	1%
Building Shell	95,653	25,645	24,518	96%	1%
Whole Home	7	24,954	17,860	72%	1%
Appliances	68	13,282	14,970	113%	1%
Total	147,811	2,625,379	2,427,775	92%	100%

1.2 Process Evaluation Results

ADM made the following key findings during its process evaluation.

- Pacific Power program staff and implementer staff work closely with each other and are in almost daily communication about program operations and performance.
- Pacific Power is required to pass cost effectiveness tests at the portfolio level, providing some flexibility at the program level to focus on additional program goals. This allowed Pacific Power to incorporate an energy equity focus on program goals. For example, upstream lighting measures were offered through stores targeting underserved customers.
- Declining UES values is the primary challenge Pacific Power faced in achieving its program objectives.
- Some data collected on rebate applications was insufficient to specify the correct measures for claimed savings.

- Some measure-defining data collected on rebate applications were stored only as an image file, such as in a .pdf format, which cannot easily be reviewed for a census of program records.

1.3 Cost Effectiveness Results

AEG estimated the cost-effectiveness results for the Washington Home Energy Savings Program based on 2021 and 2022 costs provided by Pacific Power and energy savings estimates provided by this evaluation. The program passed the Participant Cost Test (PCT). Cost-effectiveness results are reported in Table 1-4 through Table 1-9.

1.3.1 Cost-effectiveness Results without Non-energy Impacts (NEIs)

*Table 1-4: Program Cost-Effectiveness Results – 2021-2022
Without Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1888	\$9,739,021	\$6,357,744	\$3,381,278	0.65
Total Resource Cost Test (TRC) No Adder	\$0.1888	\$9,739,021	\$5,779,767	\$3,959,254	0.59
Utility Cost Test (UCT)	\$0.1421	\$7,327,832	\$5,779,767	\$1,548,065	0.79
Participant Cost Test (PCT)		\$5,553,146	\$7,766,748	\$2,213,602	1.40
Rate Impact Test (RIM)		\$11,952,624	\$5,779,767	\$6,172,857	0.48
Lifecycle Revenue Impacts (\$/kWh)					\$0.0002088
Discounted Participant Payback (years)					8.40

*Table 1-5: Program Cost-Effectiveness Results – 2021
Without Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1662	\$4,663,763	\$3,483,129	\$1,180,634	0.75
Total Resource Cost Test (TRC) No Adder	\$0.1662	\$4,663,763	\$3,166,481	\$1,497,283	0.68
Utility Cost Test (UCT)	\$0.1357	\$3,807,508	\$3,166,481	\$641,027	0.83
Participant Cost Test (PCT)		\$2,415,452	\$4,062,914	\$1,647,462	1.68
Rate Impact Test (RIM)		\$6,311,225	\$3,166,481	\$3,144,745	0.50
Lifecycle Revenue Impacts (\$/kWh)					\$0.0001103
Discounted Participant Payback (years)					6.91

*Table 1-6: Program Cost-Effectiveness Results – 2022
Without Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2100	\$5,292,387	\$3,080,262	\$2,212,125	0.58
Total Resource Cost Test (TRC) No Adder	\$0.2100	\$5,292,387	\$2,800,238	\$2,492,149	0.53
Utility Cost Test (UCT)	\$0.1441	\$3,629,851	\$2,800,238	-\$829,613	0.77
Participant Cost Test (PCT)		\$3,354,823	\$4,038,893	\$684,071	1.20
Rate Impact Test (RIM)		\$5,976,457	\$2,800,238	\$3,176,220	0.47
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000913
Discounted Participant Payback (years)					9.92

1.3.2 Cost-effectiveness Results with Non-energy Impacts (NEIs)

*Table 1-7: Program Cost-Effectiveness Results – 2021-2022
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1888	\$9,739,021	\$7,348,260	\$2,390,762	0.75
Total Resource Cost Test (TRC) No Adder	\$0.1888	\$9,739,021	\$6,770,283	\$2,968,738	0.70
Utility Cost Test (UCT)	\$0.1421	\$7,327,832	\$5,779,767	\$1,548,065	0.79
Participant Cost Test (PCT)		\$5,553,146	\$8,757,264	\$3,204,119	1.58
Rate Impact Test (RIM)		\$11,952,624	\$5,779,767	\$6,172,857	0.48
Lifecycle Revenue Impacts (\$/kWh)					\$0.0002088
Discounted Participant Payback (years)	8.40				

*Table 1-8: Program Cost-Effectiveness Results – 2021
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1662	\$4,663,763	\$3,804,182	-\$859,581	0.82
Total Resource Cost Test (TRC) No Adder	\$0.1662	\$4,663,763	\$3,487,534	\$1,176,229	0.75
Utility Cost Test (UCT)	\$0.1357	\$3,807,508	\$3,166,481	-\$641,027	0.83
Participant Cost Test (PCT)		\$2,415,452	\$4,383,967	\$1,968,516	1.81
Rate Impact Test (RIM)		\$6,311,225	\$3,166,481	\$3,144,745	0.50
Lifecycle Revenue Impacts (\$/kWh)					\$0.0001103
Discounted Participant Payback (years)	6.91				

*Table 1-9: Program Cost-Effectiveness Results – 2022
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2100	\$5,292,387	\$3,797,570	\$1,494,817	0.72
Total Resource Cost Test (TRC) No Adder	\$0.2100	\$5,292,387	\$3,517,546	\$1,774,841	0.66
Utility Cost Test (UCT)	\$0.1441	\$3,629,851	\$2,800,238	-\$829,613	0.77
Participant Cost Test (PCT)		\$3,354,823	\$4,756,201	\$1,401,379	1.42
Rate Impact Test (RIM)		\$5,976,457	\$2,800,238	\$3,176,220	0.47
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000913
Discounted Participant Payback (years)					9.92

1.4 Conclusions

ADM draws the following conclusions from its evaluation.

- Pacific Power’s 2021-2022 Home Energy Savings program resulted in a savings of 5,179,931 kWh with a realization rate of 93 percent as reported in Table 1-10.

Table 1-10: Total Program Savings by Year

Year	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
2021	2,957,392	2,752,156	93%
2022	2,625,379	2,427,775	92%
Total	5,582,772	5,179,931	93%

- Heating, Ventilation and Air Conditioning (HVAC) measures continue to grow in importance as the primary measure category in Pacific Power’s Home Energy Savings program as shown in Figure 1-1.
- The 93 percent realization rate for 2021-2022 evaluation is higher than the 2019-2020 realization rate of 86 percent and the 2017-2018 realization rate of 67 percent.
- Additional opportunities exist to increase accuracy of ex-ante program savings estimates by improving program data collection and handling.

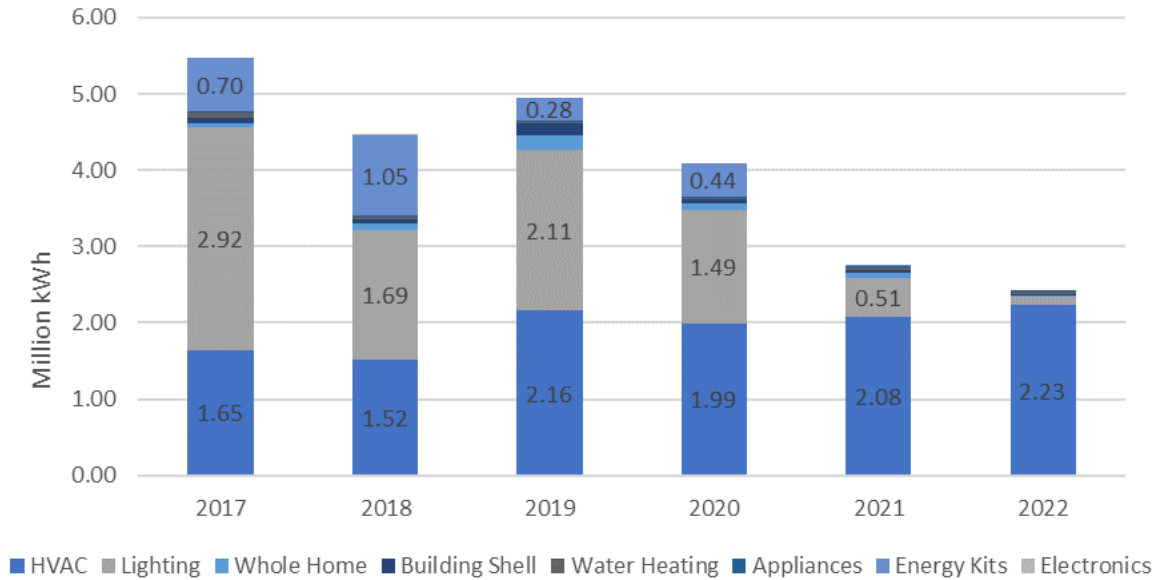


Figure 1-1: Program Savings (Evaluated) by Measure Category 2017-2022

1.5 Recommendations

ADM provides the following recommendations to improve future program implementation.

Update program rebate applications to collect the specific data needed to select the correct measure (and therefore claimed savings).

ADM recommends that Pacific Power modify its rebate applications to remove ambiguity about the requested data needed to report correct incentivized measure.

ADM recommends a comprehensive review of program data collection tools and practices to ensure that rebate applications accurately collect all data elements needed to correctly identify claimed measures.

Update program controls to improve accuracy of measure selection.

ADM recommends that program implementers add process controls to reduce or eliminate measure identification errors and verify that all program eligibility requirements are met for all measures.

Require implementation contractors to include measure-defining data elements in uploaded program dataset.

The current dataset provided to Pacific Power by the implementer does not include all data elements that are required to verify and calculate program savings. ADM recommends that Pacific Power require program implementers to provide the following data elements in addition to the data currently included in program data uploads:

- For all measures, measure-defining data elements. For example, the measure *Single Family - Heat Pump Conversion to 9.0 HSPF/14.0 SEER - Convert FAF w/CAC – WA* includes the following measure-defining elements: home type, installed equipment, efficiency rating, baseline heating system, and baseline cooling system.
- For non-HVAC measures, product manufacturer and model number or ENERGY STAR® identification number.
- For HVAC measures, AHRI certification number.
- For upstream measures, sales or distribution location and product model number at the record level.
- Additional data fields, as required, to identify the correct measure (e.g., heating and cooling system type, baseline conditions, installation location, etc.).

Storing these key data elements with Pacific Power’s program data will result in the following benefits:

- Adds data management industry best practices to Pacific Power’s energy efficiency programs.
- Allows verification of a census of program data rather than relying on sampling. A central dataset can undergo census review, while a census review of discrete image application files (.pdf formatted files) is often cost prohibitive.
- Reduce evaluation risk by requiring implementer to document measure selection.
- Improve internal program planning by having more accurate program measure participation data.

Lighting measure product mapping to measure names

Review lighting product assignments to lighting measure names. During the evaluated program period, some ANSI bulb shapes (BR40, BR30, PAR30, MR16, R30 and BR20) were reported as *General Purpose & Three-Way*. ADM recommends that these ANSI bulb types are categorized as *Reflective & Outdoor* type lighting measures.

Electric baseboard heating conversion to air source heat pump (ASHP)

Recognize electric baseboard heating to ducted heat pump conversion as a separate measure. No measure exists in the Measure Library (ML) to reflect this type of conversion, which was found in 3 of 70 records (4 percent) in the evaluated sample.

1.6 Process Changes Reported by Implementer

The program implementer has reported making the following operational and data management changes since the evaluated program period.

- Home Type validation controls have been added to the measure selection process.
- Measure model number has been added to evaluation tracking data.

The following changes are under review and consideration.

- Add AHRI certification number to data uploaded from implementer to Pacific Power.
- Increase the percentage of electronic rebate applications that are entered directly into a searchable database.

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 2021-2022 Home Energy Savings Program in Washington. This report documents ADM's findings.

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 that considers program operations.

2.1 Description of Programs

The program provides financial incentives (discounts, rebates, and free products) to Pacific Power residential customers who 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 Delivered through Program by Measure Category

Measure Category	2021	2022	Total
Appliances	89	68	157
Clothes Washer	80	60	140
Clothes Dryer	9	8	17
Building Shell	106,925	95,653	202,578
Attic Insulation (sq ft)	68,001	73,549	141,550
Floor Insulation (sq ft)	20,197	12,354	32,551
Wall Insulation (sq ft)	18,074	7,017	25,091
Window Upgrade (sq ft)	653	2,733	3,386
Energy Kits	25	-	25
Best Kit	9	-	9
LED Kit	16	-	16
HVAC	1,469	2,350	3,819
Central Air Conditioner	46	14	60
Duct Sealing and/or Insulation	642	497	1,139
Heat Pump - Air Source	485	442	927
Heat Pump - Ductless	165	214	379
Smart Thermostat	131	1,183	1,314
Lighting	169,766	49,708	219,474
ENERGY STAR Light Fixtures	1,157	92	1,249
LED Lightbulbs	168,609	49,616	218,225
Water Heating	29	25	54
Heat Pump Water Heater	29	25	54
Whole Home	22	7	29
New Home - Performance Path	12	2	14
New Homes - Eco-rated Manufactured	1	-	1
New Homes - Energy Star Manufactured	9	5	14
Total	278,325	147,811	426,136

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
Appliances	Post-purchase rebate application
Building Shell	Post-purchase rebate application
Energy Kits	Free kit requested online for mail delivery
HVAC	Post-purchase rebate application, Trade ally midmarket
Lighting	Point-of-sale pricing and Direct installation
Water Heating	Post-purchase rebate application
Whole Home	Builder 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. Point-of-sale incentives do not require the consumer to apply for the rebate; it is an efficient and cost-effective means to encourage customers to purchase high-volume, low-cost measures such as LEDs. However, upstream lighting is being discontinued per the updated Regional Technical Forum direction on retail/upstream lighting. The only remaining residential lighting offers will be direct-install and through a community-based bulb distribution offering that is an equity-based offering that does not achieve savings.

Higher value incentives for larger measures (appliances, HVAC, etc.) are processed through a post-purchase application form that is designed to verify that installed measures meet energy efficiency requirements. HVAC measures are also installed by midmarket trade allies who submit rebate applications. Home builders submit applications for new homes incentives after building completion.

2.2 Impact Evaluation Objective

The objective of the impact evaluation is to determine the energy savings (kWh) that resulted from the program.

2.3 Process Evaluation Objective

The purpose of the process evaluation is to gain an understanding of the program and its challenges. The evaluation was completed through key staff interviews with Pacific Power and implementation contractors complemented with program documentation review.

The process evaluation was designed to answer the following research questions.

- What are key barriers and drivers to program success in Pacific Power's Washington 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?

3 Impact Evaluation

The 2021-2022 Home Energy Savings Programs resulted in 5,179,931 kWh of evaluated savings (see Table 3-1 through Table 3-3).

. The removal of standard lighting incentives which historically were the program's largest savings had an impact on savings. During this period the program was additionally impacted by the COVID pandemic and adverse economic conditions that included inflation, worker shortages and supply change challenges. Detailed impact evaluation results and analysis methodology for each measure category are included in subsequent sections.

Table 3-1: Total Program Savings 2021-2022

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	4,593,709	4,308,555	94%	83.2%
Lighting	723,970	617,610	85%	11.9%
Whole Home	90,880	83,786	92%	1.6%
Water Heating	71,018	71,420	101%	1.4%
Building Shell	69,806	63,392	91%	1.2%
Appliances	29,589	31,861	108%	0.6%
Energy Kits	3,800	3,306	87%	0.1%
Total	5,582,772	5,179,931	93%	100%

Table 3-2: Total Program Savings 2021

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	2,182,438	2,079,626	95%	75.6%
Lighting	608,301	511,172	84%	18.6%
Whole Home	65,926	65,926	100%	2.4%
Building Shell	44,161	38,874	88%	1.4%
Water Heating	36,459	36,360	100%	1.3%
Appliances	16,307	16,891	104%	0.6%
Energy Kits	3,800	3,306	87%	0.1%
Total	2,957,392	2,752,156	93%	100%

Table 3-3: Total Program Savings 2022

Measure Category	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	% Evaluated Program Savings
HVAC	2,411,270	2,228,929	92%	91.8%
Lighting	115,669	106,438	92%	4.5%
Water Heating	34,559	35,060	101%	1.4%
Building Shell	25,645	24,518	96%	1.0%
Whole Home	24,954	17,860	72%	0.7%
Appliances	13,282	14,970	113%	0.6%
Total	2,625,379	2,427,775	92%	100%

3.1 Impact Evaluation Approach

ADM completed the following steps to evaluate the program.

- Reviewed and reconciled program tracking data to the claimed participation counts and ex-ante savings in 2021 and 2022 annual reports.
- Determined unit energy savings (UES) which incorporate verified variables when possible.
- Achieved a minimum precision of better than ± 10 percent with 90 percent statistical confidence (“90/10 precision”) for evaluated savings estimates by measure category.
- Administered a general population survey to determine installation rates for upstream lighting measures.
- Estimated leakage rates for lighting measures using geospatial analysis.
- Provided comprehensive documentation and transparency for all evaluation tasks.
- Provided inputs for cost benefit analyses.
- Provided ongoing technical reviews and guidance throughout the evaluation cycle.

ADM’s evaluation of UES for each measure referenced savings values in the Measure Library (ML) and associated reference files. ML reference files document savings values from the Regional Technical Forum (RTF) library of measures maintained by Northwest Power and Conservation Council.

ADM reviewed a census of records by measure category whenever possible, and a sample of records by measure category when required data elements were not available in a centralized database. For example, when documentation of baseline conditions was only available in image files (.pdf) of program rebate application forms, a sample was reviewed for the measure category or measure type; ADM then applied the sample realization rate to the entire measure category or measure type.

For the following measure categories, ADM reviewed program data to verify that the correct measure was claimed for the documented project conditions:

- HVAC
- Lighting
- Building Shell
- Appliances
- Water Heating

For example, the savings for many measures are determined by the home heating system. In these cases, ADM reviewed the home heating system documented in the program data set or in application files to verify that the appropriate measure, and therefore savings, were claimed.

When measures specify a threshold efficiency rating for an incentivized product, ADM verified product specifications using product model numbers or AHRI numbers. When ADM found that documented product specifications or baseline conditions did not match claimed savings at the record level, ADM determined which, if any, measure accurately reflected the conditions found and recorded ex-post saving for the correct measure.

Thus, ADM's analysis verified that the evaluated program savings are an accurate reflection of the correct prescribed savings for projects and products incentivized through the program.

When applicable, ADM incorporated verified variables such as in-service rates (ISRs) and hours of use (HOUs) in place of ex-ante variables used in the calculation of RTF values.

Whole Home Performance Path measure savings are site specific for each home. ADM reviewed Axis home energy modeling software outputs to verify savings.

3.2 Data Collection and Measure Verification

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

- ADM reviewed and reconciled program tracking data with ex-ante savings reported in Pacific Power's 2021 and 2022 *Washington Annual Report on Conservation Acquisition*. ADM reviewed a census of program tracking data, associated savings values, input assumptions and calculations contained in the ML referenced files provided by Pacific Power. ADM issued data requests, as needed, to ensure that all data was collected that could be expected or required for this evaluation.
- Review of measure savings assumptions and calculations maintained in the ML. The ML files include measure savings assumptions, calculations, source papers or files

(e.g., RTF files), and additional documentation that together comprise the generally accepted rules and guidance for evaluating the program. ADM reviewed all ML documentation and included in this report any errors, missing data, and inconsistencies identified during ADM’s review.

- ADM requested program tracking data, ML reports and reference files, in addition to other program data and verification, as necessary.
- ADM collected primary data from Pacific Power customers through a general customer population to collect data about upstream measures.

3.3 Sample Design

ADM achieved a sampling precision of ± 10 percent or better at the 90 percent confidence level – or 90/10 precision – for evaluated savings estimates for each measure category as reported in Table 3-4. The HVAC measure category was further stratified by measure type as reported in Table 3-5.

Table 3-4: Program Sampling Plan

Measure Category	Population Size	Sample Size	Claimed kWh	% of Program Savings	Relative Precision
Appliances	157	157	32,212	0.6%	0.00%
Building Shell ¹	174	174	63,392	1.2%	0.00%
Energy Kits	25	25	3,306	0.1%	0.00%
HVAC	3,819	1,375	4,308,555	83.2%	6.70%
Lighting ²	1,318	1,091	617,610	11.9%	1.02%
Water Heating	54	54	71,420	1.4%	0.00%
Whole Home	29	29	83,786	1.6%	0.00%
Total	5,576	2,905	5,180,282	100.0%	5.58%

¹ Quantities represent program records; quantities of building shell measures are reported in square feet elsewhere in this report.

² Quantities represent unique lighting product model numbers.

Table 3-5: HVAC Sampling Plan

Measure Type	Population Size	Sample Size	Claimed kWh	% of Program Savings	Relative Precision
Central Air Conditioner	60	59	4,027	0.09%	1.38%
Duct Sealing/Insulation	1,139	1,138	831,798	19%	0.07%
Heat Pump	1,306	70	2,996,788	70%	9.56%
Smart Thermostat	1,314	108	475,941	11%	7.58%
Total	3,819	1,375	4,308,555	100%	6.70%

Additionally, a sample of Pacific Power residential customers who were known to have not participated in any downstream offerings was surveyed using a general customer population survey to determine measure installation rates, installation locations, and process evaluation responses for upstream lighting measures. See Table 3-6 for survey participation. Results are presented in Table 3-11: Lighting Program Savings 2021-2022.

Table 3-6: Survey Sample Response Size

Survey	Number of Survey Invitations Sent	Number of Completed Surveys	Response Rate
General Population Survey	4,500	141	3%

3.4 Determination of Impact Methodology

Table 3-7 shows the methodology used to calculate evaluated savings for each measure category. The primary source of savings values was the ML along with reference files included in the ML.

Table 3-7: Impact Evaluation Methodology Approach by Measure

Measure Category	Impact Evaluation Methodologies	Inputs to Evaluated Savings
HVAC	Unit Energy Savings Review	<ul style="list-style-type: none"> Savings values from ML reference files Model specifications (from model or AHRI #s) Rebate applications (for baseline conditions) Program tracking data (for home type)
Energy Kits	Unit Energy Savings Review	<ul style="list-style-type: none"> Savings values from ML reference files 2019-2020 Energy Kits survey results
Whole Home	Unit Energy Savings Review	<ul style="list-style-type: none"> Axis outputs
Lighting	Unit Energy Savings Review	<ul style="list-style-type: none"> Savings values from ML reference files General population survey results (for ISRs and HOU's)

Measure Category	Impact Evaluation Methodologies	Inputs to Evaluated Savings
Water Heating	Unit Energy Savings Review	<ul style="list-style-type: none"> • Savings values from ML reference files • Model specifications (from model #s) • Rebate dataset (baseline condition)
Appliances	Unit Energy Savings Review	<ul style="list-style-type: none"> • Savings values from ML reference files • Model specifications (from model #s) • Rebate application data (for baseline conditions)
Building Shell	Unit Energy Savings Review	<ul style="list-style-type: none"> • Savings values from ML reference files • Rebate application data (for baseline conditions)

3.5 Net-to-Gross Ratio

Washington uses a prescribed net-to-gross ratio of 1.0. Therefore, an NTG ratio is not included in impact analyses.

3.6 Note on Measure Versions

Program measure specifications are periodically updated, as indicated by a version number in the ML. Each version is treated as a separate measure for evaluation purposes. When individual measures are documented in this report, version numbers are indicated after the measure name (e.g., *LEDs - General Purpose & Three-Way - 250 to 1049 Lumens - WA – 3* indicates version 3 of this measure).

3.7 Heating, Ventilation and Air Conditioning (HVAC)

Pacific Power offered customers financial incentives to install energy efficient HVAC measures in their homes during the evaluated program period. HVAC measures resulted in 4,308,555 kWh of savings, accounting for 83 percent of total evaluated program savings during the evaluation period. HVAC measures included heat pumps, duct sealing, smart thermostats, and central air conditioners. HVAC program savings are reported in Table 3-8 through Table 3-10.

Table 3-8: HVAC Program Savings 2021-2022

Measure Type	Quantity	Claimed UES (kWh)	Evaluated Gross UES (kWh)	Realization Rate
Central Air Conditioner	60	5,407	4,027	74%
Duct Sealing and/or Insulation	1,139	829,228	831,798	100%
Heat Pump	1,306	3,173,666	2,996,788	94%
Smart Thermostat	1,314	585,408	475,941	81%
Total	3,819	4,593,709	4,308,555	94%

Table 3-9: HVAC Program Savings 2021

Measure Type	Quantity	Claimed UES (kWh)	Evaluated Gross UES (kWh)	Realization Rate
Central Air Conditioner	46	4,465	3,325	74%
Duct Sealing and/or Insulation	642	477,046	478,525	100%
Heat Pump	650	1,637,283	1,546,032	94%
Smart Thermostat	131	63,644	51,743	81%
Total	1,469	2,182,438	2,079,626	95%

Table 3-10: HVAC Program Savings 2022

Measure Type	Quantity	Claimed UES (kWh)	Evaluated Gross UES (kWh)	Realization Rate
Central Air Conditioner	14	942	702	74%
Duct Sealing and/or Insulation	497	352,181	353,273	100%
Heat Pump	656	1,536,383	1,450,756	94%
Smart Thermostat	1,183	521,764	424,198	81%
Total	2,350	2,411,270	2,228,929	92%

3.7.1 Verification of Tracking Data

ADM reviewed program tracking data to evaluate the following.

- Did the tracking dataset include duplicate or erroneous data entries?
- Did claimed energy savings match the applicable ML source documents and calculations?
- Did data entries in the program dataset include all necessary fields for savings calculations?
- Did installed measures meet efficiency requirements obtained from AHRI numbers or manufacturer’s model numbers?

In its review of program tracking data and supplemental data from the implementer, ADM found the following in the dataset.

Review of Central Air Conditioning Records

The program data includes claimed savings for 60 central air conditioners. ADM reviewed a census of records and found:

- AHRI numbers were available for 59 records.
- 7 records (12 percent) included model specifications that did not meet the requirements of the claimed measure but qualified for a lower saving measure.
- 7 records (12 percent) included model specifications that did not meet the requirements of any program measure.
- 2 records included numbers that could not be verified as AHRI numbers.
- 1 record included an AHRI number for a heat pump.
- 10 of 60 records for CAC did not receive ex-post savings because of these errors.

Review of Duct Sealing Records

The program data includes claimed savings for 1,139 duct sealing projects. ADM reviewed the home heating type for 1,138 records to verify that the correct measure name and therefore correct savings were claimed for each record. Within this sample, ADM found:

- 90 records (8 percent) included a measure name that did not align with heating and cooling types reported in the program data.
- 5 records (0.4 percent) included claimed savings for projects for which the heating type could not be verified.

Review of Heat Pump Records

The program data included claimed savings for 1,306 installed heat pumps. ADM was able to fully review a sample of only 70 program records for which program tracking data, supplemental data, rebate application form and AHRI certificate numbers was available. For the sample, ADM verified that the baseline heating system matched the claimed measure and that installed equipment specifications met measure specification requirements. Within this sample of 70 records, ADM found:

- 1 record (1.4 percent) for which the installed equipment specifications did not meet the minimum standards required for heat pump measures (the model did not meet the minimum HSPF of 8.5).
- 6 records (8.6 percent) included measures with an incorrect baseline heating system type compared to the rebate application form.

- 6 records (8.6 percent) included measures for replaced electric forced air furnaces with rebate applications that indicate baseline electric baseboard heating. Neither the ML nor the RTF includes a measure for electric baseboard conversion to ducted heat pump.

Additionally, ADM reviewed a census of 1,248 records in which housing type was specified in the measure name to determine claimed savings. ADM found:

- 581 (47 percent) records did not document housing type.
- 9 (0.7 percent) records included a measure that identified an incorrect housing type.

Review of Smart Thermostat Records

The program data included claimed savings for 1,314 smart thermostats. ADM reviewed model numbers and home heating source for 108 records for which this data was available. Within this sample, ADM found:

- 4 records (3.7 percent) indicated that the home had gas heating.
- 4 records (3.7 percent) had model numbers that could not be confirmed as thermostats.
- 13 records (12 percent) had model numbers that did not include occupancy sensing as required by the RTF reference files.
- 37 records (34 percent) had measures that claimed savings for the incorrect home heating type.
- model numbers were not available for 1,206 records (92 percent).
- home heating system type, which determines claimed savings, was not provided for 1,156 records (88 percent).

3.7.2 Review of Claimed Savings

ADM evaluated the UES values claimed by Pacific Power to verify that claimed savings in each record were supported by the applicable ML documents for the claimed measure. Savings values reported in the tracking data matched the values reported in reference files included in the ML for the claimed measures.

3.7.3 Determination of Evaluated Savings

Evaluated savings, at the record level, equal the UES documented in the ML for the correct measure identified using program data, multiplied by the quantity indicated in the program data. When no measure in the ML could be identified to match the documented installed measure specifications, no evaluated savings were indicated.

For any measure type for which ADM reviewed a sample of records, ADM calculated a realization rate for the sample which was applied to the population of the measure type.

3.7.4 Discussion of Realization Rates

The realization rates at the record level were impacted by inaccurate selection of measure name, and therefore claimed savings, for

- 18 of 60 (30 percent) central air conditioner records
- 95 of 1,138 (8 percent) reviewed duct sealing records
- 7 of 70 (10 percent) reviewed heat pump records
- 58 of 108 (54 percent) reviewed smart thermostat records

Within the HVAC measure category, all corrections to measure selection resulted in realization rates below 100 percent. See section 3.7.1 for detailed account of measure selection errors that resulted in reduced savings.

3.8 Lighting

A total of 219,474 LED lighting measures were incentivized through the program during 2021-2022. The upstream lighting program reported the sale of 217,216 discounted LED lighting products (bulbs and fixtures) sold through 43 retail locations in Pacific Power's Washington service area, and a direct-install program reported 2,258 bulbs installed through the program.

Lighting measures resulted in 617,610 kWh of net evaluated savings during the evaluation period with a realization rate of 89 percent, representing 12 percent of program savings.

ADM reviewed claimed savings included in tracking data and ex-ante savings values reported in ML reference files. It also calculated in-service rates (ISRs) and hours of use (HOUs) for lighting measures using responses from a general population survey emailed to Pacific Power customers. Additionally, ADM calculated and applied a leakage rate to gross evaluated savings to calculate net evaluated savings. Total program savings from lighting measures are reported in Table 3-11 through Table 3-13.

Table 3-11: Lighting Program Savings 2021-2022

Measure Type	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh) ³
General Service Fixtures	1,275	18,037	17,246	96%	16,263
General Service Lamps	119,978	410,217	372,280	91%	351,060
Specialty Lamps	98,221	295,716	258,556	87%	250,287
Total	219,474	723,970	648,082	90%	617,610

Table 3-12: Lighting Program Savings 2021

Measure Type	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh) ³
General Service Fixtures	1,183	17,311	16,540	96%	15,597
General Service Lamps	91,402	378,737	344,030	91%	324,420
Specialty Lamps	77,181	212,254	178,623	84%	171,155
Total	169,766	608,301	539,193	89%	511,172

Table 3-13: Lighting Program Savings 2022

Measure Type	Quantity	Claimed Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh) ³
General Service Fixtures	92	726	706	97%	666
General Service Lamps	28,576	31,481	28,250	90%	26,640
Specialty Lamps	21,040	83,463	79,933	96%	79,132
Total	49,708	115,669	108,889	94%	106,438

3.8.1 Verification of Tracking Data

ADM reviewed program tracking data and lighting memorandums of understanding (MOUs) with lighting measure manufacturers to evaluate the following.

- Did claimed energy savings match the applicable ML source documents and calculations?

³ Net evaluated savings = Gross evaluated savings * (1 - Leakage rate).

- Did specific product model numbers sold through the program meet the requirements of the measure definition as documented in the ML reference files?
- Were retail stores that participated in the upstream lighting program located in the service area?

ADM found the following during the data review.

- The incorrect measure was indicated for 29 of 1,091 reviewed lighting product manufacturer's model numbers.
- Ten model numbers with ANSI bulb types BR40, BR30, PAR30, MR16, R30 and BR20 were reported as *General Purpose & Three-Way* lighting measures instead of *Reflective & Outdoor* lighting measures.

3.8.2 Review of Claimed Savings

ADM compared ex-ante values in ML reference documents with claimed savings included in program tracking data. Up to three different versions of each measure were included in the tracking data. ADM reviewed each version independently. All claimed savings matched savings indicated in the ML.

3.8.3 Determination of Evaluated Savings

Total evaluated savings by measure is the product of the evaluated UES and the quantity of the measure sold through the program as documented in the program tracking data.

Evaluated UESs were calculated for each lighting measure in the program by adjusting the savings indicated in the ML reference files by the following factors.

- Review of model number specifications
- Verified ISRs
- Verified HOUs

ADM calculated verified ISRs and HOUs using responses to a general population survey conducted by ADM during January 2023 (see *Appendix A*). For lighting measures that were installed through a direct-install initiative, ex-ante ISR and HOU were retained.

Total net savings for lighting measures reflect an evaluated leakage rate (5.7 percent) that estimates the percentage of bulbs sold through the program that were not installed in the service area. The leakage rate was calculated using responses to the general population survey (see section 3.8.5).

Review of model number specifications

ADM reviewed a sample of 1,091 model numbers included in MOUs with retailers to determine if the product specifications matched the measure indicated for the lighting product. An incorrect measure was identified for 29 model numbers. ADM corrected the measure identified by the model number specifications and calculated the total impact of the model specification review. This realization rate (100.3 percent) was applied as a factor in evaluated UES calculations for upstream lighting products to account for model specification errors.

Determination of In-Service Rates (ISR)

Table 3-14 reports ISRs calculated using responses (n=141) from a general population survey using Equation 3-1.

Equation 3-1: In-Service Rate – Lighting Measures

$$ISR = (Qty\ currently\ installed + (Qty\ stored/3))/Qty\ Purchased$$

Determination of Hours of Use (HOU)

Table 3-14 reports weighted average HOU calculated for lighting measure types using locations identified in the general population survey. Hours of use per room type were drawn from *Lighting HOU Residential Building Stock Assessment: Metering Study: Report #E14-283*, prepared by Northwest Energy Efficiency Alliance, (April 28, 2014) as indicated in the ML.

ADM made an exception for exterior porch and exterior security fixtures. For these lighting measures, ADM used ex-ante HOU rather than a weighted average because of the dedicated functionality of these fixtures.

Table 3-14: 2021-2022 Evaluated Lighting Measure ISRs and HOU

Measure Type	ISR	HOU
LED lightbulbs	81%	2.2
LED fixtures	89%	2.4

3.8.4 Discussion of Realization Rates

Realization rates for lighting measures were impacted by the following factors.

- Review of model number specifications. In a sample of 1,091 lighting product model numbers included in the upstream lighting program, ADM found 29 model numbers that should have claimed different savings than the measure indicated in the tracking data. The realization rate for the model number verification analysis was 100.32 percent, which was applied to all upstream lighting program records.
- In-service Rates (ISRs). Ex-post ISRs calculated from survey responses were lower than ex-ante ISRs documented in upstream lighting measures, reducing realization rates.
- Hours of Use (HOUs). For exterior porch and exterior security fixtures, ADM calculated evaluated savings using ex-ante HOUs because of the specific location and functionality of these fixtures. For remaining lighting measures, ADM used a weighted average HOU by measure type, using the RBSA hours per room as used in the ML. Ex-post HOUs for fixtures was higher than ex-ante HOUs; ex-post HOUs for general purpose bulbs was slightly lower than ex-ante HOUs. Realization rates were impacted both positively and negatively.

3.8.5 Determination of Leakage Rate

Leakage is an estimate of the percentage of upstream measures sold through the program that were installed outside Pacific Power's service area. ADM assessed leakage using geo-mapping data of participating and non-participating retailers combined with general population survey responses. The leakage rate was not applied to direct-install lighting measures.

First, ADM mapped 60-minute drive-time areas surrounding both participating and non-participating (competing) retailers⁴ (see Table 3-15). 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 customers⁵.

Thus, for each drive time circle, for each retail location, ADM determined the proportion of the population that falls inside and outside of Pacific Power's service area.

⁴ 2020 data. Safe Graph Data: <https://marketplace.arcgis.com/listing.html?id=3425348e4bee4059af2b353e52df43c2>

⁵ 2010 Census block data from Environmental System Research Institute (ESRI).

Third, ADM modified drive-time areas established in step one using general population survey⁶ 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 Table 3-15. Within each drive-time category, ADM calculated the percentage of the population that lives in Pacific Power’s service area.

Table 3-15: Drive Time Estimates

Retailer Type	0-5	5-10	10-15	15-20	20-25	25-30	30-40	40-50	50-60	60+
DIY	4%	14%	21%	22%	14%	5%	12%	6%	0%	2%
Big Box	7%	14%	26%	22%	12%	2%	9%	3%	0%	3%
Member	8%	7%	14%	16%	15%	4%	11%	8%	3%	13%
Discount	10%	27%	23%	20%	8%	1%	8%	2%	0%	1%

Fourth, for each drive-time category indicated in Table 3-15, 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 lives in Pacific Power’s service area.

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

ADM estimated that 5.7 percent of the upstream lighting measures sold at participating retailers were purchased by residents living outside of Pacific Power’s service area.

3.9 Whole Homes

Pacific Power offered financial incentives to build new homes that exceeded Washington State Building Code and manufactured homes that met ENERGY STAR, Ecorated™, and NEEM+® guidelines. Program tracking data listed 14 new homes and 15 manufactured homes, totaling 83,786 kWh of evaluated savings with a 92 percent realization rate, as reported in Table 3-16.

Table 3-16: Whole Homes Program Savings 2021-2022

Year	Quantity	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate (%)
2021	22	65,926	65,926	100%
2022	7	24,954	17,860	72%
Total	29	90,880	83,786	92%

⁶ ADM conducted the general population survey in Jan 2023.

3.9.1 Verification of Tracking Data

ADM reviewed a census of whole homes tracking data as well as REM/Rate home energy models and Axis energy modeling output to evaluate the following.

- Did the tracking dataset include duplicate or erroneous data entries?
- Did the program data include copies of certificates for all EnergyStar and Eco-Rated homes?

3.9.2 Review of Claimed Savings

Energy savings for the New Manufactured Homes measures are savings values prescribed in the ML. Whole Home Performance Path measures are calculated based on as-built specifications using Axis home energy modeling software. ADM reviewed claimed savings to verify that deemed savings match ML documented savings, and site-specific savings for Performance Path measures match Axis outputs, as indicated in the ML reference files.

Two of 14 records (14 percent) for Performance Path measures did not match Axis outputs.

3.9.3 Determination of Evaluated Savings

For New Manufactured Homes measures, evaluated savings equals savings indicated in the ML reference files for all homes which met measure requirements (ENERGY STAR, Eco-Rated, or NEEM PLUS certification).

For Whole Homes Performance Path measures, evaluated savings equal home energy savings as calculated by Axis home energy modeling software, as indicated in the ML.

Two homes included in the program data had claimed savings that did not match Axis outputs. Evaluated savings were adjusted to Axis outputs. Additionally, both homes should have been indicated as Tier 1 instead of Tier 2 homes; tier designation determines incentive but not savings. Savings for all Whole Homes measures are reported in Table 3-17 through Table 3-19.

Table 3-17: Whole Home Program Savings by Measure 2021-2022

Measure Type	Qty	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
New Home - Performance Path	14	52,124	45,030	86%
New Homes - Eco-rated Manufactured	1	5,691	5,691	100%
New Homes - Energy Star Manufactured	14	33,065	33,065	100%
Total	29	90,880	83,786	92%

Table 3-18: Whole Home Program Savings by Measure 2021

Measure Type	Qty	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
New Home - Performance Path	12	39,043	39,043	100%
New Homes - Eco-rated Manufactured	1	5,691	5,691	100%
New Homes - Energy Star Manufactured	9	21,192	21,192	100%
Total	22	65,926	65,926	100%

Table 3-19: Whole Home Program Savings by Measure 2022

Measure Type	Qty	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
New Home - Performance Path	2	13,081	5,987	46%
New Homes - Energy Star Manufactured	5	11,873	11,873	100%
Total	7	24,954	17,860	72%

3.9.4 Discussion of Realization Rates

Realization rates were impacted by the following factor.

- Two performance path homes had claimed savings that were higher than Axis outputs for the homes. ADM could not determine how claimed savings were established, as they were neither REM/Rate nor Axis outputs.

3.10 Building Shell

Pacific Power offered rebates to customers who installed insulation or energy efficient windows in their homes during the evaluated program period. Pacific Power provided incentives for 199,192 square feet of wall, attic, and floor insulation and 3,386 square feet of upgraded windows. These measures resulted in evaluated savings of 63,189 kWh with a 91 percent realization rate, accounting for 1.2 percent of total program savings as reported in Table 3-20.

Table 3-20: Building Shell Program Savings 2021-2022

Measure Type	Quantity (sq ft)	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Insulation	199,192	68,961	62,424	91%
Attic Insulation	141,550	35,681	33,112	93%
Floor Insulation	32,551	10,432	7,756	74%
Wall Insulation	25,091	22,849	21,556	94%
Windows	3,386	845	766	91%
Window Upgrade	3,386	845	766	91%
Total	202,578	69,806	63,189	91%

Table 3-21: Building Shell Program Savings 2021

Measure Type	Quantity (sq ft)	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Insulation	106,272	43,941	38,439	88%
Attic Insulation	68,001	20,359	18,679	92%
Floor Insulation	20,197	6,072	3,796	63%
Wall Insulation	18,074	17,510	15,963	91%
Windows	653	220	213	97%
Window Upgrade	653	220	213	97%
Total	106,925	44,161	38,652	88%

Table 3-22: Building Shell Program Savings 2022

Measure Type	Quantity (sq ft)	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Insulation	92,920	25,020	23,985	96%
Attic Insulation	73,549	15,322	14,432	94%
Floor Insulation	12,354	4,359	3,960	91%
Wall Insulation	7,017	5,339	5,593	105%
Windows	2,733	625	553	88%
Window Upgrade	2,733	625	553	88%
Total	95,653	25,645	24,538	96%

3.10.1 Verification of Tracking Data

ADM reviewed a census of building shell tracking data to evaluate the following.

- Did the program tracking dataset include duplicate or erroneous data?
- Were all energy savings claimed in accordance with the applicable ML source documents and calculations?

ADM found the following:

- The program data documented cooling source and heating fuel from customer rebate applications. Heating fuel, but not heating *system type*, was included in program data even though claimed savings were based on heating system type. For example, electricity is the fuel for heat pumps and electric forced air furnaces, though the savings generated by these two system types are not the same.
- Program building shell measures are defined by home heating type as well as pre- and post-R values. Baseline and replacement R values were not included in the program data.
- Based on the cooling source and heating fuel indicated in the program data, 55 of 169 records (33 percent) of building shell measures identified the incorrect measure and therefore the incorrect savings.
- 15 records (9 percent) did not have a heating source indicated in the program data.

3.10.2 Review of Claimed Savings

ADM verified that the UES values claimed by Pacific Power matched the savings values documented in the applicable ML documents.

3.10.3 Determination of Evaluated Savings

ADM reviewed program data provided by Pacific Power and the program implementer to verify claimed measures, and therefore savings, at the record level. When program data did not support the claimed measure, ADM identified the correct measure and the corresponding savings documented in the ML.

Correct measures were determined based on the primary heating fuel and cooling source indicated in program data.

The program data indicating cooling source was less ambiguous than heating fuel; therefore, ADM made the following assumptions when determining the correct measure, and therefore savings, which should have been entered in the program data:

- If a ducted heat pump was indicated as the cooling source, ADM assumed that a ducted heat pump was also used for heating.

- If a ductless heat pump was indicated as the cooling source, ADM assumed that a zonal or ductless heat pump was used for heating.
- If natural gas was indicated as the primary heating fuel, ADM identified gas as the correct heating fuel.
- When central air conditioning was indicated as the cooling source and electricity as primary heat fuel, ADM did not correct any measures that indicated electric forced air furnace was used for heating.

ADM used an ISR of 1.0 for building shell measures.

3.10.4 Discussion of Realization Rates

The realization rates at the record level were impacted by inaccurate measure selections, and therefore claimed savings, for 55 of 174 records (32 percent).

There were two types of errors: inaccurate data collection from the rebate application, and incorrect selection of measure.

The application requested heating fuel; however, electric heating fuel is accurate for both a low-efficiency electric forced air furnace and a high-efficiency electric heat pump. The rebate application did not collect heating data that could be used to determine the correct measure.

For other records, an inaccurate measure selection was made, even when heating type on the rebate application was unambiguous. For example, if gas was indicated as the primary heating fuel on the rebate application, and the tracking data reported insulation for a home with electric forced air furnace (eFAF), ADM assumed that the correct measure type should indicate gas heating.

Forty-three errors resulted in realization rates lower than 100 percent; 8 errors resulted in realization rates over 100 percent.

3.11 Water Heating

Pacific Power offered rebates to customers who bought qualified heat pump water heaters during the evaluated program period. Rebates were issued for 54 water heaters resulting in savings of 71,420 kWh, accounting for 1.4 percent of program savings as reported in Table 3-23.

Table 3-23: Water Heater Program Savings

Year	Quantity	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
2021	29	36,459	36,360	100%
2022	25	34,559	35,060	101%
Total	54	71,018	71,420	101%

3.11.1 Verification of Tracking Data

ADM reviewed the program tracking data to evaluate the following.

- Did installed measures meet efficiency requirements as indicated in ML files?
- Did the program tracking dataset include duplicate or erroneous data entries?

ADM found the following information was missing from the program tracking dataset:

- baseline conditions
- installation location or conditions as indicated by measure names
- heating system type as indicated by the measure names

ADM found the following in the data set.

- Six of 54 records (11 percent) included primary heat fuel for which an inaccurate measure was selected (e.g., gas heating was indicated for a measure that specified electric resistance heating type).

3.11.2 Review of Claimed Savings

ADM verified that the UES values claimed by Pacific Power matched corresponding values for claimed measures as documented in ML reference files.

3.11.3 Determination of Evaluated Savings

Evaluated savings, at the record level, equal the UES documented in the ML for the correct measure identified using program data, multiplied by the quantity indicated in the program data. ADM reviewed the manufacturer's model specifications for each heat pump water heater reported in the program tracking data to determine the correct measure.

ADM assumed an ISR of 1.0 for water heating measures.

3.11.4 Discussion of Realization Rates

Realization rates were impacted by inaccurate selection of measure name, and therefore claimed savings, for six of 54 records (11 percent).

Five of the corrected measures resulted in higher savings, one resulted in lower savings. The net result was a 101 percent realization rate.

3.12 Appliances

Pacific Power offered rebates to verified customers who bought qualified energy efficient clothes washers and clothes dryers during the evaluated program period. Rebates were issued for 157 appliances resulting in evaluated savings of 31,861 kWh. Appliance measures accounted for 0.6 percent of program savings, with a 109 percent realization rate (see Table 3-24).

Table 3-24: Appliances Savings by Measure Type 2021-2022

Measure Type	Quantity	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
2021	89	16,307	16,891	104%
Clothes Dryers	9	3,961	4,328	109%
Clothes Washers	80	12,346	12,563	102%
2022	68	13,282	14,970	113%
Clothes Dryers	8	2,928	3,548	121%
Clothes Washers	60	10,354	11,422	110%
Total	157	29,589	31,861	108%

3.12.1 Verification of Tracking Data

ADM reviewed the program tracking data to evaluate the following.

- Did the program tracking dataset include duplicate or erroneous data entries?
- Did installed measures meet the energy efficiency requirements for all appliances, as documented in the ML reference files?

ADM found the following in the dataset:

- Sixty of 157 (38 percent) records included appliance model numbers with specifications for which an inaccurate measure was selected (e.g., efficiency rating, vented versus ventless dryers, or appliance type).

3.12.2 Review of Claimed Savings

ADM verified that all but one record included UES that matched UES in the ML for claimed measures.

3.12.3 Determination of Evaluated Savings

ADM reviewed manufacturer model specifications for a census of records to determine if the model specifications met claimed measure requirements as indicated in ML reference documents. When model specifications did not meet the claimed measure requirements (in 64 records), ADM determined the appropriate measure and corresponding evaluated savings.

ADM assumed an ISR of 1.0 for appliances.

3.12.4 Discussion of Realization Rates

The realization rate was impacted by inaccurate measure selection, and therefore claimed savings, for 60 records that included model numbers with an efficiency rating different than indicated in the claimed measure. Evaluated savings reflect the correct savings corresponding to efficiency ratings of model numbers provided in the tracking data.

- 1 record resulted in 0 kWh savings
- 40 records resulted in realization rates over 100 percent
- 19 records resulted in realization rates under 100 percent

3.13 Energy Saving Kits

Pacific Power reported 25 energy-saving kits (Starter Kits) in the 2021 program data. The kits resulted in 3,306 kWh of evaluated savings with an 87 percent realization rate, accounting for 0.1 percent of total evaluated program savings. Pacific Power discontinued Starter Kits measures on January 4, 2021.

All kits contained four standard LED bulbs. Customers who indicated that they had an electric water heater also received two water-saving aerators and a low-flow showerhead. Pacific Power customer eligibility was determined through a web-based portal where customers ordered kits. Total Starter Kit savings are presented in Table 3-25.

Table 3-25: Starter Kit Program Savings 2021

Measure - Version	Quantity	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Energy Savings Kit - Best - 1 Bathroom - WA - 5	9	3,352	2,782	83%
Energy Savings Kit - LED - WA - 5	16	448	524	117%
Total	25	3,800	3,306	87%

3.13.1 Verification of Tracking Data

ADM reviewed program tracking data and verified that claimed energy savings matched the applicable ML source documents and calculations. ADM noted that two customers received two kits, though neither received two kits with water saving measures, per 2020 program guidelines.

3.13.2 Review of Claimed Savings

ADM reviewed ex-ante data to verify that claimed savings in the tracking data reflected the ex-ante values in the ML reference documents.

3.13.3 Determination of Evaluated Savings

Total claimed savings (3,800 kWh) for Starter Kits accounted for only 0.13 percent of 2021 program savings. The evaluation expense required to complete a new analysis was not justified for such a small program component. Therefore, the realization rates from the 2020 kits analysis⁷ were applied by kit type.

3.13.4 Discussion of Realization Rates

The realization rate for kits was 87 percent, based on results of the previous evaluation (2019-2020). In the previous evaluation, the realization rate for *Energy Savings Kit - LED - WA* was 117 percent because of higher-than-expected ISRs for kit components. The realization rate for *Energy Savings Kit - Best - 1 Bathroom – WA* was 83 percent because only 89 percent of recipients had electric water heaters. These realization rates were applied at the record level for the appropriate kit type in the current evaluation cycle.

⁷ Evaluation, Verification and Measurement Report Residential Home Energy Savings Program: Washington Program Years 2019-2020. September 2021. Pg 63.

4 Process Evaluation

ADM completed a process analysis of the program which included in-depth interviews and conversations with key staff at Pacific Power and Resource Innovations, the program delivery partner (program implementer). Additional information was gathered from a general population survey and a review of program materials.

4.1 Roles and Responsibilities

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

Delivery partner responsibilities include program implementation, contract management, client management, and overseeing day-to-day operations.

4.2 Program Design and Goals

The Home Energy Savings program is one of several programs that Pacific Power operates to achieve conservation targets established through the integrated resource planning process as required by the Energy Independence Act. Pacific Power is required to pass cost effectiveness tests at the portfolio level, providing some flexibility at the program level to focus on additional program goals. This allows Pacific Power to incorporate an energy equity focus on program goals.

For example, discounted retail lighting measures are offered through discount stores in highly impacted communities. Direct-install lighting measures, primarily focused on vulnerable populations, are installed when service providers are already in a customer's home installing measures such as duct sealing. These measures are included in the program as equity elements.

Program participant recruiting has also focused on equity goals. Program marketing includes multilingual collateral and media, as well as outreach through community events, and staffing multilingual speakers to assist customers when selecting home energy saving measures.

4.3 Tracking and Reporting

Pacific Power savings documentation is comprised of the ML and its associated files, and the program data uploaded to Pacific Power by the implementer. Additional program data is collected and managed by the implementer, though not transferred to Pacific Power.

Measure Library (ML)

Ex-ante program savings, as well as other measure specifications, are documented in Pacific Power's ML. The ML is comprised of all program measures and all versions of each measure. Measure specifications are updated as required by changing regulatory and market conditions. The ML 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 document UES values or savings calculation methodologies.

ML reference files are frequently briefs that summarize relevant measures included in the RTF library of measures maintained by Northwest Power and Conservation Council to verify and evaluate energy efficiency savings. RTF reference files include the basis for unit energy savings values. RTF reference documents are frequently updated.

Program Tracking Dataset

Pacific Power maintains a program tracking dataset that includes:

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

The following data elements are not required in the dataset that the implementer uploads to Pacific Power:

- Product manufacturer, model numbers, efficiency ratings
- Retail sales location for upstream measures
- Baseline and efficient conditions

Some data collected from the customer on rebate applications is stored only as an image file, such as in a .pdf format, which cannot easily be reviewed for a census of program records.

4.4 Communication

Pacific Power has weekly meetings with implementation staff and frequent ad hoc communication. Weekly meeting topics include program status and performance, long-term strategy, day-to-day tactical decisions, and marketing activities. Pacific Power program staff and implementer staff work closely with each other and are in nearly daily communication about program operations and performance.

4.5 General Population Survey Results

This section presents key findings from surveys administered online by ADM and completed by 168 customers. Customers shared their experience with Pacific Power’s programs during 2021 and 2022. ADM sent customers email invitations to complete the questionnaire through an online survey platform and offered a \$5 electronic gift card for completing the survey. The data collected in the survey was used for both the process evaluation and impact analysis.

4.5.1 LED Lighting Measures

Participants provided information on whether they participated in the Home Energy Savings program by purchasing LED lighting products. Eighty-six percent of respondents bought LED light bulbs, and 42 percent bought LED fixtures or floodlights.

Table 4-1: What type of ENERGY STAR LED lighting products did you buy?⁸

Type	Percentage (n = 168)
LED light bulb(s)	86%
LED fixture(s) or floodlight(s)	42%

Customers who bought LED measures reported where they purchased their measures. The top retail stores among the survey respondents were: The Home Depot (44 percent); Walmart (29 percent); and Ace Hardware (23 percent). Other retailers included: Lowe’s (22 percent); Bi-Mart (10 percent); Dollar Tree (5 percent); and Fred Meyer (5 percent). See Figure 4-4 for more details.

⁸ Multiple response questions. Percentage exceeds 100 percent.

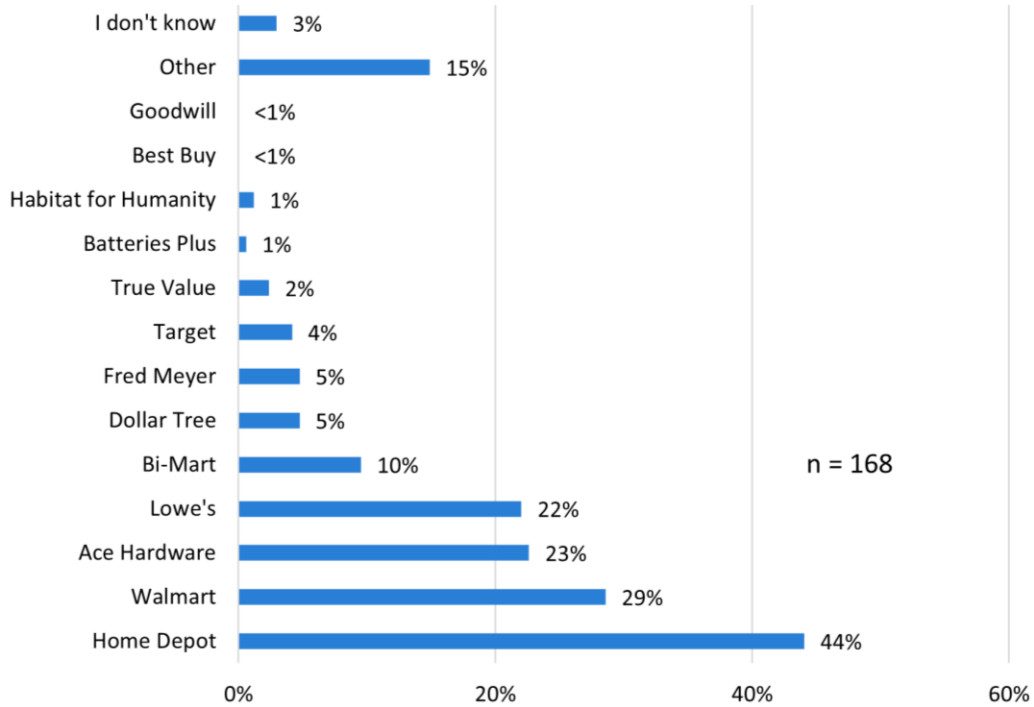


Figure 4-1: Which store(s) did you buy your ENERGY STAR LED lighting from?⁹

As shown above, of the 168 respondents, 15 percent indicated they purchased their LEDs from other unlisted sources. Of the respondents who bought their LEDs from another store, 88 percent indicated they bought their lights from Costco, 4 percent indicated they bought from Amazon, electrical distributors, the power company, and Southgate Market, respectively. See Figure 4-2 for more details.

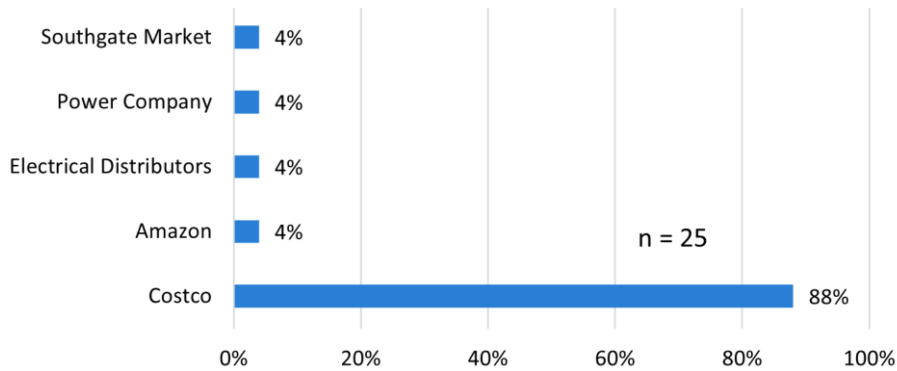


Figure 4-2: Which store(s) did you buy your ENERGY STAR LED lighting from?⁹

Customers provided responses about LED lighting purchases in both 2021 and 2022 (see Table 4-2). Many participants bought LEDs during both years.

⁹ Multiple response questions. Percentage exceeds 100 percent.

Table 4-2: When did you buy the ENERGY STAR LED bulbs?¹⁰

LED Types	2021	2022
Standard LED bulb(s) (n = 168)	72%	78%
LED fixture(s) (n = 70)	66%	69%

4.5.2 Participant Motivations for Purchasing LEDs

Survey participants stated the reasons why they decided to purchase the LEDs. The most common answer was that they wanted to replace their burned-out bulbs (62 percent), followed by those who wanted to replace their working bulbs with ones that consumed less energy (45 percent). Another 21 percent indicated they had added a new light fixture in their home, and 6 percent wanted to take advantage of the discount pricing. One percent of respondents could not recall. People who indicated "other" as their response stated they wanted a different color of the light (n = 3), for a health condition (n = 1), to reduce their energy bill (n = 1), because they were the only ones available (n = 1), and because they like them (n = 1).

Table 4-3: Why did you purchase the ENERGY STAR LED lighting?¹⁰

Response	Percentage (n = 168)
To replace burned out bulbs	62%
To replace working bulbs to lower energy use	45%
To add new light fixture(s) in my home	21%
To take advantage of discounted pricing	6%
Other	4%
I don't know	1%

Regarding the discount pricing (n = 144), 9 percent of respondents indicated they recalled that the standard LED lightbulbs had been discounted, compared to 55 percent who stated the measures were not discounted, and 36 percent did not recall. Of the people who recalled the discount (n = 13), 15 percent remembered seeing a label or sign indicating Pacific Power provided the discount compared to the 46 percent who did not see a label, and 38 percent who could not recall.

The 144 individuals that bought LED bulbs purchased 1,655 in total, and installed 74 percent of those, put 22 percent in storage, and removed, discarded, or threw away 4 percent. See Table 4-4.

¹⁰ Multiple response questions. Percentage exceeds 100 percent.

Table 4-4: Of the (total number of) bulbs you bought, how many are currently...

Response	Percentage (n = 1,655)
Installed	74%
In storage	22%
Removed, discarded, or given away	4%

Of the installed bulbs (n = 1,226), 43 percent replaced other LED bulbs, 40 percent replaced non-LEDs, 9 percent were placed in new lamps, fixtures, or floodlights, and 7 percent could not recall. See Table 4-5.

Table 4-5: Of the (total number of) bulbs that you have installed, how many replaced LEDs and how many replaced bulbs that were not LEDs?

Response	Percentage (n = 1,226)
Replaced LED bulbs	43%
Replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.)	40%
Installed in new lamps, fixtures, or floodlights	9%
I don't know	8%

Three percent of the bulbs were installed in commercial buildings, while 97 percent were installed in non-commercial buildings. Figure 4-3 shows where the 144 individuals installed the LED bulbs in their homes. The highest percentage of bulbs were installed in the bathroom (19 percent), the bedroom (17 percent), and the living room (13 percent). See Figure 4-3.

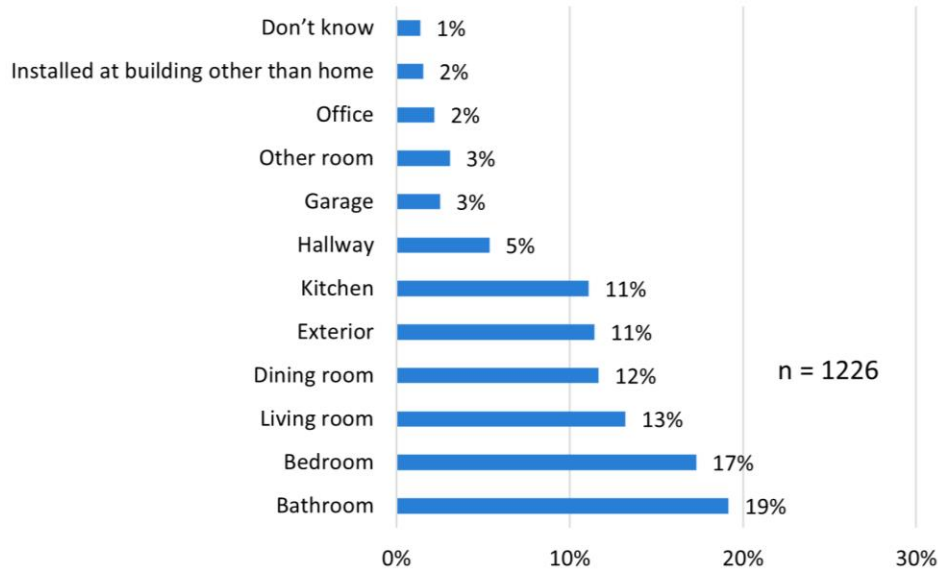


Figure 4-3: How many of the (total number of) LED bulbs that are installed are in your home are in each of the following locations?¹¹

Of the 70 people who bought LED fixtures, 6 percent knew the measures were discounted, 57 percent did not, and 37 percent could not recall at the time of the survey. Of the 4 people who recalled the discount, only 1 person remembered seeing a label indicating the discount was provided by Pacific Power compared to 3 who did not see the label.

The 70 people that bought LED fixtures or floodlights purchased 425 in total, and installed 83 percent of them, put 13 percent in storage, and removed, discarded, or threw away 4 percent.

Table 4-6: Of the (total number of) fixtures or floodlights you bought, how many are currently:

Response	Percentage (n = 425)
Installed	83%
In storage	13%
Removed, discarded, or given away	4%

Of the installed fixtures and floodlights (n = 353), 39 percent replaced other LED bulbs, 41 percent replaced non-LEDs, 14 percent were new fixtures or floodlights, and 6 percent could not recall.

¹¹ Multiple response questions. Percentage exceeds 100 percent.

Table 4-7: Of the fixtures or floodlights that you have installed, how many replaced LEDs and how many replaced fixtures or floodlights that were not LEDs?

Response	Percentage (n = 353)
Replaced LED bulbs	39%
Replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.)	41%
Installed in new lamps, fixtures, or floodlights	14%
I don't know	6%

The figure below illustrates the top characteristics customers considered when purchasing LED lighting such as brightness of the bulb (61 percent) and energy efficiency (61 percent).

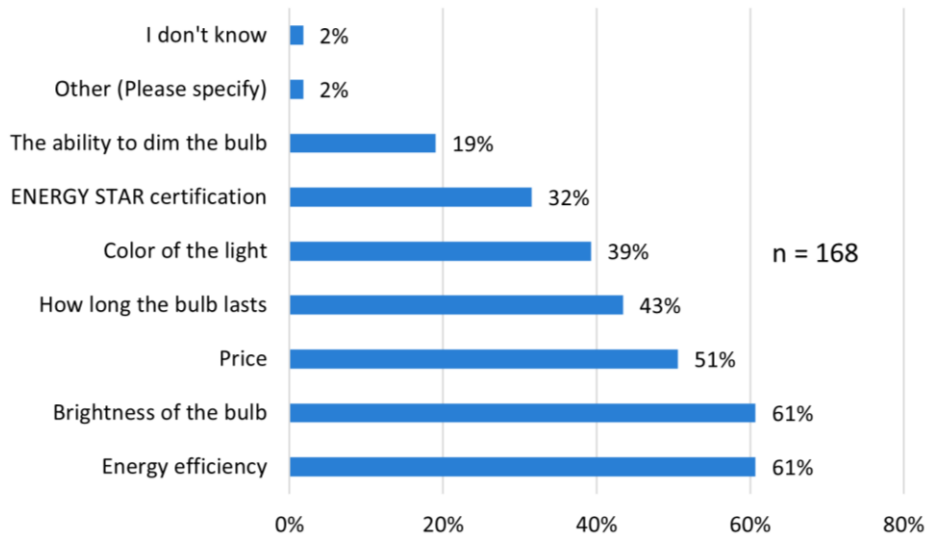


Figure 4-4: Characteristics customers considered when purchasing light bulbs¹²

¹² Multiple response questions. Percentage exceeds 100 percent.

5 Cost-Effectiveness Results

AEG estimated the cost-effectiveness results for the Washington Home Energy Savings Program based on 2021 and 2022 costs provided by Pacific Power and energy savings estimates provided by this evaluation. The program passed the Participant Cost Test (PCT).

Table 5-1: 2021-2022 Benefit/Cost Ratios

Year	PTRC	TRC	UCT	PCT	RIM
Cost-effectiveness results without NEIs					
2021	0.75	0.68	0.83	1.68	0.50
2022	0.58	0.53	0.77	1.20	0.47
2021-2022	0.65	0.59	0.79	1.40	0.48
Cost-effectiveness results with NEIs					
2021	0.82	0.75	0.83	1.81	0.50
2022	0.72	0.66	0.77	1.42	0.47
2021-2022	0.75	0.70	0.79	1.58	0.48

5.1 Cost Effectiveness Inputs

Program inputs used in the cost effectiveness analysis are included in *Table 5-2* through *Table 5-4*.

Table 5-2: Program Inputs

Parameter	2021	2022
Discount Rate	6.92%	6.88%
Residential Line Loss	7.68%	7.68%
Residential Energy Rate (\$/kWh)	\$0.0828	\$0.09
Inflation Rate	2.28%	2.16%

Table 5-3: Program Costs by Year

Program Year	Program Delivery	Utility Admin	Program Development	Incentives	Total Utility Budget	Gross Customer Costs	Program Delivery
2021	\$2,183,272	\$51,296	\$13,743	\$1,559,196	\$3,807,508	\$2,415,452	\$2,183,272
2022	\$1,904,039	\$26,299	\$7,227	\$1,692,287	\$3,629,851	\$3,354,823	\$1,904,039
2021-2022	\$4,087,310	\$77,595	\$20,970	\$3,251,484	\$7,437,359	\$5,770,274	\$4,087,310

Table 5-4: Program Savings by Year

Program Year	Gross kWh Savings	Realization Rate	Adjusted Gross kWh Savings	Net to Gross Ratio	Net kWh Savings	Measure Life
2021	2,957,392	93%	2,752,156	100%	2,752,156	15
2022	2,625,379	92%	2,427,775	100%	2,427,775	15
2021-2022	5,582,772	93%	5,179,931	100%	5,179,931	15

5.2 Cost-effectiveness Results without Non-energy Impacts (NEIs)

Cost-effectiveness results without NEIs are reported in Table 5-5 through Table 5-7.

Table 5-5: Program Cost-Effectiveness Results – 2021-2022
Without Non-energy Impacts (NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1888	\$9,739,021	\$6,357,744	\$3,381,278	0.65
Total Resource Cost Test (TRC) No Adder	\$0.1888	\$9,739,021	\$5,779,767	\$3,959,254	0.59
Utility Cost Test (UCT)	\$0.1421	\$7,327,832	\$5,779,767	\$1,548,065	0.79
Participant Cost Test (PCT)		\$5,553,146	\$7,766,748	\$2,213,602	1.40
Rate Impact Test (RIM)		\$11,952,624	\$5,779,767	\$6,172,857	0.48
Lifecycle Revenue Impacts (\$/kWh)					\$0.0002088
Discounted Participant Payback (years)					8.40

*Table 5-6: Program Cost-Effectiveness Results – 2021
Without Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1662	\$4,663,763	\$3,483,129	\$1,180,634	0.75
Total Resource Cost Test (TRC) No Adder	\$0.1662	\$4,663,763	\$3,166,481	\$1,497,283	0.68
Utility Cost Test (UCT)	\$0.1357	\$3,807,508	\$3,166,481	\$641,027	0.83
Participant Cost Test (PCT)		\$2,415,452	\$4,062,914	\$1,647,462	1.68
Rate Impact Test (RIM)		\$6,311,225	\$3,166,481	\$3,144,745	0.50
Lifecycle Revenue Impacts (\$/kWh)					\$0.0001103
Discounted Participant Payback (years)					6.91

*Table 5-7: Program Cost-Effectiveness Results – 2022
Without Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2100	\$5,292,387	\$3,080,262	\$2,212,125	0.58
Total Resource Cost Test (TRC) No Adder	\$0.2100	\$5,292,387	\$2,800,238	\$2,492,149	0.53
Utility Cost Test (UCT)	\$0.1441	\$3,629,851	\$2,800,238	-\$829,613	0.77
Participant Cost Test (PCT)		\$3,354,823	\$4,038,893	\$684,071	1.20
Rate Impact Test (RIM)		\$5,976,457	\$2,800,238	\$3,176,220	0.47
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000913
Discounted Participant Payback (years)					9.92

5.3 Cost-effectiveness Results with Non-energy Impacts (NEIs)

Cost-effectiveness results without NEIs are reported in Table 5-8 through Table 5-10.

*Table 5-8: Program Cost-Effectiveness Results – 2021-2022
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1888	\$9,739,021	\$7,348,260	\$2,390,762	0.75
Total Resource Cost Test (TRC) No Adder	\$0.1888	\$9,739,021	\$6,770,283	\$2,968,738	0.70
Utility Cost Test (UCT)	\$0.1421	\$7,327,832	\$5,779,767	\$1,548,065	0.79
Participant Cost Test (PCT)		\$5,553,146	\$8,757,264	\$3,204,119	1.58
Rate Impact Test (RIM)		\$11,952,624	\$5,779,767	\$6,172,857	0.48
Lifecycle Revenue Impacts (\$/kWh)					\$0.0002088
Discounted Participant Payback (years)					8.40

*Table 5-9: Program Cost-Effectiveness Results – 2021
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1662	\$4,663,763	\$3,804,182	-\$859,581	0.82
Total Resource Cost Test (TRC) No Adder	\$0.1662	\$4,663,763	\$3,487,534	\$1,176,229	0.75
Utility Cost Test (UCT)	\$0.1357	\$3,807,508	\$3,166,481	-\$641,027	0.83
Participant Cost Test (PCT)		\$2,415,452	\$4,383,967	\$1,968,516	1.81
Rate Impact Test (RIM)		\$6,311,225	\$3,166,481	\$3,144,745	0.50
Lifecycle Revenue Impacts (\$/kWh)					\$0.0001103
Discounted Participant Payback (years)					6.91

*Table 5-10: Program Cost-Effectiveness Results – 2022
With Non-energy Impacts (NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/ Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.2100	\$5,292,387	\$3,797,570	1,494,817	0.72
Total Resource Cost Test (TRC) No Adder	\$0.2100	\$5,292,387	\$3,517,546	1,774,841	0.66
Utility Cost Test (UCT)	\$0.1441	\$3,629,851	\$2,800,238	-\$829,613	0.77
Participant Cost Test (PCT)		\$3,354,823	\$4,756,201	\$1,401,379	1.42
Rate Impact Test (RIM)		\$5,976,457	\$2,800,238	3,176,220	0.47
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000913
Discounted Participant Payback (years)					9.92

6 Conclusions and Recommendations

ADM provides the following conclusions and recommendations from its evaluation of the 2021-2022 Washington Home Energy Savings program.

6.1 Conclusions

ADM draws the following conclusions from its evaluation:

- Pacific Power’s 2021-2022 Home Energy Savings program resulted in a savings of 5,179,931 kWh with a realization rate of 93 percent as reported in Table 6-1.

Table 6-1: Total Program Savings by Year

Year	Claimed Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
2021	2,957,392	2,752,156	93%
2022	2,625,379	2,427,775	92%
Total	5,582,772	5,179,931	93%

- HVAC measures continue to grow in importance as the primary measure category in Pacific Power’s Home Energy Savings program as shown in Figure 6-1.
- The 93 percent realization rate for 2021-2022 evaluation is higher than the 2019-2020 realization rate of 86 percent and the 2017-2018 realization rate of 67 percent.
- Additional opportunities exist to increase accuracy of ex-ante program savings estimates by improving program data collection and handling.

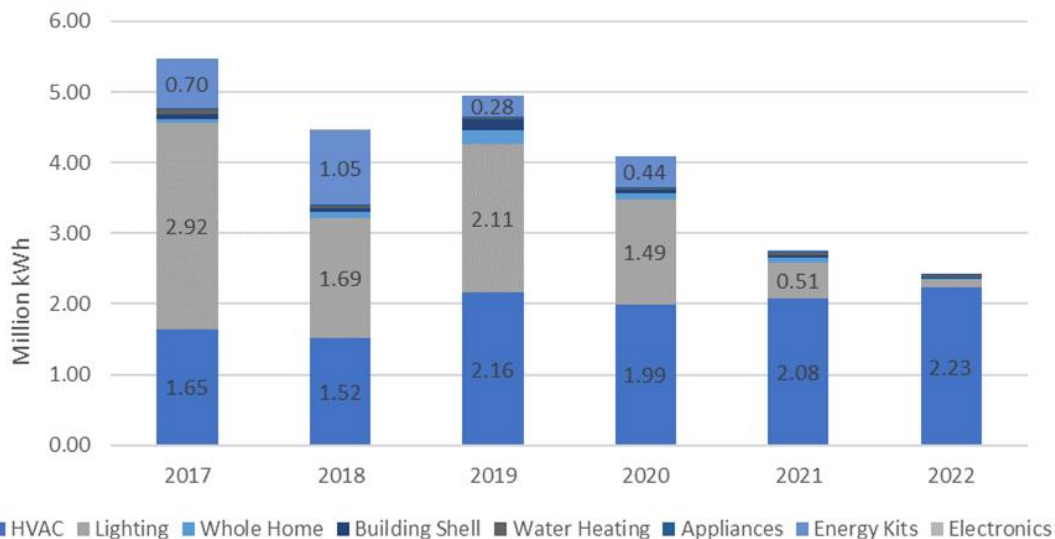


Figure 6-1: Program Savings by Measure Category 2017-2022

6.2 Recommendations

ADM provides the following recommendations to improve future program implementation.

Update program rebate applications to collect the specific data needed to select the correct measure (and therefore claimed savings).

ADM recommends that Pacific Power modify its rebate applications to remove ambiguity about the requested data needed to report correct incentivized measure.

ADM recommends a comprehensive review of program data collection tools and practices to ensure that rebate applications accurately collect all data elements needed to correctly identify claimed measures.

Update program controls to improve accuracy of measure selection.

ADM recommends that program implementers add process controls to reduce or eliminate measure identification errors and verify that all program eligibility requirements are met for all measures.

Require implementation contractors to include measure-defining data elements in uploaded program dataset.

The current dataset provided to Pacific Power by the implementer does not include all data elements that are required to verify and calculate program savings. ADM recommends that Pacific Power require program implementers to provide the following data elements in addition to the data currently included in program data uploads:

- For all measures, measure-defining data elements.
- For non-HVAC measures, product manufacturer and model number or Energy Star identification number.
- For HVAC measures, AHRI certificate number.
- For upstream measures, sales or distribution location and product model number at the record level.
- Additional data fields, as required, are needed to identify the correct measure (e.g., heating, and cooling system, baseline conditions, installation location, etc.).

Storing these key data elements with Pacific Power's program data will result in the following benefits:

- Adds data management industry best practices to Pacific Power's energy efficiency programs.

- Allows verification of a census of program data rather than relying on sampling. A central dataset can undergo census review, while a census review of discrete image application files (.pdf formatted files) is often cost prohibitive.
- Reduce evaluation risk by requiring implementer to document measure selection.
- Improve internal program planning by having more accurate program measure participation data.

Lighting measure product mapping to measure names

Review lighting product assignments to lighting measure names. During the evaluated program period, some ANSI bulb shapes (BR40, BR30, PAR30, MR16, R30 and BR20) were reported as *General Purposed & Three-Way*. ADM recommends that these ANSI bulb types are categorized as *Reflective & Outdoor* type lighting measures.

Electric baseboard heating conversion to ASHP

Recognize electric baseboard heating to ducted heat pump conversion as a separate measure. No measure exists in the Measure Library (ML) to reflect this type of conversion, which was found in 3 of 70 records (4 percent) in the evaluated sample.

6.3 Process Changes Reported by Implementer

The following operational and data management changes have been reported by the program implementer.

- Home Type validation controls have been added to the measure selection process.
- Measure model number has been added to evaluation tracking data.

The following changes are under review and consideration.

- Addition of AHRI certification number to data uploaded from implementer to Pacific Power.
- Implement strategies to increase the percentage of electronic rebate applications that feed directly into a searchable database.
- Review measure selection accuracy semi-annually.
- Review measure selection accuracy by trade ally.

Appendix A – 2022 General Population Survey

1. Did you buy any ENERGY STAR LED lightbulbs, light fixtures, or floodlights in a physical store in 2021 or 2022? Please do not include online purchases.
 - Yes
 - No
 - I don't recall

2. Which stores did you buy your ENERGY STAR LED lighting from?
 - Select all that apply.
 - Ace Hardware
 - Batteries Plus
 - Best Buy
 - Bi-Mart
 - Dollar Tree
 - Fred Meyer
 - Habitat for Humanity
 - Home Depot
 - Goodwill
 - Lowe's
 - Target
 - True Value
 - Walmart
 - Other (Please specify) _____
 - I don't know

3. What type of ENERGY STAR LED lighting products did you buy? Select all that apply.
 - LED bulb(s)
 - LED fixture(s) or floodlight(s)
 - I don't know

4. When did you buy the ENERGY STAR LED bulbs? Select all that apply.
 - 2021
 - 2022

5. How many ENERGY STAR LED bulbs did you buy during 2021-2022? If you are unsure of the exact number, an estimate is okay.
 - Number of Bulbs _____
6. Of the [number bought] bulbs you bought how many are currently:
 - Installed: _____
 - In storage: _____
 - Removed, discarded, or given away: _____
 - Total: _____
7. Of the [number installed] bulbs that you have installed, how many replaced LEDs and how many replaced bulbs that were not LEDs?
 - Number of replaced LED bulbs: _____
 - Number of replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.): _____
 - Number installed in new lamps, fixtures, or floodlights: _____
 - I don't know: _____
 - Total: _____
8. Do you recall if the ENERGY STAR 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 Pacific Power provided the discount?
 - Yes
 - No
 - I don't remember
10. Were any of the ENERGY STAR LED bulbs you purchased in 2021 or 2022 installed in a business or commercial building?
 - Yes
 - No
 - I don't know

11. Approximately how many of the ENERGY STAR LED bulbs you purchased were installed in a business or commercial building?
- Number of bulbs: _____
12. How many of the [number installed] installed LED bulbs are in each of the following locations?
- Bathroom: _____
 - Bedroom: _____
 - Dining room: _____
 - Exterior: _____
 - Garage: _____
 - Hallway: _____
 - Kitchen: _____
 - Living room: _____
 - Office: _____
 - Other room: _____
 - Installed at building other than home: _____
 - Don't know: _____
 - Total: _____
13. When did you buy the ENERGY STAR LED fixtures or floodlights?
- Select all that apply.
 - 2021
 - 2022
14. How many ENERGY STAR LED fixtures or floodlights did you buy during 2021-2022? If you are unsure of the exact number, an estimate is okay.
- Number of fixtures or floodlights

15. Of the [number installed] fixtures or floodlights you bought how many are currently:
- Installed: _____
 - In storage: _____
 - Removed, discarded, or given away: _____
 - Total: _____

16. Of the [number installed] fixtures or floodlights that you have installed, how many replaced LEDs and how many replaced bulbs that were not LEDs?
- Number of replaced bulbs that were LEDs: _____
 - Number of replaced bulbs that were not LEDs (CFL, incandescent, halogen, etc.): _____
 - Number installed in new lamps fixtures, or floodlights: _____
 - I don't know: _____
 - Total: _____
17. Do you recall if the ENERGY STAR LED fixtures or floodlights 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 Pacific Power provided the discount?
- Yes
 - No
 - I don't remember
19. Were any of the ENERGY STAR LED fixtures or floodlights you purchased in 2021-2022 installed in a business or commercial building?
- Yes
 - No
 - I don't know
20. Approximately how many of the ENERGY STAR LED fixtures or floodlights you purchased were installed in a business or commercial building?
- Number of bulbs: _____
21. How many of the [number installed] LED fixtures or floodlights that are installed are in your home are in each of the following locations?
- Bathroom: _____
 - Bedroom: _____
 - Dining room: _____
 - Exterior: _____

- Garage: _____
- Hallway: _____
- Kitchen: _____
- Living room: _____
- Office: _____
- Other room: _____
- Installed in a building other than home: _____
- I don't know: _____
- Total: _____

22. 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

23. 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 fixtures or floodlights in my home
- To take advantage discounted pricing
- Other (please specify) _____
- I don't know

24. 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: [customer email]

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

- No thanks, I'll pass on the gift card