

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

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PROGRAM YEARS 2021-2022

Prepared for  
Pacific Power

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Prepared by



ADM Associates, Inc.  
3239 Ramos Circle  
Sacramento, CA 95827  
916-363-8383

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# 1 Executive Summary

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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 California. 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 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

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The program provided financial incentives (rebates) for Pacific Power residential customers to purchase and install selected energy-efficient appliances, smart thermostats, heat pumps, and heat pump water heaters. Products included in the program and program participation are reported in Table 1-1.

ADM determined the evaluated energy (kWh) savings achieved through Pacific Power's 2021-2022 Home Energy Savings Program in California. Pacific Power contracted with [CE CONTRACTOR] 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 understanding of program operations, challenges, and evaluation needs through Pacific Power and implementation contractor key staff interviews, complemented with a program documentation review. Given the limited scope of the program, ADM completed a limited process evaluation.

*Table 1-1: 2021-2022 California Home Energy Savings Program  
Participation and Claimed Savings*

Measure Category	Quantity	Claimed Annual Saving kWh
<b>2021-2022</b>		
Appliances	19	2,454
HVAC	9	10,651
Water Heating	15	21,247
<b>Total</b>	<b>43</b>	<b>34,352</b>
<b>2021</b>		
Appliances	10	1,632
HVAC	5	9,987
Water Heating	8	10,657
<b>Total</b>	<b>23</b>	<b>22,276</b>
<b>2022</b>		
Appliances	9	822
HVAC	4	664
Water Heating	7	10,590
<b>Total</b>	<b>20</b>	<b>12,076</b>

## 1.2 Impact Evaluation Results

Table 1-2, Table 1-3, and Table 1-4 present impact evaluation results, including claimed savings, evaluated gross savings, realization rates, and evaluated net savings. Net-to-gross ratios are presented at the measure level in the detailed Section 3 of the report.

*Table 1-2: Total Program Savings by Measure Category 2021-2022*

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>19</b>	<b>2,454</b>	<b>1,612</b>	<b>5%</b>	<b>66%</b>	<b>594</b>
Clothes Dryers	1	392	392	1%	100%	216
Clothes Washers	18	2,062	1,220	4%	59%	378
<b>HVAC</b>	<b>9</b>	<b>10,651</b>	<b>10,651</b>	<b>32%</b>	<b>100%</b>	<b>5,858</b>
Heat Pump	2	9,489	9,489	28%	100%	5,219
Smart Thermostat	7	1,162	1,162	3%	100%	639
<b>Water Heating</b>	<b>15</b>	<b>21,247</b>	<b>21,448</b>	<b>64%</b>	<b>101%</b>	<b>11,796</b>
Water Heater	15	21,247	21,448	64%	101%	11,796
<b>Total</b>	<b>43</b>	<b>34,352</b>	<b>33,711</b>	<b>100%</b>	<b>98%</b>	<b>18,248</b>

Table 1-3: Total Program Savings by Measure Category 2021

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>10</b>	<b>1,632</b>	<b>933</b>	<b>5%</b>	<b>57%</b>	<b>383</b>
Clothes Dryers	1	392	392	2%	100%	216
Clothes Washers	9	1,240	541	3%	44%	168
<b>HVAC</b>	<b>5</b>	<b>9,987</b>	<b>9,987</b>	<b>50%</b>	<b>100%</b>	<b>5,493</b>
Heat Pump	2	9,489	9,489	47%	100%	5,219
Smart Thermostat	3	498	498	2%	100%	274
<b>Water Heating</b>	<b>8</b>	<b>10,657</b>	<b>9,248</b>	<b>46%</b>	<b>87%</b>	<b>5,086</b>
Water Heater	8	10,657	9,248	46%	87%	5,086
<b>Total</b>	<b>23</b>	<b>22,276</b>	<b>20,168</b>	<b>100%</b>	<b>91%</b>	<b>10,963</b>

Table 1-4: Total Program Savings by Measure Category 2022

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>9</b>	<b>822</b>	<b>679</b>	<b>5%</b>	<b>83%</b>	<b>210</b>
Clothes Washers	9	822	679	5%	83%	210
<b>HVAC</b>	<b>4</b>	<b>664</b>	<b>664</b>	<b>5%</b>	<b>100%</b>	<b>365</b>
Smart Thermostat	4	664	664	5%	100%	365
<b>Water Heating</b>	<b>7</b>	<b>10,590</b>	<b>12,200</b>	<b>90%</b>	<b>115%</b>	<b>6,710</b>
Water Heater	7	10,590	12,200	90%	115%	6,710
<b>Total</b>	<b>20</b>	<b>12,076</b>	<b>13,543</b>	<b>100%</b>	<b>112%</b>	<b>7,286</b>

### 1.3 Process Evaluation Results

ADM made the following key findings during its process analysis.

Data errors were found in 48 percent of program records, primarily the incorrect identification of measure when identifying the climate zone, the housing type, or the correct efficiency level as specified in the ML.

### 1.4 Cost Effectiveness Results

Applied Energy Group (AEG) estimated the cost-effectiveness results for the California Home Energy Savings Program based on 2021 and 2022 costs and savings estimates provided by PacifiCorp. The program passed 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 – 2021-2022

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.68	\$110,648	\$19,223	-\$91,425	0.17
Total Resource Cost Test (TRC) No Adder	\$0.68	\$110,648	\$17,475	-\$93,173	0.16
Utility Cost Test (UCT)	\$0.68	\$111,803	\$17,475	-\$94,328	0.16
Participant Cost Test (PCT)		\$19,984	\$51,036	\$31,052	2.55
Rate Impact Test (RIM)		\$151,029	\$17,475	-\$133,554	0.12
Lifecycle Revenue Impacts	0.000021 \$/kWh				
Discounted Participant Payback	4.41 years				

Table 1-6: Program Cost-Effectiveness Results – 2021

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.71	\$73,728.47	\$12,068	-\$61,661	0.16
Total Resource Cost Test (TRC) No Adder	\$0.71	\$73,728	\$10,971	-\$62,758	0.15
Utility Cost Test (UCT)	\$0.71	\$73,656.91	\$10,971	-\$62,686	0.15
Participant Cost Test (PCT)		\$13,637	\$32,791	\$19,154	2.40
Rate Impact Test (RIM)		\$99,198.00	\$10,971	-\$88,227	0.11
Lifecycle Revenue Impacts	0.000014 \$/kWh				
Discounted Participant Payback	5.04 years				

Table 1-7: Program Cost-Effectiveness Results – 2022

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.62	\$36,920	\$7,155	-\$29,764	0.19
Total Resource Cost Test (TRC) No Adder	\$0.62	\$36,920	\$6,505	-\$30,415	0.18
Utility Cost Test (UCT)	\$0.64	\$38,146	\$6,505	-\$31,642	0.17
Participant Cost Test (PCT)		\$6,348	\$18,245	\$11,897	2.87
Rate Impact Test (RIM)		\$51,831	\$6,505	-\$45,327	0.13
Lifecycle Revenue Impacts	0.0000087 \$/kWh				
Discounted Participant Payback	3.48 years				

## 1.5 Conclusions and Recommendations

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ADM provides the following conclusions and recommendations to improve future program results.

### 1.5.1 Conclusions

ADM provides the following conclusions based on its program evaluation:

#### Program scale

Pacific Power's Home Energy Savings program energy savings impact has declined as the result of California Public Utilities Commission 2020 guidance requiring program savings to be determined using unmodified DEER<sup>1</sup> values. In response, Pacific Power anticipates shifting to an energy equity focus, i.e., offering efficiency measures to lower-income customers who experience the greatest energy burdens.

#### Program data errors

Twenty-two of 46 records (48 percent) in the tracking data included errors because 1) the climate zone indicated in the measure name did not match the customer's climate zone (8), the housing type was incorrect (13), or because the product model number provided in the tracking data did not meet measure specifications indicated in the program reference files (6)<sup>2</sup>. Errors in identifying the correct measure name both increased and decreased savings. Errors in validating product eligibility reduced realization rates by removing ineligible savings from program totals.

*Table 1-8: Errors in Tracking Data*

	Appliances	HVAC	Water heating	Total
Climate zone errors	5	0	3	8
Housing type errors	6	2	5	13
Product-measure type mismatch	5	0	1	6
Number of incorrectly identified measures <sup>2</sup>	14	2	6	22

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<sup>1</sup> [California Database for Energy Efficiency Resources](#)

<sup>2</sup> Some records included more than one error.

## **1.5.2 Recommendations**

ADM provides the following recommendations to improve future program implementation.

### **Add process controls to program implementation**

ADM recommends that Pacific Power work with program implementers to revise program controls to ensure that program eligibility requirements are met for all measures and that program records identify the correct measure for each transaction.

### **Add data elements to tracking and reporting**

ADM recommends that Pacific Power adds measure manufacturer and model numbers to its internal program database.

### **Establish required data elements for each measure**

ADM recommends that Pacific Power, the program implementer, and the evaluator explicitly establish which data elements are required to calculate ex-post program savings by measure, prior to the program year and prior to the addition of new measures to the program. ADM also recommends that a commitment from all parties is established to include required data elements in program tracking data.



## 2 Introduction and Purpose of Study

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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 California. 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 of the program, focusing on participant and program staff perspectives regarding the program's implementation and ADM's observations about the program. Given the limited scope of the program, ADM completed a limited process evaluation.

### 2.1 Description of Programs

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The program provided financial incentives (rebates) for Pacific Power residential customers to purchase and install energy-efficient products. Products included in the program are reported in Table 2-1. Customers receive incentives by applying for a rebate either online or by mail. To receive rebates, customers are required to provide product make and model number, proof of purchase, and installation address.

*Table 2-1: 2021 CA Program Participation and Claimed Savings*

Measure Category	Quantity	Claimed Annual Saving kWh
<b>2021-2022</b>		
Appliances	19	2,454
HVAC	9	10,651
Water Heating	15	21,247
<b>Total</b>	<b>43</b>	<b>34,352</b>
<b>2021</b>		
Appliances	10	1,632
HVAC	5	9,987
Water Heating	8	10,657
<b>Total</b>	<b>23</b>	<b>22,276</b>
<b>2022</b>		
Appliances	9	822
Water Heating	7	10,590
HVAC	4	664
<b>Total</b>	<b>20</b>	<b>12,076</b>

## 2.2 Discussion of Program Size

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The size of Pacific Power’s California Home Energy Savings program has contracted in recent years (see Table 2-2) because of the California Public Utilities Commission (CPUC) 2020 guidance requiring program savings to be determined using unmodified DEER<sup>3</sup> values.

Program staff reviewed all current statewide workpapers in 2020 to identify cost-effective measures that could be included in the program. Measures that no longer passed TRC or UCT tests (e.g., heat pumps) were removed from the program. The revised program offerings took effect on 9/24/2020. Reduced program scale since 2020 was the result of CPUC-directed changes.

Going forward, Pacific Power anticipates shifting the California Home Energy Savings program to an energy equity focus, i.e., offering efficiency measures to lower-income customers who experience the greatest energy burdens.

*Table 2-2: Program Savings 2017-2022*

Program Year	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
2022	12,076	13,543	112%	7,286
2021	22,276	20,168	91%	10,963
2020	603,374	220,062	91%	308,649
2019	692,897	715,344	103%	404,206
2018	1,128,461	1,162,378	103%	666,786
2017	1,906,852	1,675,163	88%	1,153,937

## 2.3 Impact Evaluation Objectives

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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 for which incentives were paid. Net energy savings reflect gross savings multiplied by the deemed net-to-gross (NTG) ratio prescribed by the CPUC in DEER.

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

- Determined if claimed savings matched unit energy savings (UES) documented in California DEER.

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<sup>3</sup> [California Database for Energy Efficiency Resources](#)

- Verified deemed DEER NTG values for each measure to determine net energy savings.
- Reviewed a census of tracking data records to verify that correct measures were identified in program tracking data to determine UES.
- Provided inputs for cost-benefit analyses.

Note that ADM did not conduct on-site verification or equipment monitoring as part of this evaluation.

## **2.4 Process Evaluation Objectives**

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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. Given the limited scale of the program during the evaluation period, the process evaluation was limited to an in-depth interview of program staff.

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

- What are the 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 18,248 kWh during the evaluation period with a 98 percent realization rate. 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 2021-2022*

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>19</b>	<b>2,454</b>	<b>1,612</b>	<b>5%</b>	<b>66%</b>	<b>594</b>
Clothes Dryers	1	392	392	1%	100%	216
Clothes Washers	18	2,062	1,220	4%	59%	378
<b>HVAC</b>	<b>9</b>	<b>10,651</b>	<b>10,651</b>	<b>32%</b>	<b>100%</b>	<b>5,858</b>
Heat Pump	2	9,489	9,489	28%	100%	5,219
Smart Thermostat	7	1,162	1,162	3%	100%	639
<b>Water Heating</b>	<b>15</b>	<b>21,247</b>	<b>21,448</b>	<b>64%</b>	<b>101%</b>	<b>11,796</b>
Water Heater	15	21,247	21,448	64%	101%	11,796
<b>Total</b>	<b>43</b>	<b>34,352</b>	<b>33,711</b>	<b>100%</b>	<b>98%</b>	<b>18,248</b>

*Table 3-2: Total Program Savings by Measure Category 2021*

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>10</b>	<b>1,632</b>	<b>933</b>	<b>5%</b>	<b>57%</b>	<b>383</b>
Clothes Dryers	1	392	392	2%	100%	216
Clothes Washers	9	1,240	541	3%	44%	168
<b>HVAC</b>	<b>5</b>	<b>9,987</b>	<b>9,987</b>	<b>50%</b>	<b>100%</b>	<b>5,493</b>
Heat Pump	2	9,489	9,489	47%	100%	5,219
Smart Thermostat	3	498	498	2%	100%	274
<b>Water Heating</b>	<b>8</b>	<b>10,657</b>	<b>9,248</b>	<b>46%</b>	<b>87%</b>	<b>5,086</b>
Water Heater	8	10,657	9,248	46%	87%	5,086
<b>Total</b>	<b>23</b>	<b>22,276</b>	<b>20,168</b>	<b>100%</b>	<b>91%</b>	<b>10,963</b>

Table 3-3: Total Program Savings by Measure Category 2022

Measure Category	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	% Total Program Savings	Realization Rate	Net Evaluated Savings (kWh)
<b>Appliances</b>	<b>9</b>	<b>822</b>	<b>679</b>	<b>5%</b>	<b>83%</b>	<b>210</b>
Clothes Washers	9	822	679	5%	83%	210
<b>Water Heating</b>	<b>7</b>	<b>10,590</b>	<b>664</b>	<b>5%</b>	<b>100%</b>	<b>365</b>
Water Heater	7	10,590	664	5%	100%	365
<b>HVAC</b>	<b>4</b>	<b>664</b>	<b>12,200</b>	<b>90%</b>	<b>115%</b>	<b>6,710</b>
Smart Thermostat	4	664	12,200	90%	115%	6,710
<b>Total</b>	<b>20</b>	<b>12,076</b>	<b>13,543</b>	<b>100%</b>	<b>112%</b>	<b>7,286</b>

### 3.1 Impact Evaluation Approach

ADM's evaluated unit energy savings (UES) for each measure takes into consideration savings values presented in ML reference files. TRL reference files 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.

#### 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 2021 and 2022 annual reports. ADM reviewed a census of program tracking data, associated savings values, input assumptions, and calculations contained in the ML reference 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 reviewed a census of the program tracking dataset for completeness, consistency, and compliance with the reference files documented in the ML.

Review of measure savings assumptions and calculations maintained in the ML. 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 guidelines for evaluating the program.

ADM requested program tracking data and ML reference files, in addition to other program data and verification, as necessary.

ADM included the following datasets in its evaluation:

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

### 3.2 Appliances

Pacific Power offered rebates to verified customers on qualified energy-efficient clothes washers and dryers during the evaluation period. Rebates were issued on 19 appliances resulting in 594 kWh net evaluated savings with a 66 percent realization rate.

*Table 3-4: Appliance Program Savings 2019-2020*

Measure Type	Quantity	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG	Net Evaluated Savings (kWh)
<b>2021</b>	<b>10</b>	<b>1,632</b>	<b>933</b>	<b>57%</b>	<b>0.41</b>	<b>383</b>
Clothes Dryers	1	392	392	100%	0.55	216
Clothes Washers	9	1,240	541	44%	0.31	168
<b>2022</b>	<b>9</b>	<b>822</b>	<b>679</b>	<b>83%</b>	<b>0.31</b>	<b>210</b>
Clothes Washers	9	822	679	83%	0.31	210
<b>Total</b>	<b>19</b>	<b>2,454</b>	<b>1,612</b>	<b>66%</b>	<b>0.37</b>	<b>594</b>

#### 3.2.1 Tracking Data Verification

ADM reviewed program tracking data to verify that:

- the tracking dataset did not include duplicate data entries
- claimed energy savings matched the applicable ML reference documents
- products (model numbers) for which incentives were paid met product eligibility requirements as documented in ML reference documents.
- ADM verified that the UES values claimed by Pacific Power were supported by the applicable ML documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2021 and 2022
- correct measures were indicated for each record, identifying the correct housing type and climate zone.

ADM made the following findings:

- Climate zone was incorrectly identified for five records.
- Housing type was incorrectly identified for five records.
- Measure name did not meet model specifications for five records.

### 3.2.2 Discussion of Realization Rates

Errors in identifying the correct measure resulted in incorrect ex-ante savings for 12 of 21 records with both positive and negative impacts on realization rates.

### 3.2.3 Net-to-Gross Ratio

The default deemed NTG ratio of 0.55 was applied to clothes dryers; 0.31 was applied to clothes washers, as indicated in California DEER.

## 3.3 HVAC

Pacific Power offered customers financial incentives to install heat pumps and smart thermostats in their homes during the evaluation period. HVAC measures resulted in 5,858 kWh of net evaluated savings with a 100 percent realization rate.

*Table 3-5: HVAC Savings 2021*

Measure Type	Qty	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG	Net Evaluated Savings (kWh)
<b>2021</b>	<b>5</b>	<b>9,987</b>	<b>9,987</b>	<b>100%</b>	<b>0.55</b>	<b>5,493</b>
Heat Pump	2	9,489	9,489	100%	0.55	5,219
Smart Thermostat	3	498	498	100%	0.55	274
<b>2022</b>	<b>4</b>	<b>664</b>	<b>664</b>	<b>100%</b>	<b>0.55</b>	<b>365</b>
Smart Thermostat	4	664	664	100%	0.55	365
<b>Total</b>	<b>9</b>	<b>10,651</b>	<b>10,651</b>	<b>100%</b>	<b>0.55</b>	<b>5,858</b>

### 3.3.1 Tracking Data Verification

ADM reviewed program tracking data to verify that:

- the tracking dataset did not include duplicate data entries
- claimed energy savings matched the applicable ML reference documents
- products (model numbers) for which incentives were paid met product eligibility requirements as documented in ML reference documents

- correct measures were indicated for each record, identifying the correct housing type and climate zone

ADM made the following finding:

- Housing type was incorrectly identified for two records.

### 3.3.2 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 ML.

### 3.3.3 Evaluated Savings

Evaluated savings were calculated using UES values included in the reference files. No adjustments were made to the claimed savings. Evaluated savings for the HVAC measure category resulted in a 100 percent realization rate.

### 3.3.4 Net-to-Gross Ratio

The default deemed NTG ratio of 0.55 was applied to all HVAC measures as indicated in California’s DEER.

## 3.4 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 fifteen heat pump water heaters, resulting in 11,796 kWh net evaluated savings with a 101 percent realization rate as reported in Table 3-6.

*Table 3-6: Water Heating Program Savings 2019-2020*

Year	Quantity	Claimed Saving (kWh)	Gross Evaluated Savings (kWh)	Realization Rate	Deemed NTG	Net Evaluated Savings (kWh)
2021	8	10,657	9,248	87%	0.55	5,086
2022	7	10,590	12,200	115%	0.55	6,710
<b>Total</b>	<b>15</b>	<b>21,247</b>	<b>21,448</b>	<b>101%</b>	<b>0.55</b>	<b>11,796</b>



### **3.4.1 Tracking Data Verification**

ADM reviewed program tracking data to verify that:

- the tracking dataset did not include duplicate data entries
- claimed energy savings matched the applicable Measure Library (ML) reference documents
- products (model numbers) for which incentives were paid met product eligibility requirements as documented in ML reference documents
- correct measures were indicated for each record, identifying the correct housing type and climate zone.

ADM made the following findings:

- Climate zone was incorrectly identified for three records.
- Housing type was incorrectly identified for six records.
- One record included a model that did not meet the measure definition based on model specifications.

### **3.4.2 Ex-ante Review**

ADM verified that the UES values claimed by Pacific Power were supported by the applicable ML reference documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2021 and 2022.

### **3.4.3 Evaluated savings**

ADM reviewed the manufacturer 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 the climate zone and housing type indicated for each customer address that received a water heater rebate.

ADM assumed an ISR of 1.0 for water heaters.

### **3.4.4 Discussion of Realization Rates**

One record in the program tracking included a model number for a standard electric water heater; it did not meet the measure requirements and resulted in no savings. The tracking data included three heat pump water heaters for which the climate zone of the claimed savings did not match the climate zone of the customers' addresses, and six records had the incorrect housing type. Evaluated savings equal deemed savings for the correct housing type and climate zone. Errors in identifying the correct measure type had both

positive and negative impacts on savings. The realization rate for the measure category for the evaluation period was 101 percent.

#### **3.4.5 Net-to-Gross Ratio**

The default deemed NTG ratio of 0.55 was applied to heat pump water heaters as indicated in California DEER.

## 4 Process Evaluation

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### 4.1 Review of Program Materials and In-Depth Interviews

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ADM completed a process analysis of the program which included an in-depth interview and additional conversations with key staff at Pacific Power and Resource Innovations, the program implementer. Additional information was gathered from a review of program materials.

#### 4.1.1 Roles and Responsibilities

The Pacific Power program manager oversees the Wattsmart Home Energy Savings programs in California and Washington. In addition to overseeing the regulatory process, the program manager is responsible for assessing the cost-effectiveness of the program, the marketing campaigns and program participation and procedures, and designing and implementing procedures.

#### 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 California Public Utility Commission. 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.

#### 4.1.3 Tracking and Reporting

Pacific Power savings documentation is comprised of the ML with its associated files, the program tracking dataset, and supplementary data provided by the program implementer.

##### 4.1.3.1 Measure Library (ML)

Ex-ante measure savings, as well as other measure specifications, are documented in Pacific Power's ML. The ML compiles all program measures and all versions of each measure along with measure specifications. Measures are updated by version number as required by changing regulatory and market conditions. The ML 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 unit energy savings (UES) 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 ML includes multiple versions of specific measures for which the savings values can vary, the accuracy of ML necessitates that a specific reference file is indicated for each version of each measure.

#### **4.1.3.2 Program Tracking Dataset**

Pacific Power maintains a program tracking dataset that includes:

- Measure name and corresponding data that ties to ML
- 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
- Baseline conditions

ADM found that key program tracking data elements are retained with the program implementer and are not integrated into Pacific Power's program tracking database. Program data provided by Pacific Power and the implementer included the following data errors.

#### **Climate Zone**

Eight (17 percent) of 46 records included measures with the incorrect climate zone indicated.

#### **Housing Type**

Thirteen (28 percent) of 46 records included measures with the incorrect climate zone indicated.

#### **Measure Requirements**

Six (13 percent) of 46 records reported the incorrect measure for the product specifications indicated by the model number installed.

#### **4.1.4 Communication**

Pacific Power and the implementer report constant communication and program coordination, often communicating several times per day. The 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.

#### **4.1.5 Marketing and Program Outreach**

The program implementer works in coordination with Pacific Power to market the Home Energy Savings program and determine what messaging is delivered to customers. Pacific Power uses multiple marketing avenues to promote the program including social and traditional media, presence at community events, the company's website, and promotion through participating vendors and trade allies.

### **4.2 Process Evaluation Key Findings**

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ADM made the following key findings during its process analysis.

Data errors were found in 48 percent of program records, primarily the incorrect identification of measure when identifying the climate zone, the housing type, or the correct efficiency level as specified in the ML.

## 5 Cost-Effectiveness

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Applied Energy Group (AEG) estimated program cost-effectiveness results based on 2021 and 2022 costs provided by Pacific Power and energy savings included in this report. The program passed the Participant Cost Test (PCT).

Hourly values provided by PacifiCorp for PY2021 were based on the 2019 Integrated Resource Plan (IRP) Preferred Portfolio, converted into annual values using California load shapes from the same IRP. The hourly values provided by PacifiCorp for 2022 were sourced from the 2021 Integrated Resource Plan (IRP) Preferred Portfolio, utilizing the 2020 California Avoided Cost Calculator consistent with PacifiCorp annual budget advice letter for 2022 (Advice Letter 697-E). These are converted into annual values using California load shapes from the IRP. Program and measure costs and incentive amounts were provided by PacifiCorp. Program inputs used in the cost-effectiveness analysis are included in Table 5-1.

*Table 5-1: Program Inputs*

<b>Parameter</b>	<b>2021</b>	<b>2022</b>
Discount Rate	6.92%	6.88%
Residential Line Loss	8.78%	8.78%
Residential Energy Rate (\$/kWh)	\$0.13	\$0.12
Inflation Rate <sup>4</sup>	2.28%	2.16%

Table 5-2 through Table 5-6 include total program cost-effectiveness results.

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<sup>4</sup> Future rates determined using an annual escalator.

Table 5-2: Annual Program Costs, Nominal – PY2021-2022<sup>5</sup>

Measure Category	Program Delivery	Utility Admin	Program Dev.	Incentives	Total Utility Costs	Gross Customer Costs
<b>2021-2022</b>						
Appliances	\$5,432	\$1,476	\$245	\$1,410	\$8,562	\$1,941
HVAC	\$24,370	\$6,296	\$953	\$2,800	\$34,419	\$8,848
Water Heating	\$46,070	\$12,904	\$2,248	\$7,600	\$68,822	\$9,195
<b>Total Program</b>	<b>\$75,872</b>	<b>\$20,676</b>	<b>\$3,445</b>	<b>\$11,810</b>	<b>\$111,803</b>	<b>\$19,984</b>
<b>2021</b>						
Appliances	\$3,762	\$961	\$142	\$1,050	\$5,915	\$1,283
HVAC	\$23,021	\$5,881	\$870	\$2,600	\$32,372	\$8,252
Water Heating	\$24,566	\$6,275	\$929	\$3,600	\$35,370	\$4,101
<b>Total Program</b>	<b>\$51,349</b>	<b>\$13,117</b>	<b>\$1,941</b>	<b>\$7,250</b>	<b>\$73,657</b>	<b>\$13,637</b>
<b>2022</b>						
Appliances	\$1,670	\$515	\$102	\$360	\$2,647	\$658
HVAC	\$1,348	\$416	\$83	\$200	\$2,047	\$596
Water Heating	\$21,505	\$6,629	\$1,319	\$4,000	\$33,453	\$5,094
<b>Total Program</b>	<b>\$24,523</b>	<b>\$7,559</b>	<b>\$1,504</b>	<b>\$4,560</b>	<b>\$38,146</b>	<b>\$6,348</b>

Table 5-3: 2021-2022 Benefit/Cost Ratios by Measure Category

Measure Category	PTRC	TRC	UCT	PCT	RIM
<b>2021-2022</b>					
Appliances	0.08	0.07	0.07	1.70	0.05
HVAC	0.22	0.20	0.21	2.03	0.14
Water Heating	0.16	0.15	0.14	3.24	0.11
<b>Total</b>	<b>0.17</b>	<b>0.16</b>	<b>0.16</b>	<b>2.55</b>	<b>0.12</b>
<b>2021</b>					
Appliances	0.07	0.07	0.06	1.72	0.05
HVAC	0.22	0.20	0.21	2.07	0.15
Water Heating	0.12	0.11	0.11	3.29	0.08
<b>Total</b>	<b>0.16</b>	<b>0.15</b>	<b>0.15</b>	<b>2.40</b>	<b>0.11</b>
<b>2022</b>					
Appliances	0.09	0.08	0.08	1.67	0.06
HVAC	0.18	0.16	0.17	1.46	0.13
Water Heating	0.20	0.18	0.18	3.20	0.13
<b>Total</b>	<b>0.19</b>	<b>0.18</b>	<b>0.17</b>	<b>2.87</b>	<b>0.13</b>

<sup>5</sup> To align with annual budget expectations, cost-effectiveness inputs are presented in nominal dollars.

Table 5-4: Program Cost-Effectiveness Results – 2021-2022

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.68	\$110,648	\$19,223	-\$91,425	0.17
Total Resource Cost Test (TRC) No Adder	\$0.68	\$110,648	\$17,475	-\$93,173	0.16
Utility Cost Test (UCT)	\$0.68	\$111,803	\$17,475	-\$94,328	0.16
Participant Cost Test (PCT)		\$19,984	\$51,036	\$31,052	2.55
Rate Impact Test (RIM)		\$151,029	\$17,475	-\$133,554	0.12
Lifecycle Revenue Impacts	0.000021 \$/kWh				
Discounted Participant Payback	4.41 years				

Table 5-5: Program Cost-Effectiveness Results – 2021

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.71	\$73,728.47	\$12,068	-\$61,661	0.16
Total Resource Cost Test (TRC) No Adder	\$0.71	\$73,728	\$10,971	-\$62,758	0.15
Utility Cost Test (UCT)	\$0.71	\$73,656.91	\$10,971	-\$62,686	0.15
Participant Cost Test (PCT)		\$13,637	\$32,791	\$19,154	2.40
Rate Impact Test (RIM)		\$99,198.00	\$10,971	-\$88,227	0.11
Lifecycle Revenue Impacts	0.000014 \$/kWh				
Discounted Participant Payback	5.04 years				

Table 5-6: Program Cost-Effectiveness Results – 2022

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.62	\$36,920	\$7,155	-\$29,764	0.19
Total Resource Cost Test (TRC) No Adder	\$0.62	\$36,920	\$6,505	-\$30,415	0.18
Utility Cost Test (UCT)	\$0.64	\$38,146	\$6,505	-\$31,642	0.17
Participant Cost Test (PCT)		\$6,348	\$18,245	\$11,897	2.87
Rate Impact Test (RIM)		\$51,831	\$6,505	-\$45,327	0.13
Lifecycle Revenue Impacts	0.0000087 \$/kWh				
Discounted Participant Payback	3.48 years				



## 6 Conclusions and Recommendations

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ADM provides the following conclusions and recommendations to improve future program results.

### 6.1 Conclusions

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Pacific Power's 2021-2022 Home Energy Savings program resulted in 18,260 kWh of net evaluated savings with a 98 percent realization rate (see Table 6-1).

*Table 6-1: Total Program Savings by Year*

Program Year	Claimed Saving (kWh)	Evaluated Savings (kWh)	Realization Rate	Net Evaluated Savings (kWh)
2021	22,276	20,155	90%	10,959
2022	12,076	13,595	113%	7,302
<b>Total</b>	<b>34,352</b>	<b>33,750</b>	<b>98%</b>	<b>18,260</b>

Table 6-2 includes a breakdown of savings by measure category for the evaluation period.

*Table 6-2: Total Program Savings by Measure Category 2021-2022*

Measure Category	Claimed Saving	Evaluated Savings	Realization Rate	Net Evaluated Savings	% Program Savings
Water Heating	21,247	21,448	101%	11,796	65%
HVAC	10,651	10,651	100%	5,858	32%
Appliances	2,454	1,651	67%	606	3%
<b>Total</b>	<b>34,352</b>	<b>33,750</b>	<b>98%</b>	<b>18,260</b>	<b>100%</b>

### Program scale

Pacific Power's Home Energy Savings program energy savings impact has declined as the result of California Public Utilities Commission 2020 guidance requiring program savings to be determined using unmodified DEER values. In response, Pacific Power anticipates shifting to an energy equity focus, i.e., offering efficiency measures to lower-income customers who experience the greatest energy burdens.

## **Program data errors**

Twenty-two of 46 records (48 percent) in the tracking data included errors because 1) the climate zone indicated in the measure name did not match the customer's climate zone (8), the housing type was incorrect (13), or because the product model number provided in the tracking data did not meet measure specifications indicated in the Measure Library (6). Errors in identifying the correct measure name both increased and decreased savings. Errors in validating product eligibility reduced realization rates by removing ineligible savings from program totals.

## **6.2 Recommendations**

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ADM provides the following recommendations to improve future program implementation.

### **Add process controls to program implementation**

ADM recommends that Pacific Power work with program implementers to revise program controls to ensure that program eligibility requirements are met for all measures and that program records identify the correct measure for each transaction.

### **Add data elements to tracking and reporting**

ADM recommends that Pacific Power adds the following additional data elements to its internal program database:

- Measure manufacturer and model numbers

### **Establish required data elements for each measure**

ADM recommends that Pacific Power, the program implementer, and the evaluator explicitly establish which data elements are required to calculate ex-post program savings by measure, prior to the program year and prior to the addition of new measures to the program. Establish a commitment from all parties to include required data elements in program tracking data.