

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

Final Evaluation Report, Program Years 2017-2018

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Prepared for:  
***Pacific Power***

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# 1 Executive Summary

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

During the 2017 and 2018 program years, the Home Energy Savings Program claimed gross energy savings of 14,778,646 kWh. The Home Energy Savings Program provided incentives for the following measure categories:

- **Appliances:** clothes washers and dryers
- **Building Shell:** air sealing, insulation and windows
- **Electronics:** advanced power strips (APS)
- **Energy Kits:** mailed energy kits containing combinations of LEDs, bathroom and kitchen faucet aerators, and showerheads
- **Heating, ventilation, and air conditioning (HVAC):** controls and thermostats, central air conditioning, evaporative coolers, duct sealing and insulation, and heat pumps
- **Lighting:** LED bulbs and fixtures and CFL bulbs (2017 only)
- **Whole Homes:** whole homes projects
- **Water Heating:** heat pump water heaters

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

## 1.1 Evaluation Results

### 1.1.1 Impact Evaluation Results

Table 1-1 and Figure 1-1 present the impact evaluation results, including the claimed savings, evaluated gross savings, realization rates, evaluated net savings and net-to-gross (NTG) values for each measure category across both program years, 2017 and 2018. Table 1-2 and Table 1-3 present this information for each year 2017 and 2018 individually.

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

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017-2018	Appliances	35,857	35,857	100%	28,727	80%
	Building Shell	126,685	126,685	100%	101,459	80%
	Electronics	630	630	100%	515	82%
	Energy Kits	1,741,903	1,848,005	106%	1,753,572	95%
	HVAC	3,985,925	3,187,479	80%	3,170,009	99%
	Lighting	8,561,875	6,095,321	71%	4,609,613	76%
	Water Heating	144,998	144,998	100%	115,964	80%
	Whole Homes	180,772	180,772	100%	145,750	81%
<b>2017-2018 TOTAL</b>		<b>14,778,646</b>	<b>11,619,747</b>	<b>79%</b>	<b>9,925,609</b>	<b>85%</b>

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

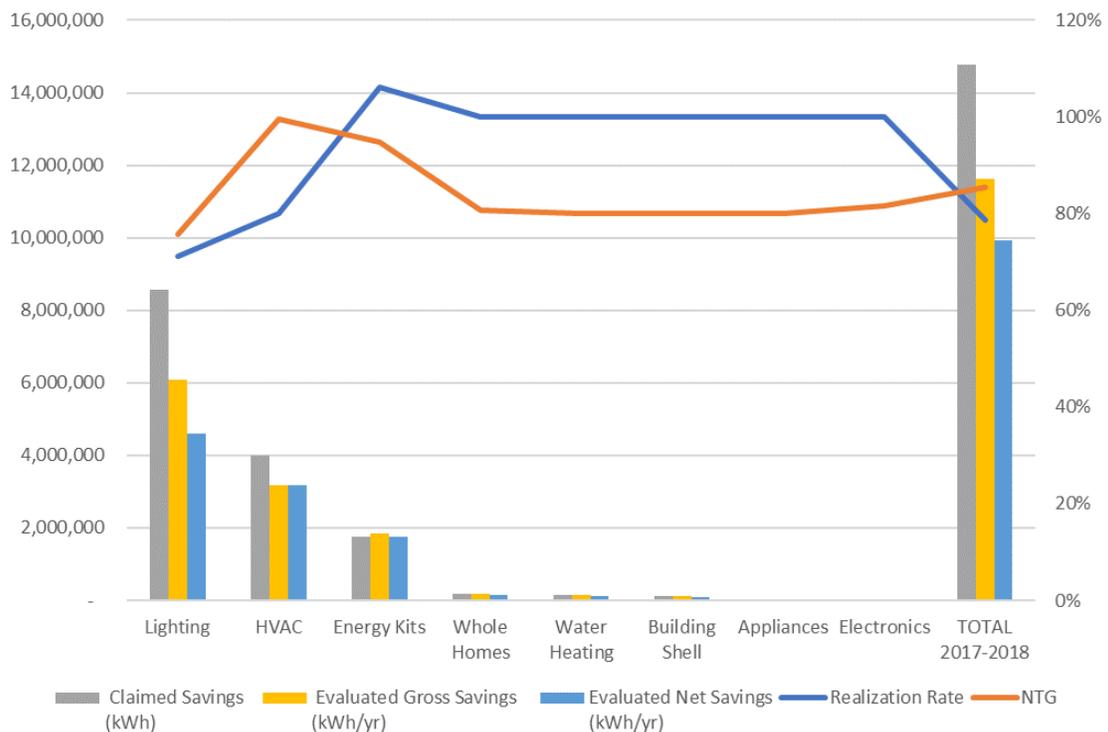


Table 1-2: Washington Home Energy Savings Program Claimed and Evaluated Savings by Measure Category, 2017

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017	Appliances	20,613	20,613	100%	16,273	79%
	Building Shell	74,057	74,057	100%	58,466	79%
	Electronics	-	-	-	-	-
	Energy Kits	655,954	740,170	113%	702,347	95%
	HVAC	2,036,915	1,654,610	81%	1,646,339	100%
	Lighting	5,340,901	3,846,435	72%	2,918,662	76%
	Water Heating	90,640	90,640	100%	71,558	79%
	Whole Homes	70,180	70,180	100%	55,405	79%
<b>2017 TOTAL</b>		<b>8,289,259</b>	<b>6,496,704</b>	<b>78%</b>	<b>5,469,051</b>	<b>84%</b>

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

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2018	Appliances	15,244	15,244	100%	12,453	82%
	Building Shell	52,629	52,629	100%	42,993	82%
	Electronics	630	630	100%	515	82%
	Energy Kits	1,085,949	1,107,835	102%	1,051,225	95%
	HVAC	1,949,011	1,532,869	79%	1,523,670	99%
	Lighting	3,220,974	2,248,886	70%	1,690,951	75%
	Water Heating	54,358	54,358	100%	44,406	82%
	Whole Homes	110,592	110,592	100%	90,345	82%
<b>2018 TOTAL</b>		<b>6,489,387</b>	<b>5,123,043</b>	<b>79%</b>	<b>4,456,558</b>	<b>87%</b>

### 1.1.2 Process Evaluation Results

Key process evaluation results include the following:

- **Survey respondents are satisfied with Pacific Power as their electricity provider.** The large majority of survey respondents reported being either very satisfied or satisfied with Pacific Power (PP) as their electricity service provider, with approximately 78% of General Population Survey respondents, 81% of Energy Kits Survey respondents and 92% of HVAC Survey respondents reporting that they were either very satisfied or satisfied.
- **Program participants are satisfied with Pacific Power’s Home Energy Savings Program.** Approximately 78% of Energy Kit Survey respondents and 89% of HVAC Survey respondents reported being either satisfied or very satisfied with the Home Energy Savings program overall.

- **Website and bill inserts were the top ways participants learned of Pacific Power energy kits.** Program participant survey respondents that received energy kits most commonly reported learning about the energy kits through the Pacific Power website (46%) or bill inserts (28%).
- **Pacific Power representatives or friends, neighbors, relatives or colleagues were the top ways participants learned of Pacific Power incentives for HVAC equipment.** Program participant survey respondents that received incentives for HVAC equipment most commonly reported learning about the HVAC incentives through Pacific Power representatives (27%) or friends, neighbors, relatives or colleagues (20%).
- **Energy efficiency, price and lifetime of bulbs were important to customers when purchasing light bulbs.** General population survey respondents reported that the most important characteristics considered when purchasing light bulbs were energy efficiency (74%), price (62%), and length of the bulb's life (58%).
- **Saving money on utility bills was most important to participants receiving energy kits.** Almost 60% of Energy Kits Survey respondents reported that "saving money on utility bills" was the most important reason for requesting an energy kit and 37% reported this as the second most important reason. Additionally, 21% of survey respondents reported that "concern for the environment" was the most important reason for requesting an energy kit and 22% reported this as the second most important reason.
- **HVAC incentives were important drivers of participants' decisions to install duct sealing and insulation and ductless heat pumps.** HVAC Survey respondents reported that the HVAC incentive was important or extremely important in driving their decision to install duct sealing and insulation 94% of the time and 74% of the time for ductless heat pumps.

### **1.1.3 Cost-Effectiveness Results**

The Washington Home Energy Savings Program was cost-effective during the 2017-2018 evaluation period, across all cost-effectiveness tests except for the Ratepayer Impact Measure (RIM) test. Table 1-4 below shows the results for the overall program for the combination of program years 2017 and 2018 without Net Energy Impacts (NEIs) and Table 1-5 shows the results with NEIs, based on the Washington standard net-to-gross (NTG) ratio of 1.

*Table 1-4: 2017-2018 Washington Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
PacifiCorp Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0702	\$7,437,941	\$7,315,687	-\$122,254	0.98
Total Resource Cost Test (TRC) No Adder	\$0.0702	\$7,437,941	\$6,650,625	-\$787,316	0.89
Utility Cost Test (UCT)	\$0.0429	\$4,545,475	\$6,650,625	\$2,105,150	1.46
Rate Impact Test (RIM)		\$14,683,301	\$6,650,625	-\$8,032,676	0.45
Participant Cost Test (PCT)		\$5,500,767	\$12,746,127	\$7,245,360	2.32
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000065915
Discounted Participant Payback (years)					2.86

*Table 1-5: 2017-2018 Washington Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
PacifiCorp Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0702	\$7,437,941	\$12,383,868	\$4,945,927	1.66
Total Resource Cost Test (TRC) No Adder	\$0.0702	\$7,437,941	\$11,718,805	\$4,280,864	1.58
Utility Cost Test (UCT)	\$0.0429	\$4,545,475	\$6,650,625	\$2,105,150	1.46
Rate Impact Test (RIM)		\$14,683,301	\$6,650,625	-\$8,032,676	0.45
Participant Cost Test (PCT)		\$5,500,767	\$17,814,307	\$12,313,541	3.24
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000065915
Discounted Participant Payback (years)					2.86

Table 1-6 (without NEIs) and Table 1-7 (including NEIs) below show the Washington Home Energy Savings Program cost effectiveness results for 2017 and Table 1-8 and Table 1-9 show cost-effectiveness results for 2018, based on the Washington standard NTG ratio of 1. The 2017 program passes the cost-effectiveness for all tests except the RIM test. The 2018 program passes the cost-effectiveness for the Utility Cost Test (UCT) and Participant Cost Test (PCT).

*Table 1-6: 2017 Washington Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0631	\$3,968,232	\$5,345,979	\$1,377,747	1.35
Total Resource Cost Test (TRC) No Adder	\$0.0631	\$3,968,232	\$4,859,981	\$891,749	1.22
Utility Cost Test (UCT)	\$0.0396	\$2,490,647	\$4,859,981	\$2,369,334	1.95
Rate Impact Test (RIM)		\$8,598,382	\$4,859,981	-\$3,738,401	0.57
Participant Cost Test (PCT)		\$2,934,176	\$7,564,326	\$4,630,150	2.58
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061621				
Discounted Participant Payback (years)	2.56				

*Table 1-7: 2017 Washington Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0631	\$3,968,232	\$8,197,468	\$4,229,236	2.07
Total Resource Cost Test (TRC) No Adder	\$0.0631	\$3,968,232	\$7,711,470	\$3,743,238	1.94
Utility Cost Test (UCT)	\$0.0396	\$2,490,647	\$4,859,981	\$2,369,334	1.95
Rate Impact Test (RIM)		\$8,598,382	\$4,859,981	-\$3,738,401	0.57
Participant Cost Test (PCT)		\$2,934,176	\$10,415,815	\$7,481,639	3.55
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061621				
Discounted Participant Payback (years)	2.56				

*Table 1-8: 2018 Washington Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0805	\$3,469,709	\$1,969,709	-\$1,500,001	0.57
Total Resource Cost Test (TRC) No Adder	\$0.0805	\$3,469,709	\$1,790,644	-\$1,679,065	0.52
Utility Cost Test (UCT)	\$0.0477	\$2,054,828	\$1,790,644	-\$264,184	0.87
Rate Impact Test (RIM)		\$6,084,920	\$1,790,644	-\$4,294,275	0.29
Participant Cost Test (PCT)		\$2,566,591	\$5,181,801	\$2,615,210	2.02
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000070172				
Discounted Participant Payback (years)	3.25				

Table 1-9: 2018 Washington Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0805	\$3,469,709	\$4,186,400	\$716,691	1.21
Total Resource Cost Test (TRC) No Adder	\$0.0805	\$3,469,709	\$4,007,335	\$537,626	1.15
Utility Cost Test (UCT)	\$0.0477	\$2,054,828	\$1,790,644	-\$264,184	0.87
Rate Impact Test (RIM)		\$6,084,920	\$1,790,644	-\$4,294,275	0.29
Participant Cost Test (PCT)		\$2,566,591	\$7,398,492	\$4,831,901	2.88
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000070172
Discounted Participant Payback (years)					3.25

## 1.2 Conclusions and Recommendations

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

- **Lighting Measure Category:**

Conclusion #1: ADM’s calculation of a 6% leakage rate for lighting in Washington is on the low end of leakage rates for lighting and is likely due to the relatively large and connected Pacific Power territory in Washington and the effective or strategic placement of participating retailer locations. The implementation contractor has indicated that the Retail Sales Allocation Tool (RSAT) may be a predictor of bulb leakage in Pacific Power territories and is used to determine allocations of bulbs to participating stores.

Recommendation #1: To understand further how the RSAT tool accounts for leakage and how the store allocations relate to the Program Tracking Data, ADM recommends that the next evaluation of subsequent program years includes a full life-cycle review of the lighting contracts, including the participation agreements with the implementation contractor and a sample of all associated invoices. This would allow the evaluation to follow the life-cycle of the bulbs from the original agreement to final installation.

Conclusion #2: The hours of use (HOU), installation rate (ISR), interactive effects factor (IEF) and baseline and efficient wattage inputs to the lighting savings engineering calculation are not specified in the Technical Resource Library (TRL) files. Instead, the TRL files point to the Regional Technical Forum (RTF) source files that include these inputs.

Recommendation #2: The TRL files should specify the inputs to the lighting savings engineering calculation. This would increase the efficiency of the impact evaluation process and would be consistent with other PacifiCorp states' TRL files.

- **Energy Kits Measure Category:**

Conclusion: The showerhead energy kits component had the lowest overall ISR of all energy kit components. This was driven by a 50% ISR for the second showerhead in the Best Kit – 2 Bathroom Energy Kits compared to a 70% ISR for the first showerhead.

Recommendation: ADM recommends that Pacific Power consider including only one showerhead in the Best Kit – 2 Bathroom Energy Kits, which could increase the overall ISR for showerheads.

- **HVAC Measure Category:**

HVAC Conclusion: The heat pump HVAC measures accounted for approximately 18% of overall claimed savings in 2017-2018. Through a billing analysis, ADM estimated a net realization rate of approximately 74% for the heat pump measure category across both program years 2017 and 2018. The use of wood as a supplemental heating source was not considered in ADM's analysis and could impact the baseline conditions in the claimed savings values for the heat pump measures.

HVAC Recommendation: In the next evaluation cycle, primary data should be collected regarding the use of wood as a supplemental heating source.

- **Whole Homes Measure Category:**

Conclusion: The whole homes measure category accounted for approximately 1% of overall claimed savings in 2017-2018. ADM conducted a deemed savings review for this measure category and verified the proper application of the TRL values for the whole homes measures. Some site-specific UES values for whole homes measures were on the upper end of the range of savings values that ADM would expect.

Recommendation: If the whole homes measure category is expected to grow in subsequent program years, ADM will request the REM/Rate™ modeling files to further verify savings.

## 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 ex-post verified energy (kWh) savings that are achieved through PacifiCorp's 2017-2018 Home Energy Savings Program in the states of California and Washington; and wattsmart Homes Program in Idaho, Utah and Wyoming.

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

### 2.1 Description of the Programs

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The Program in the state of Washington provides incentives for Pacific Power residential customers who purchase various eligible products or measures. Measures include energy-efficient appliances, lighting such as ENERGY STAR® light emitting diodes (LEDs), building shell measures, energy kits, heating, ventilation, and air conditioning (HVAC) equipment, heat pump water heaters and whole homes measures.

The Program is promoted by Pacific Power's marketing team and cross-promoted with participating retailers and trade allies. There is also significant effort to provide information and educational opportunities to customers and participating market partners. The Program leverages relationships with manufacturers, distributors, and retailers to ensure effective program implementation and optimize participation.

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

effective means to provide consumers instant incentives for relatively high-volume, low-cost measures such as LEDs.

A typical midstream incentive or ‘midstream distribution method’ is a point-of-sale incentive provided through an equipment distributor, such as an HVAC equipment incentive funded at the HVAC distributor, who subsequently discounts energy-efficient equipment prices to reflect the program incentive.

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

## **2.2 Distribution Methods and Measure Categories**

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

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

Measure Category and Measure Type	Distribution Method	
	Upstream or Midstream	Downstream
<b>Appliances</b>		
Clothes Dryers		Yes
Clothes Washers		Yes
<b>Building Shell</b>		
Air Sealing		Yes
Insulation		Yes
Windows		Yes
<b>Electronics</b>		
Advanced Power Strips		Yes
<b>Energy Kits</b>		
Lighting		Yes
Lighting and Plumbing		Yes
<b>HVAC</b>		
Cooling		Yes
Ducting		Yes
Heat Pump		Yes
Smart Thermostat		Yes
<b>Lighting</b>		
General Service Fixtures	Yes	
General Service Lamps	Yes	
Specialty Lamps	Yes	
<b>Water Heating</b>		

Measure Category and Measure Type	Distribution Method	
	Upstream or Midstream	Downstream
Heat Pump Water Heater		Yes
<b>Whole Homes</b>		
Whole Home		Yes

### 2.3 Program Participation

During the 2017-2018 program years, Pacific Power provided incentives to residential customers that resulted in the quantity of measures shown in Table 2-2 and Table 2-3. Pacific Power also provided upstream discounts for 28,160 lighting fixtures and 331,798 lighting bulbs in 2017 and 7,646 lighting fixtures and 234,755 lighting bulbs in 2018. Table 2-2 and Table 2-3 also show the associated claimed savings for each measure during 2017 and 2018.

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

Measure Category	Measure Type	Claimed Quantity	Quantity Type	Claimed kWh Savings
Appliances	Clothes Dryers	1	Measures	228
	Clothes Washers	161	Measures	20,385
Building Shell	Air Sealing	3,268	Square Feet	295
	Insulation	137,854	Square Feet	61,475
	Windows	12,715	Square Feet	12,287
Energy Kits	Lighting	395	Kits	24,980
	Lighting and Plumbing	1,562	Kits	630,974
HVAC	Cooling	39	Measures	14,166
	Ducting	839	Measures	795,232
	Heat Pump	436	Measures	1,202,397
	Smart Thermostat	40	Measures	25,120
Lighting	General Service Fixtures	28,160	Fixtures	445,210
	General Service Lamps	248,508	Bulbs	3,790,317
	Specialty Lamps	83,290	Bulbs	1,105,375
Water Heating	Water Heater	58	Measures	90,640
Whole Homes	Whole Homes	21	Measures	70,180
<b>2017 TOTAL</b>				<b>8,289,259</b>

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

Measure Category	Measure Type	Claimed Quantity	Quantity Type	Claimed kWh Savings
Appliances	Clothes Washers	108	Measures	15,244
Building Shell	Air Sealing	1,388	Square Feet	83
	Insulation	145,558	Square Feet	52,242
	Windows	605	Square Feet	303
Electronics	Advanced Power Strips	3	Measures	630
Energy Kits	Lighting	463	Kits	23,641
	Lighting and Plumbing	2,442	Kits	1,062,308
HVAC	Cooling	43	Measures	19,200
	Ducting	515	Measures	447,136
	Heat Pump	424	Measures	1,451,627
	Smart Thermostat	55	Measures	31,048
Lighting	General Service Fixtures	7,646	Fixtures	168,300
	General Service Lamps	184,308	Bulbs	2,059,591
	Specialty Lamps	50,447	Bulbs	993,083
Water Heating	Water Heater	33	Measures	54,358
Whole Homes	Whole Homes	33	Measures	110,592
<b>2018 TOTAL</b>				<b>6,489,387</b>

## 2.4 Impact Evaluation Objectives

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

- Review and reconcile program tracking data to the claimed participation counts and ex-ante savings in the 2017 and 2018 annual reports.
- Administer participant surveys to determine actual installation rates at the measure level. Surveys were administered online-only in Washington.
- Determine gross unit energy savings (“UES”), which incorporate verified measure installation rates and employ engineering analyses for lighting and energy kits; or employ billing analysis (regression analysis) for some HVAC measures; or employ deemed savings review for appliances, electronics, some HVAC, building shell, and whole homes measures.
- For determining net energy savings and calculating cost-effectiveness, Washington standards utilize a NTG value of 1.0. In an effort to provide information that can be used for comparison and further program evaluation purposes, ADM also calculated evaluated net savings in Washington. ADM determined net savings by applying survey results for the upstream lighting and energy kits measure categories. Note that no net savings adjustments are needed for the HVAC

measures for which billing analyses are utilized to determine ex-post verified savings.

- Net-to-gross and realization values used to determine net savings by measure category and program level.
- Achieve a minimum precision of  $\pm 10\%$  with 90% statistical confidence (“90/10 precision”) for gross realized savings estimates by program.
- Provide comprehensive documentation and transparency for all evaluation tasks.
- Estimate leakage impacts utilizing geospatial analysis (i.e., ArcGIS or similar).
- Provide inputs for cost benefit analyses.
- Provide ongoing technical reviews and guidance throughout the evaluation cycle.
- There was no on-site verification or equipment monitoring.

## **2.5 Process Evaluation Objectives**

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The overarching approach to process evaluation is the following.

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

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

- How well did Pacific Power staff, implementation staff, participants, and trade allies work together?
- How do participants learn about the program? What percentage is contacted directly by Pacific Power or implementation staff? What percentage hears about the program through another avenue and then contacts Pacific Power?
- Were program participants satisfied with their experiences? What was the level of satisfaction with the work performed, the scheduling/application process, and other aspects of program participation? What are the perceived energy and non-energy benefits associated with the program?
- What are key barriers and drivers to program success within Pacific Power’s service territories? How can those be addressed to improve program operations in the future

### 3 Impact Evaluation

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

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

Year	Measure Category	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	NTG
2017-2018	Appliances	Clothes Dryers	228	228	100%	180	79%
		Clothes Washers	35,629	35,629	100%	28,547	80%
	Building Shell	Air Sealing	378	378	100%	301	80%
		Insulation	113,717	113,717	100%	91,211	80%
		Windows	12,590	12,590	100%	9,948	79%
	Electronics	Advanced Power Strips	630	630	100%	515	82%
	Energy Kits	LED Only	48,621	34,703	71%	32,929	95%
		Best Kit - 1 Bathroom	438,130	472,720	108%	448,564	95%
		Best Kit - 2 Bathroom	1,255,152	1,340,583	107%	1,272,079	95%
	HVAC	Cooling	33,366	33,366	100%	26,869	81%
		Ducting	1,242,367	1,139,996	92%	1,139,996	100%
		Heat Pump	2,654,024	1,957,949	74%	1,957,949	100%
		Smart Thermostat	56,168	56,168	100%	45,195	80%
	Lighting	General Service Fixtures	613,510	504,326	82%	468,922	93%
		General Service Lamps	5,849,907	3,753,723	64%	2,780,007	74%
		Specialty Lamps	2,098,458	1,837,273	88%	1,360,684	74%
	Water Heating	Water Heater	144,998	144,998	100%	115,964	80%
	Whole Homes	Whole Home	180,772	180,772	100%	145,750	81%
	<b>2017-2018 Total</b>			<b>14,778,646</b>	<b>11,619,747</b>	<b>79%</b>	<b>9,925,609</b>

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

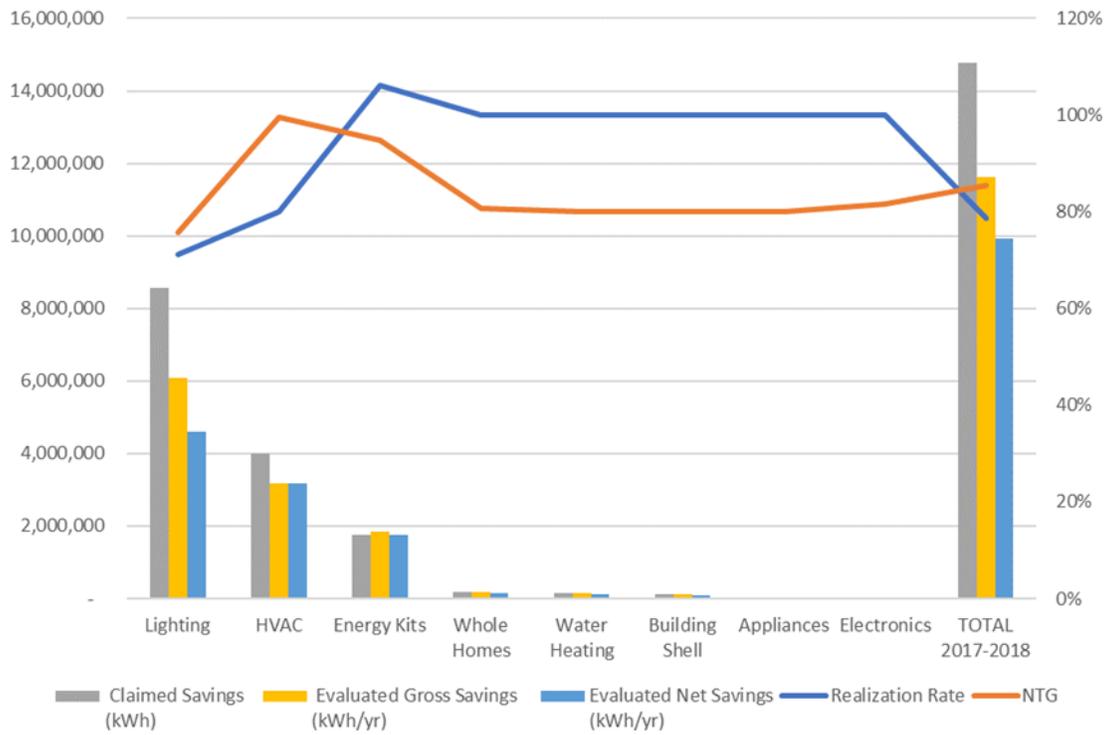


Table 3-2: Washington Home Energy Savings Program Claimed and Evaluated Savings for 2017 and 2018

Year	Measure Category	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	NTG
2017	Appliances	Clothes Dryers	228	228	100%	180	79%
		Clothes Washers	20,385	20,385	100%	16,093	79%
	Building Shell	Air Sealing	295	295	100%	233	79%
		Insulation	61,475	61,475	100%	48,533	79%
		Windows	12,287	12,287	100%	9,700	79%
	Electronics	Advanced Power Strips	-	-	-	-	-
	Energy Kits	LED Only	24,980	16,740	67%	15,885	95%
		Best Kit - 1 Bathroom	137,734	163,134	118%	154,798	95%
		Best Kit - 2 Bathroom	493,240	560,296	114%	531,665	95%
	HVAC	Cooling	14,166	14,166	100%	11,184	79%
		Ducting	795,232	729,705	92%	729,705	100%
		Heat Pump	1,202,397	885,619	74%	885,619	100%
		Smart Thermostat	25,120	25,120	100%	19,832	79%
	Lighting	General Service Fixtures	445,210	369,938	83%	343,968	93%
		General Service Lamps	3,790,317	2,290,285	60%	1,696,185	74%
		Specialty Lamps	1,105,375	1,186,211	107%	878,508	74%
	Water Heating	Water Heater	90,640	90,640	100%	71,558	79%
Whole Homes	Whole Home	70,180	70,180	100%	55,405	79%	
<b>2017 Total</b>			<b>8,289,259</b>	<b>6,496,704</b>	<b>78%</b>	<b>5,469,051</b>	<b>84%</b>
2018	Appliances	Clothes Dryers	-	-	-	-	-
		Clothes Washers	15,244	15,244	100%	12,453	82%
	Building Shell	Air Sealing	83	83	100%	68	82%
		Insulation	52,242	52,242	100%	42,678	82%
		Windows	303	303	100%	248	82%
	Electronics	Advanced Power Strips	630	630	100%	515	82%
	Energy Kits	LED Only	23,641	17,962	76%	17,045	95%
		Best Kit - 1 Bathroom	300,396	309,586	103%	293,766	95%
		Best Kit - 2 Bathroom	761,911	780,287	102%	740,414	95%
	HVAC	Cooling	19,200	19,200	100%	15,685	82%
		Ducting	447,136	410,292	92%	410,292	100%
		Heat Pump	1,451,627	1,072,330	74%	1,072,330	100%
		Smart Thermostat	31,048	31,048	100%	25,364	82%
	Lighting	General Service Fixtures	168,300	134,388	80%	124,954	93%
		General Service Lamps	2,059,591	1,463,437	71%	1,083,822	74%
		Specialty Lamps	993,083	651,061	66%	482,176	74%
	Water Heating	Water Heater	54,358	54,358	100%	44,406	82%
Whole Homes	Whole Home	110,592	110,592	100%	90,345	82%	
<b>2018 Total</b>			<b>6,489,387</b>	<b>5,123,043</b>	<b>79%</b>	<b>4,456,558</b>	<b>87%</b>

### **3.1 Impact Evaluation Approach**

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#### **3.1.1 Data Collection and Measure Verification**

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

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

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

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

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

### **3.1.2 Sample Design**

A representative participant sample was developed for each of the following measure categories in Washington: appliances, energy kits, HVAC, and lighting. ADM achieved a sampling precision of  $\pm 10\%$  with 90% statistical confidence – or “90/10 precision” – for gross realized savings estimates at the measure category level for all significant measures. (Notably, 90/10 precision can be difficult to achieve for a very small population of participants for a given measure category.)

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

For upstream measure categories, including lighting measures – for which participants are not known – the Washington sampling frame is the population of Pacific Power residential customers excluding these residential customers: known participants in 2017-2018 Programs and known participants in other energy efficiency programs that Pacific Power is implementing in 2017 or 2018.

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

- Census review for all measures listed in the DSMC program tracking database to ensure appropriate use of deemed savings values (described in detail above).
- Review of a stratified sample of 51 lighting invoices associated with upstream lighting measures. The sampling precision was 8.58% at the 90% confidence interval.
- A sample of known program participants were surveyed for measure installation rates, net-to-gross (NTG) analyses, and process evaluation questions regarding the specific measures they implemented according to DSMC datasets. A sample of all other residential customers was surveyed using a general population survey. Survey sample sizes per measure category are provided in the following Table 3-3.

Table 3-3: Impact Evaluation Survey Sample Size

Survey	Number of Survey Invites Sent	Number of Completed Surveys	Response Rate	Impact Evaluation Survey Sample (n)
General Population Survey	2,400	401	17%	293
Energy Kits Survey	1,258	82	7%	74
HVAC Survey	272	69	25%	69

### 3.1.3 Impact Evaluation Approach by Measure Category

Table 3-4 shows the methodology approach for each gross and net savings evaluation step for each measure. For the measure types with no adjustment made to the gross evaluated savings, ADM performed a review of the deemed savings values, savings assumptions and calculations, modeling files, and other information contained in the applicable TRL files, Regional Technical Forum (RTF) files and other sources of savings values. Through this review, ADM did not find any reasons to adjust the claimed savings for these measures. For the measures in which ADM did not have a NTG value resulting from participant surveys or did not have net savings results from a billing analysis, ADM applied the program level NTG values for each year. The program level NTG values are representative of approximately 70% of overall claimed program savings and thus are used as an approximation for a value for the measures that did not have a unique NTG value. This approach results in a more conservative net evaluated savings value than using an assumed NTG value of 1. The program level NTG values applied to these measures do not include the measures for which ADM conducted a billing analysis. Additionally, for measures in which ADM conducted a billing analysis, the evaluated results are net results. Thus, there was no additional NTG value applied to the evaluated savings for those measures.

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

Measure Category	Measure Type	Impact Evaluation Methodologies	Inputs to Gross Evaluated Savings	Inputs to Evaluated NTG
Appliances	Clothes Dryer and Clothes Washer	Deemed Savings Review	No adjustment	Program-level NTG
Building Shell	Air Sealing and Insulation	Deemed Savings Review	No adjustment	Program-level NTG
	Windows	Deemed Savings Review	No adjustment	Program-level NTG
Electronics	Advanced Power Strips	Deemed Savings Review / Literature Review	No adjustment	Program-level NTG
Energy Kits	Lighting, and Lighting and Plumbing	Engineering Analysis / Energy Kits Survey	Energy Kits Survey	Energy Kits Survey
HVAC	Cooling	Deemed Savings Review	No adjustment	Program-level NTG
	Ducting	Billing Analysis	Billing Analysis	N/A
	Heat Pump	Billing Analysis	Billing Analysis	N/A
	Smart Thermostat	Deemed Savings Review	No adjustment	Program-level NTG
Lighting	General Service Lamps and Fixtures	Engineering Analysis / General Population Survey	General Population Survey	General Population Survey

Measure Category	Measure Type	Impact Evaluation Methodologies	Inputs to Gross Evaluated Savings	Inputs to Evaluated NTG
	Specialty Lamps	Engineering Analysis / General Population Survey	General Population Survey	General Population Survey
Water Heating	Water Heater	Deemed Savings Review	No adjustment	Program-level NTG
Whole Homes	Whole Homes	Desk review of savings/modeling files	No adjustment	Program-level NTG

### 3.2 Evaluated Savings

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

ADM’s estimation of verified UES per measure takes into consideration Washington’s deemed savings values and the measure savings assumptions and calculations contained in the provided TRL files. Washington deemed savings values refer to the Regional Technical Forum (RTF), which maintains a library of UES measures. Although ADM completed and presents in this report an evaluation of net savings for the Program in Washington, the net results are not employed in the overall program cost-effectiveness calculations. Using Washington evaluation standards, the cost-effectiveness of programs in Washington are evaluated using a NTG value of 1. Additionally, for comparison purposes, ADM does include a section on cost-effectiveness using the evaluated net savings results in the Cost Effectiveness Chapter 5.

#### 3.2.1 Lighting

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

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

Measure Category	Measure Type	2017 Quantity	2017 Savings (kWh)	2018 Quantity	2018 Savings (kWh)
Lighting	General Service Fixtures	28,160	445,210	7,646	168,300
	General Service Lamps	248,508	3,790,317	184,308	2,059,591
	Specialty Lamps	83,290	1,105,375	50,447	993,083
<b>TOTAL</b>		<b>359,958</b>	<b>5,340,901</b>	<b>242,401</b>	<b>3,220,974</b>

### 3.2.1.1 Database Review

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

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

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

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

ADM reviewed each of the four individual lighting lamp measures for 2017 and 12 individual lighting lamp measures for 2018, including both general service lamps and specialty lamps. ADM verified for all lighting measures that the claimed savings per measure and the savings assumptions and calculations were supported by the applicable TRL and RTF documents. The TRL values for lighting measures in Washington were based off of the RTF file ResLighting\_Bulbs\_v.4.0 in 2017 and the RTF file ResLighting\_v5.2 in 2018. Using the deemed values in conjunction with the total number of measures incentivized as provided in the program tracking database results in the claimed program energy savings.

#### 3.2.1.1.2 General Service Fixtures

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

- Verification of measure incentive requirements (e.g. ENERGY STAR® qualified status)

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

ADM reviewed the one individual lighting fixture measure for 2017 and 14 individual lighting fixture measures for 2018. ADM verified for all general service fixtures that the claimed savings per measure and the savings assumptions and calculations were supported by the applicable TRL and RTF documents. Using the deemed values in conjunction with the total number of measures incentivized as provided in the program tracking database results in the claimed program energy savings.

### *3.2.1.2 Verified Inputs to Savings Calculation*

ADM acquired information from the General Population survey in order to calculate an ex-post installation rate (ISR) factor and hours-of-use (HOU) value to generate the evaluated gross lighting program energy savings for both lamps and fixtures. The resulting ISR factor of 87.2% for lamps and 91.6% for fixtures and the daily HOU value of 1.82 for lamps and 1.80 for fixtures are shown in Table 3-6 below. The HOU values are based on results derived from the General Population survey regarding installation percentage by room type and HOU values by room type contained in a KEMA Study on Residential Lighting End-Use Consumption.<sup>1</sup> Because ADM collected installation percentages by room type through the General Population survey, a study that includes HOU values by room type is appropriate to use in this case. Additionally, this is the most recent lighting study of its magnitude. The overall HOU values in the study are within the range of other HOU values and studies reviewed by ADM.

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

<b>Measure Type</b>	<b>Evaluated ISR</b>	<b>Evaluated Daily HOU</b>
Lamps	87.2%	1.82
Fixtures	91.6%	1.80

ADM also determined the fraction of lighting measures that are installed in commercial premises or other non-residential premises (e.g., small medical or dental offices or schools, houses of worship, etc.). Although the Programs are designed to encourage residential customers to purchase discounted LEDs in participating retail outlets, a

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

fraction of residential customers may purchase an additional quantity for a small office or school or various non-residential premises. The fraction of upstream lighting measures installed in non-residential premises is also called “cross-sector sales.” ADM determined the fraction of cross-sector sales in Washington in the 2017-2018 Programs as 2.3% for lamps and 2.3% for fixtures.

### 3.2.1.3 Leakage Analysis

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

*Table 3-7: Participating Washington Stores by Channel*

<b>Retail Channel</b>	<b>Number of Stores</b>
Discount	12
DIY	11
Mass Merchant	8
<b>TOTAL</b>	<b>31</b>

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

- First, ADM developed a mapping of concentric circles (drive times) surrounding each participating retailer. The initial modeling assumed the “reach” of a retailer is a 60-minute drive. If drive times overlap between one or more retailer locations, the drive times are split between the stores with the assumption that customers will drive to the nearest store.
- Second, ADM used 2010 Census block data from Environmental System Research Institute (ESRI) to determine the proportion of the population that falls within each drive time circle (from Step 1), as well as the proportion of the population that falls within the Pacific Power territory and within the state of the participating retailer. Thus, for each drive time circle for each retail location, the Evaluators determined the proportion of the population within the Pacific Power territory and within state, outside of Pacific Power territory and within state, and outside of the state of the participating retailer. ADM utilized a shapefile (a format commonly used in GIS that geographically displays the underlying tabular data)

showing the service areas of Pacific Power in the analyzed states from Platts/McGraw-Hill.<sup>2</sup>

- Third, ADM used an online survey to assess the shopping habits of customers within the radius of participating retailers. This was used to assess the total and maximum drive time that consumers accepted when shopping for products incentivized by the retail channel. This was used in modifying the initial 60-minute drive assumption established in Step 1. An online survey was performed for Pacific Power in 2019 and the results of this survey are shown in Table 3-8. This approach uses a log transformation of the drive times to smooth the data and estimates the cumulative percent via a second order polynomial regression. The log transformation takes the log of the drive time and uses that as the independent variable in the regression. A log transformation is common when the relationship between the variables is logarithmic and linear regression is being used, since linear regression assumes the data are linearly related.
- Lastly, ADM calculated the percentage of bulbs that leaked out of Pacific Power territory (but still within state) and the percent of bulbs that leaked out of state.

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

Channel/ Drive time (minutes)	0-4	5-9	10-14	15-19	20-24	25-29	30-39	40-49	50-59	60+	N
DIY	1%	13%	18%	27%	16%	5%	13%	5%	2%	1%	199
Discount	5%	24%	23%	17%	15%	3%	8%	4%	1%	1%	190
Mass Merchant	2%	17%	26%	17%	18%	4%	9%	6%	1%	1%	198
<b>TOTAL</b>	<b>3%</b>	<b>18%</b>	<b>22%</b>	<b>20%</b>	<b>16%</b>	<b>4%</b>	<b>10%</b>	<b>5%</b>	<b>1%</b>	<b>1%</b>	<b>199</b>

Table 3-9 shows the leakage estimate of 6% for Washington overall across all retailer channels and Table 3-10 provides leakage estimates by retail channel.

Table 3-9: Leakage Estimate in Washington

Quantity Sold	Leakage Quantity	Leakage Rate
229,238	13,824	6.0%

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

Retailer Type	Quantity Sold	Leakage Quantity	Leakage Rate
Discount	3,161	456	14.4%
DIY	64,800	2,645	4.1%
Mass Merchant	161,277	10,722	6.6%
<b>TOTAL</b>	<b>229,238</b>	<b>13,824</b>	<b>6.0%</b>

<sup>2</sup> Source: [http://www.platts.com/IM.Platts.Content/ProductsServices/Products/gismetadata/iou\\_terr.pdf](http://www.platts.com/IM.Platts.Content/ProductsServices/Products/gismetadata/iou_terr.pdf).

Table 3-11 provides a benchmark comparison of the estimated Washington leakage rates with other leakage estimates for utilities ADM has evaluated in the past couple of years. The leakage estimates for these other states vary from a low of 10% overall leakage for OG&E Arkansas to a high of 50% for SWEPCO Arkansas. Pacific Power’s leakage rate of 6% in Washington is on the low end and is due to the relatively large and connected Pacific Power territory and effective or strategic placement of participating retailer locations.

*Table 3-11: Leakage Benchmarking*

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

### 3.2.1.4 Gross Energy Savings

#### 3.2.1.4.1 Engineering Calculation for Lighting Measure

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

#### *Formula 3.1 Energy Savings for LEDs*

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

Where:

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

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

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

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

Source of deemed values in Washington are the RTF files.

Example Calculation for Lighting Measure:

The following is an example of an LED ceiling and wall flush mount fixture with a lumen range of 1000 to 1999. The TRL source document for this measure indicates a UES of 18.52 kWh/yr and is based off the RTF file ResLighting\_v5.2. The RTF file specifies an hours of use value of 1.92, an installation rate of 100%, and a heat exchange factor of 89%. Inserting these values into the equation above verifies the 18.52 kWh/yr savings. ADM verified the UES values for each individual lighting measure in 2017 and 2018.

*Example 3.1 Energy Savings for LEDs*

$$18.52 \text{ kWh} = \left( \frac{(44.9 - 15.4)}{1000} \right) * (1 - 0.0) * (1.92 * 365.25) * (1 - (-.11))$$

Using deemed UES values in conjunction with the total quantity of measures incentivized as provided in the program tracking database results in the ex-ante program energy savings. For this example of an LED ceiling and wall flush mount fixture with a lumen range of 1000 to 1999 measure, the program tracking data indicates that this measure was incentivized 2,937 times in 2018. This results in ex-ante energy savings of 54,393.24 kWh/Yr for 2018. Appendix Table 7-1 shows the input values and UES savings for sample of 2018 lighting measures.

3.2.1.4.2 Evaluated Gross Energy Savings for Lighting Measures

Table 3-12 below shows the claimed and evaluated gross savings by lighting measure category in addition to the realization rates. Appendix Table 7-2 and Table 7-3 provide the claimed and evaluated gross savings for each individual lighting measure in addition to the realization rates. The realization rates for general service lamps in 2017 and 2018 were driven by a lower evaluated ISR of 87.2% compared to the RTF ISR assumption of 98% and a lower evaluated daily HOU of 1.82 compared to a range of values in the RTF HOU assumptions. The realization rates for specialty lamps varied significantly from 2017 to 2018. This is due to the high occurrence in 2017 of the LED – Specialty (Decorative and Directional) individual measure which had a realization rate of 111% due to low HOU assumptions for this individual measure in the RTF. The realization rate for general service fixtures was driven by a lower evaluated ISR of 91.6% compared to the RTF ISR assumption of 100% and a lower evaluated daily HOU of 1.80 compared to a range of values in the RTF HOU assumptions.

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

Measure Category	Year	Measure Type	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
Lighting	2017	General Service Fixtures	445,210	369,938	83.1%
		General Service Lamps	3,790,317	2,290,285	60.4%
		Specialty Lamps	1,105,375	1,186,211	107.3%
	2018	General Service Fixtures	168,300	134,388	79.8%
		General Service Lamps	2,059,591	1,463,437	71.1%
		Specialty Lamps	993,083	651,061	65.6%
<b>2017-2018 TOTAL</b>			<b>8,561,875</b>	<b>6,095,321</b>	<b>71.2%</b>

### 3.2.1.5 Evaluated Net Energy Savings

#### 3.2.1.5.1 Free Ridership and Spillover Survey Results

ADM calculated freeridership and spillover from the General Population survey results to arrive at the net program energy savings and the overall net-to-gross ratio presented in this section. Table 3-13 shows the freeridership and spillover results for lighting measures in 2017 and 2018. Table 3-14 shows the net savings evaluation results, including the evaluated gross savings, evaluated net savings and the NTG for each lighting measure category in 2017 and 2018. The same information for each individual lighting measure in 2017 and 2018 is included in Appendix Table 7-4 and Table 7-5. The methodology for calculating NTG for Lighting measures is discussed in Appendix C. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

Table 3-13: 2017-2018 Lighting Freeridership and Spillover

Measure Type	Free Ridership	Spillover	NTG
Lamps	26.4%	0.5%	74.1%
Fixtures	7.5%	0.5%	93.0%

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

Measure Category	Year	Measure Type	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
Lighting	2017	General Service Fixtures	369,938	124,954	93.0%
		General Service Lamps	2,290,285	1,083,822	74.1%
		Specialty Lamps	1,186,211	482,176	74.1%
	2018	General Service Fixtures	134,388	343,968	93.0%
		General Service Lamps	1,463,437	1,696,185	74.1%
		Specialty Lamps	651,061	878,508	74.1%
<b>2017-2018 TOTAL</b>			<b>6,095,321</b>	<b>4,609,613</b>	<b>75.6%</b>

### 3.2.2 Energy Kits

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

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

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

Configuration	Measure	Quantity	2017 and 2018 (pre TRL change) Claimed Savings (kWh/yr) <sup>1</sup>	2018 (post TRL change) Claimed Savings (kWh/yr) <sup>1</sup>
LED Only	9.5 W LED A-Lamp	4	63.2	32.8
Best Kit - 1 Bathroom	9.5 W LED A-Lamp	4	271.1	393.4
	1.5GPM Aerator Kitchen	1		
	0.5GPM Aerator Bath	1		
	1.5GPM Showerhead	1		
Best Kit - 2 Bathroom	9.5 W LED A-Lamp	4	468.0	604.4
	1.5GPM Aerator Kitchen	1		
	0.5GPM Aerator Bath	2		
	1.5GPM Showerhead	2		

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

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

Kit Type	2017 Quantity	2017 Total Claimed Savings (kWh/yr)	2018 Quantity	2018 Total Claimed Savings (kWh/yr)
LED Only	395	24,980	463	23,641
Best Kit – 1 Bathroom	508	137,734	969	300,396
Best Kit – 2 Bathroom	1054	493,240	1473	761,911
<b>TOTAL</b>	<b>1,957</b>	<b>655,954</b>	<b>2,905</b>	<b>1,085,949</b>

### 3.2.2.1 Database Review

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

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

ADM reviewed each energy kit component in each energy kit measure. ADM verified that the Pacific Power claimed savings were based on the applicable source TRL documents. Using the UES values in the TRL documents in conjunction with the total number of measures incentivized as provided in the program tracking database results in the total claimed program energy savings shown in Table 3-16.

### 3.2.2.2 Verified Inputs to Savings Calculation

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

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

Energy Kit Component	Installation Rate
LED Lamps	92.3%
Showerheads	60.7%
Bathroom Aerator	66.7%
Kitchen Aerator	69.1%

### 3.2.2.3 Gross Energy Savings

#### 3.2.2.3.1 Engineering Calculation for Energy Kit Measures

Energy savings can be calculated for the individual components of each measure using engineering formulas, inputs from the TRL and RTF source documents and inputs gathered from primary surveying. LED annual energy (kWh) savings per lamp are calculated using the same formulas as provided above for lighting lamps and fixtures.

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

#### *Formula 3.4 Energy Savings for Aerators*

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

Where:

*ISR* = In-Service Rate determined from Energy Kits surveys

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

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

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

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

$\Delta T$  = Average temperature differential between hot and cold water (°F)

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

$U_E$  = Unit Conversion: 1 kWh/3413 BTU

$WH_E$  = Fraction of Homes with Electric Water Heaters

*Eff* = Efficiency of Electric Water Heater

*F/home* = Average number of faucets in the home

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

#### *Formula 3.5 Energy Savings for Showerheads*

$$\text{Savings (kWh)} = \text{ISR} \times [(\text{F}_B - \text{F}_P) \div \text{F}_B] \times \text{G}_{\text{Shower}} \times \text{N}_{\text{Persons}} \times 365 \times \Delta T \times U_H \times U_E \div \text{Eff} \div S$$

Where:

*ISR* = In-Service Rate determined from Energy Kits surveys

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

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

$G_{\text{Shower}}$  = Average gallons of hot water used per person per shower per day

$N_{\text{Persons}}$	= Average number of persons per household (state-specific values)
$\Delta T$	= Average temperature differential between hot and cold water ( $^{\circ}\text{F}$ )
$U_{\text{H}}$	= Unit Conversion: $8.33\text{BTU}/(\text{Gallons}\cdot^{\circ}\text{F})$
$U_{\text{E}}$	= Unit Conversion: $1\text{ kWh}/3413\text{ BTU}$
Eff	= Efficiency of Electric Water Heater
S	= Average number of showers in the home

**Example Ex-Ante Calculation for Energy Kits Measures:**

The following example demonstrates the energy savings calculations for aerators and showerheads in a 2018 (post-TRL change) 'Best Kit – 1 Bathroom' Energy Kit that includes four 9.5 W LED A-Lamps, one 1.5 GPM Kitchen Aerator, one 0.5 GPM Bathroom Aerator, and one 1.5 GPM Showerhead. ADM's calculations are based on inputs obtained from the applicable TRL and RTF source documents.

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

$$32.8\text{ kWh (per kit)} = 8.19\text{ kWh (per bulb)} * 4$$

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

$$151.46\text{ kWh (kitchen)} = 0.63 * (2.2 - 1.5) * 4.5 * 2.37 * 365.25 * (93 - 56.95) * 8.345 * \left(\frac{1}{3413.14}\right) * 0.98 \div 0.98 \div 1$$

and

$$41.99\text{ kWh (bathroom)} = 0.61 * (2.2 - 0.5) * 1.6 * 2.37 * 365.25 * (86 - 56.95) * 8.345 * \left(\frac{1}{3413.14}\right) * 0.98 \div 0.98 \div 2.43$$

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

$$171.6\text{ kWh} = 0.60 * [(2.3-1.35)/2.3] * 7.76 * 2.37 * 365.25 * (128 - 53) * 8.345 * \left(\frac{1}{3413.14}\right) \div 1 \div 1.78$$

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

$$397.85\text{ kWh} = 32.8 + 151.46 + 48.64 + 171.6$$

ADM's calculated ex-ante savings values for each individual energy kit component were not exactly matched to the deemed UES values found in the Energy Kits source TRL documents. For instance, ADM was not able to reverse engineer the values for kitchen and bathroom aerators contained in the TRL documents from the known input values in the TRL and source documents. ADM calculated 2018 values of 151.46 kWh/yr for kitchen aerators and 41.99 kWh/yr for bathroom aerators compared to the deemed 2018 UES values of 149.7 kWh/yr for kitchen aerators and 49.30 kWh/yr for bathroom aerators. The deemed UES values for these energy kit components are based on hardcoded

values in the implementation contractor's savings calculation that ADM was not able to trace back to its source, and thus was not able to determine with certainty what is driving the difference in savings values. The difference may be partially attributed to the water temperature differential utilized in the engineering calculation. For the example of the 2018 (post-TRL change) 'Best Kit – 1 Bathroom' Energy Kit calculated above, the ADM calculated ex-ante savings of 397.83 kWh/Yr does not exactly match the Energy Kits TRL UES value and the Pacific Power claimed savings value of 393.44 kWh/Yr. Appendix B include tables that list the TRL and RTF source documents used to calculate the evaluated savings for each individual component of the Energy Kits.

### 3.2.2.3.2 Evaluated Gross Energy Savings for Energy Kits Measures

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

The drivers of realization rates for the lighting Energy Kit component are the ISR and the HOU inputs. In 2017 and 2018 (pre-TRL change), both the evaluated ISR of 92% and the evaluated HOU of 1.8 for LED lamps are lower than the RTF inputs of 98% for ISR and approximately 2.5 for HOU, leading to a realization rate of 67%. In 2018 (post-TRL change), the realization rate for the LED lamp component of Energy Kits is 102%, driven by an evaluated ISR of 92% that compares to RTF inputs for ISR that include a 74% installation rate and 24% storage rate. For the showerheads Energy Kits component, the evaluated ISR of 61% drives the 95% realization rate in 2017 and 2018 (pre-TRL change) where the input ISR to the claimed savings value is 76%. The showerhead Energy Kit component realization rate in 2018 (post-TRL change) is slightly above 100% because the input ISR to the claimed savings value is 60%. For both the bathroom and kitchen aerator Energy Kits components, the respective evaluated ISRs of 67% and 69% do impact the realization rates slightly compared to the ISR inputs to the claimed savings values. However, the realization rates are most significantly driven by the difference in ex-ante calculated savings values. For instance, because the kitchen aerator had a claimed savings value of 11.05 kWh/yr in 2017 and 2018 (pre-TRL change) and a claimed savings value of 149.7 kWh./yr in 2018 (post-TRL change) the evaluated savings value of 48.64 kWh/yr across both years leads to different realization rates. While there is a range of realization rates across each Energy Kit component, the overall realization rate for Energy Kits in 2017 and 2018 is 106%.

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

Year <sup>1</sup>	Energy Kit Component	Claimed Gross Savings Per Unit (kWh)	Evaluated Gross Savings Per Unit (kWh)	Realization Rate
2017 and 2018 (pre TRL change)	LED Lamps	15.81	10.59	67.0%
	Showerheads	170.00	161.82	95.2%
	Bathroom Aerator	26.84	48.64	181.2%
	Kitchen Aerator	11.05	68.30	618.1%
2018 (post TRL change)	LED Lamps	8.19	8.35	102.0%
	Showerheads	161.68	161.82	100.1%
	Bathroom Aerator	49.30	48.64	98.7%
	Kitchen Aerator	149.70	68.30	45.6%

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

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

Year	Configuration	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	LED Only	24,980	16,740	67.0%
	Best Kit - 1 Bathroom	137,734	163,134	118.4%
	Best Kit - 2 Bathroom	493,240	560,296	113.6%
2018	LED Only	23,641	17,962	76.0%
	Best Kit - 1 Bathroom	300,396	309,586	103.1%
	Best Kit - 2 Bathroom	761,911	780,287	102.4%
<b>2017-2018 TOTAL</b>		<b>1,741,903</b>	<b>1,848,005</b>	<b>106.1%</b>

#### 3.2.2.4 Evaluated Net Energy Savings

ADM calculated freeridership and spillover from the Energy Kits survey results to arrive at the net program energy savings and the overall net-to-gross ratio presented in this section. Table 3-20 shows the freeridership, spillover and NTG results for Energy Kits measures and Table 3-21 shows the net savings evaluation results, including the evaluated gross savings, evaluated net savings and NTG for each Energy Kits configuration. The methodology for calculating NTG for Energy Kits measures is discussed in Appendix C. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

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

Measure Category	Free Ridership	Spillover	Non-Participant Spillover	NTG
Energy Kits	10.1%	4.5%	0.5%	94.9%

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

Year	Configuration	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	LED Only	16,740	15,885	94.9%
	Best Kit - 1 Bathroom	163,134	154,798	94.9%
	Best Kit - 2 Bathroom	560,296	531,665	94.9%
2018	LED Only	17,962	17,045	94.9%
	Best Kit - 1 Bathroom	309,586	293,766	94.9%
	Best Kit - 2 Bathroom	780,287	740,414	94.9%
<b>2017-2018 TOTAL</b>		<b>1,848,005</b>	<b>1,753,572</b>	<b>94.9%</b>

### 3.2.3 HVAC

The HVAC measure category included cooling, ducting, heat pump, and smart thermostat measures across the Program years 2017 and 2018. The following Table 3-22 shows the quantity of HVAC measures installed and the claimed savings attributed to each HVAC measure in 2017 and 2018. The ducting and heat pump measures accounted for 98% of total HVAC measure savings in 2017 and 97% of total HVAC measure savings in 2018.

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

Measure Type	2017 Quantity	2017 Claimed Savings (kWh)	2018 Quantity	2018 Claimed Savings (kWh)
Cooling	39	14,166	43	19,200
Ducting	839	795,232	515	447,136
Heat Pump	436	1,202,397	424	1,451,627
Smart Thermostat	40	25,120	55	31,048
<b>TOTAL</b>	<b>1,354</b>	<b>2,036,915</b>	<b>1,037</b>	<b>1,949,011</b>

#### 3.2.3.1 Database Review

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

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

ADM reviewed all 27 individual HVAC measures in 2017 and all 45 individual HVAC measures in 2018 and verified for all individual measures that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each of these measures accurately reflected the quantity of that measure installed in 2017 and 2018.

### *3.2.3.2 Verified Inputs to Savings Calculation*

ADM applied a 100% ISR for the HVAC measure categories for which a billing analysis was not completed, consistent with ISRs for other HVAC measures that ADM has evaluated in other jurisdictions. The ISR is accounted for in the billing analysis for ducting and heat pump HVAC measures.

### *3.2.3.3 Evaluated Gross and Net Energy Savings*

ADM conducted billing analyses to determine net energy savings associated with the two largest HVAC measure categories, ducting and heat pumps, representing approximately 98% of HVAC measure claimed savings. The billing analysis for HVAC measures included the following three steps and is discussed in more detail in Appendix D.

1. Data cleaning: Clean billing and Program Tracking Data to develop a streamlined, simple format for the analysis.
2. Incorporate weather data: Zip codes in the billing data were used to match line items with the nearest weather stations and an optimizing algorithm applied on integer sets of possible cooling degree day (CDD) and heating degree day (HDD) base conditions was used on the billing data and associated weather data.
3. Regression analysis: Control groups were developed using “Late Installs”, or program participants who had a measure installed too late (after June 1, 2018) to be considered in the regression analysis due to not yet having sufficient post period data for analysis. The June 1, 2018 date was selected based on a determination of acquiring a sufficient number of potential control group homes to be able to have a reasonably high probability of acquiring a representative control population. The size of the control groups and the treatment groups for each HVAC measure billing analysis is shown in Table 3-23.

*Table 3-23: Control Group and Treatment Group Size for HVAC Measure Billing Analyses*

<b>HVAC Billing Analysis Group</b>	<b>Control and Treatment Group Size</b>
Duct Sealing	236
Ductless Heat Pump	34
Heat Pump	90

Additionally, ADM acquired information from the HVAC survey in order to benchmark the billing analysis net evaluation results. ADM calculated freeridership and spillover from the HVAC survey results to arrive at the net-to-gross ratio presented in Table 3-24 below. The methodology for calculating NTG for HVAC measures is discussed in Appendix C. ADM used this calculated net-to-gross value as a benchmark for the billing analysis results. The net-to-gross value calculated from the HVAC survey shows a similar net evaluation result for duct sealing and a higher net evaluation results for ductless heat pumps and heat pumps. This was a useful benchmark to the billing analysis because approximately 95% of the HVAC survey respondents were either duct sealing or heat pump HVAC participants.

*Table 3-24: 2017-2018 Freeridership, Spillover and NTG for HVAC Measures*

Measure Category	Free Ridership	Spillover	Non-Participant Spillover	NTG
HVAC	6.9%	0.5%	0.5%	94.1%

For the cooling and smart thermostat measures, which represented less than 3% of 2017-2018 HVAC claimed savings and 0.6% of overall 2017-2018 program claimed savings, ADM performed a deemed savings review of the claimed gross savings and applied the yearly program level NTG values to estimate net savings. Table 3-25 below shows the evaluation results for HVAC measure in 2017 and 2018.

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

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings <sup>1</sup> (kWh/yr)	Realization Rate <sup>1</sup>	Evaluated Net Savings (kWh/yr)	NTG
2017	Cooling	19,200	19,200	100.0%	15,685	81.7%
	Ducting	447,136	410,292	91.8%	410,292	100.0%
	Heat Pump	1,451,627	1,072,330	73.9%	1,072,330	100.0%
	Smart Thermostat	31,048	31,048	100.0%	25,364	81.7%
2018	Cooling	14,166	14,166	100.0%	11,184	78.9%
	Ducting	795,232	729,705	91.8%	729,705	100.0%
	Heat Pump	1,202,397	885,619	73.7%	885,619	100.0%
	Smart Thermostat	25,120	25,120	100.0%	19,832	78.9%
<b>2017-2018 TOTAL</b>		<b>3,985,925</b>	<b>3,187,479</b>	<b>80.0%</b>	<b>3,170,009</b>	<b>99.5%</b>

<sup>1</sup> The evaluated savings and realization rates for HVAC measures evaluated through a billing analysis are net results.

### 3.2.3.3.1 Cooling

The cooling measure group did not have a sample size large enough to calculate savings through a billing analysis. Additionally, this measure group only represented approximately 0.23% of the overall program savings in 2017 and 2018. Therefore, ADM conducted a deemed savings review of the cooling measure claimed savings values, including the TRL files provided and the source savings documents. ADM concludes that

the UES values in the TRL are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values for cooling measures.

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 cooling measures and the 2018 program-level NTG value of 81.7% to 2018 cooling measures. The program-level NTG value applied to the cooling measures does not include measures that ADM evaluated through a billing analysis. Table 3-25 shows the realization rate and evaluated net savings for the cooling measures in 2017 and 2018.

#### 3.2.3.3.2 Ducting

Through a billing analysis of HVAC ducting measure program participants and a control group, ADM estimated average annual net savings of approximately 864 kWh per duct sealing measure. The evaluated average annual net savings of approximately 864 kWh per duct sealing measure represents a net realization rate of 92% of the claimed average annual savings of approximately 942 kWh per duct sealing measure that was evaluated in the billing analysis. Table 3-25 shows the net realization rate and evaluated savings for the ducting measures in 2017 and 2018.

#### 3.2.3.3.3 Heat Pump

Through a billing analysis of HVAC heat pump measure program participants and a control group, ADM estimated average annual net savings of approximately 1,819 kWh per ductless heat pump measure and 2,690 kWh per other heat pump measures. The evaluated average annual net savings of approximately 1,819 kWh per ductless heat pump measure represents a net realization rate of 79% of the claimed average annual savings of approximately 2,308 kWh per ductless heat pump measure that was evaluated in the billing analysis. The evaluated average annual net savings of approximately 2,690 kWh per other heat pump measure represents a net realization rate of 72% of the claimed average annual savings of approximately 3,716 kWh per other heat pump measure that was evaluated in the billing analysis. Table 3-25 shows the net realization rate and evaluated savings for the heat pump measures in 2017 and 2018.

The use of wood as a supplemental heating source was not considered in ADM's analysis and could impact the baseline conditions in the claimed savings values for the heat pump measures. In the next evaluation cycle, ADM recommends that primary data is collected regarding the use of wood as a supplemental heating source.

#### 3.2.3.3.4 Smart Thermostat

The smart thermostat measure group did not have a sample size large enough to calculate savings through a billing analysis. Additionally, this measure group only represented approximately 0.38% of the overall program savings in 2017 and 2018.

Therefore, ADM conducted a deemed savings review of the smart thermostat measure claimed savings values, including the TRL files provided and the source savings RTF file “ResConnectedTstats\_v1\_3\_4\_10\_18”. ADM concludes that the UES values in the TRL files are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values for smart thermostat measures.

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 smart thermostat measures and the 2018 program-level NTG value of 81.7% to 2018 smart thermostat measures. The program-level NTG value applied to the smart thermostat measures does not include measures that ADM evaluated through a billing analysis. Table 3-25 shows the realization rate and evaluated net savings for the smart thermostat measures in 2017 and 2018.

### **3.2.4 Whole Homes**

The following Table 3-26 shows the quantity of whole homes measures installed and the claimed savings in each year 2017 and 2018. The whole home measure category represented 1.2% of overall claimed program savings in 2017 and 2018.

*Table 3-26: 2017-2018 Whole Homes Quantities and Claimed Savings*

<b>Measure Category</b>	<b>Quantity</b>	<b>Claimed Savings (kWh)</b>
2017 Whole Homes	21	70,180
2018 Whole Homes	33	110,592
<b>2017-2018 TOTAL</b>	<b>54</b>	<b>180,772</b>

#### *3.2.4.1 Database Review*

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

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

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

### 3.2.4.2 Verified Inputs to Savings Calculation

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

### 3.2.4.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the whole homes measure claimed savings values, including the TRL files provided, the source savings documents indicated and any modeling files provided. ADM’s review included an analysis of the whole home performance and manufactured homes whole homes measures, which account for 75% of whole homes measure category savings in 2017 and 2018. For the whole homes whole home performance path measures, the UES values are site specific and based off of modeling using REM/Rate. The baseline indicated is WSEC 2015 and the efficient case is a minimum of 10% over the WSEC 2015. The savings range from 2,678.39 kWh/yr to 8,948.28 kWh/yr. The upper end of this range reflects large claimed savings values for whole home sites, and if this measure category is expected to grow in subsequent program years, ADM will request the REM/Rate modeling files to further verify the savings values. For the new manufactured homes measures, savings are claimed to be the difference between a code built manufactured home and one built to ENERGY STAR manufactured home standards. The provided workbooks contain links to the modeling tool, which is called SEEM (Simplified Energy Enthalpy Model). ADM’s review indicates that the assumptions, modeling tools, and UES values in the TRL files for whole homes measures are within the bounds of reasonable estimates and ADM did not adjust the savings values for whole homes measures. Thus, ADM applied a 100% ISR to all whole homes measures resulting in a 100% realization rate and the evaluated gross energy savings in 2017 and 2018 shown in Table 3-27.

*Table 3-27: 2017-2018 Evaluated Gross Energy Savings and Realization Rates for Whole Homes Measures*

Measure Category	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
2017 Whole Homes	70,180	70,180	100%
2018 Whole Homes	110,592	110,592	100%
<b>2017-2018 TOTAL</b>	<b>180,772</b>	<b>180,772</b>	<b>100%</b>

### 3.2.4.4 Evaluated Net Energy Savings

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 whole homes measures and the 2018 program-level NTG value of 81.7% to 2018 whole homes measures. The program-level NTG value applied to the whole homes measures does not include measures that ADM evaluated through a billing analysis.

Table 3-28 shows the evaluated net savings and NTG for whole homes measures in 2017 and 2018. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

*Table 3-28: 2017-2018 Evaluated Net Energy Savings and NTG for Whole Homes Measures*

Measure Category	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
2017 Whole Homes	70,180	55,405	78.9%
2018 Whole Homes	110,592	90,345	81.7%
<b>2017-2018 TOTAL</b>	<b>180,772</b>	<b>145,750</b>	<b>80.6%</b>

### 3.2.5 Water Heating

The following Table 3-29 shows the quantity of water heating measures installed and the claimed savings in each year 2017 and 2018. The water heating measure category represented approximately 1% of overall claimed program savings in 2017 and 2018.

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

Measure Category	Quantity	Claimed Savings (kWh)
2017 Water Heating	58	90,640
2018 Water Heating	33	54,358
<b>TOTAL</b>	<b>91</b>	<b>144,998</b>

#### 3.2.5.1 Database Review

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

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

ADM reviewed all 20 of the individual water heating measures in 2017 and 13 individual water heating measures in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2017 and 2018.

*3.2.5.2 Verified Inputs to Savings Calculation*

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

*3.2.5.3 Evaluated Gross Energy Savings*

ADM conducted a deemed savings review of the water heating measure claimed savings values, including the TRL files provided and the source savings documents, including the heat pump water heater RTF file “Res\_HPWH\_v.3.0”. ADM’s review included an analysis of the baseline and efficient case conditions for the heat pump water heater measures. The baseline is established by estimates of electric resistance heater (weighted at 98%) and heat pump water heater (2%) penetration. The TRL and RTF savings values are estimated for three tiers of 0-55 gallon tanks and tier levels are based on minimum Energy Factors. A heating interaction factor of 65% is applied to interior installation locations, as the garage and basement locations are not subject to HVAC interaction. There is also an exhaust ducting identifier for Tiers 2 and 3 that are installed in interior spaces, as ducted units have the capability of rejecting exhaust air to the outside of the building. The RTF uses an hourly water heater simulation model to estimate water heater energy use for the baseline and efficient case. ADM concludes that the assumptions and UES values in the TRL files for water heating measures are within the bounds of reasonable estimates and did not adjust the savings values for water heating measures. Thus, ADM applied a 100% ISR to all water heating measures resulting in a 100% realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-30.

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

<b>Measure Category</b>	<b>Claimed Gross Savings (kWh)</b>	<b>Evaluated Gross Savings (kWh)</b>	<b>Realization Rate</b>
2017 Water Heating Measures	90,640	90,640	100.0%
2018 Water Heating Measures	54,358	54,358	100.0%
<b>2017-2018 TOTAL</b>	<b>144,998</b>	<b>144,998</b>	<b>100.0%</b>

*3.2.5.4 Evaluated Net Energy Savings*

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 water heating measures and the 2018 program-level NTG value of 81.7% to 2018 water heating measures. The program-level NTG value applied to the water heating measures does not include measures that ADM evaluated through a billing analysis. Table 3-31 shows the evaluated net savings and NTG for water heating measures in 2017 and 2018. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of

1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

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

Measure Category	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
2017 Water Heating Measures	90,640	71,558	78.9%
2018 Water Heating Measures	54,358	44,406	81.7%
<b>2017-2018 TOTAL</b>	<b>144,998</b>	<b>115,964</b>	<b>80.0%</b>

### 3.2.6 Building Shell

The building shell measure category included air sealing, insulation and windows measures across the Program years 2017 and 2018. The following Table 3-32 shows the quantity of building shell measures installed and the claimed savings attributed to each building shell measure in 2017 and 2018. The building shell measure category represented 0.9% of overall claimed program savings in 2017 and 2018.

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

Measure Type	2017 Quantity (sq. ft.)	2017 Claimed Savings (kWh)	2018 Quantity (sq. ft.)	2018 Claimed Savings (kWh)
Air Sealing	3,268	295	1,388	83
Insulation	137,854	61,475	145,558	52,242
Windows	12,715	12,287	605	303
<b>TOTAL</b>	<b>153,837</b>	<b>74,057</b>	<b>147,551</b>	<b>52,629</b>

#### 3.2.6.1 Database Review

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

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

ADM reviewed each of the 19 individual building shell measures incentivized in 2017 and the 29 individual building shell measures incentivized in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for each measure accurately reflected the quantity of that measure installed in 2017 and 2018.

### 3.2.6.2 Verified Inputs to Savings Calculation

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

### 3.2.6.3 Evaluated Gross Energy Savings

ADM conducted a deemed savings review of the building shell measure claimed savings values, including the TRL files provided and the source savings documents. ADM's review included an analysis of the baseline and efficient case conditions for each building shell measure. The air sealing baselines are established using a regression based on RBSA data and the efficient case is 0.35 Air Changes per Hour (ACH). The insulation baselines and efficient cases vary for each type of insulation. For floor insulation, the baseline is no insulation and the efficient case is R-30 insulation. For attic insulation, the baseline is established through a weighted average of pre-installed levels and the efficient case is R-49 insulation. For wall insulation, the baseline is no insulation and the efficient case is R-11 insulation. The windows baseline is 0.30-U and the efficient case is 0.22-U. ADM concludes that the baseline and efficient case assumptions and the UES values in the TRL files for building shell measures are within the bounds of reasonable estimates and did not find any reasons to adjust the savings values for building shell measures. Thus, ADM applied a 100% ISR to all building shell measures resulting in a 100% realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-33.

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

Year	Measure	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	Air Sealing	295	295	100.0%
	Insulation	61,475	61,475	100.0%
	Windows	12,287	12,287	100.0%
2018	Air Sealing	83	83	100.0%
	Insulation	52,242	52,242	100.0%
	Windows	303	303	100.0%
<b>2017-2018 TOTAL</b>		<b>126,685</b>	<b>126,685</b>	<b>100.0%</b>

### 3.2.6.4 Evaluated Net Energy Savings

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 building shell measures and the 2018 program-level NTG value of 81.7% to 2018 building shell measures. The program-level NTG value applied to the building shell measures does not include measures that ADM evaluated through a billing analysis. Table 3-34 shows the evaluated net savings and NTG for building shell measures in 2017

and 2018. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

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

Year	Measure	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	Air Sealing	295	233	78.9%
	Insulation	61,475	48,533	78.9%
	Windows	12,287	9,700	78.9%
2018	Air Sealing	83	68	81.7%
	Insulation	52,242	42,678	81.7%
	Windows	303	248	81.7%
<b>2017-2018 TOTAL</b>		<b>126,685</b>	<b>101,459</b>	<b>80.1%</b>

### 3.2.7 Appliances

The appliance measure category included clothes washers and clothes dryers measures across the Program years 2017 and 2018. The following Table 3-35 shows the quantity of appliance measures installed and the claimed savings attributed to each appliance measure in 2017 and 2018. The appliance measure category represented 0.2% of overall claimed program savings in 2017 and 2018.

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

Measure Type	2017 Quantity	2017 Claimed Savings (kWh)	2018 Quantity	2018 Claimed Savings (kWh)
Clothes Dryers	1	228	-	-
Clothes Washers	161	20,385	108	15,244
<b>TOTAL</b>	<b>162</b>	<b>20,613</b>	<b>108</b>	<b>15,244</b>

#### 3.2.7.1 Database Review

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

- Verification of measure incentive requirements for a sample of appliances (e.g. model numbers)
- Verification that the program tracking dataset does not include duplicate or erroneous data entries
- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations

- Verification that all energy savings are claimed in accordance with the applicable TRL document

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

#### *3.2.7.2 Verified Inputs to Savings Calculation*

Due to the low savings attributed to appliance measures, ADM did not survey these program participants separately to calculate an ISR. ADM applied a 100% ISR for the appliance measure category, consistent with ISRs for other appliance measures that ADM has evaluated in other jurisdictions.

#### *3.2.7.3 Evaluated Gross Energy Savings*

ADM conducted a deemed savings review of the appliance measure claimed savings values, including the TRL files provided and the source savings documents, including the RTF files “ResClothesWashersSF\_v5.4” and “ResClothesWashersSF\_v5.2”. ADM reviewed the baseline Modified Energy Factor (MEF) of 2.36, which is a weighted value from the CEC database and the efficient case requirement of an MEF of 2.75 or higher. ADM also benchmarked the RTF assumption of an average of 295 laundry cycles a year to the average of 234 laundry cycles a year acquired from the General Population Survey. Although the RTF assumption is approximately 20% greater than the results of the General Population Survey, ADM concludes that the UES values in the TRL files for appliance measures are within the bounds of reasonable estimates and did not adjust the savings values for appliance measures. Thus, ADM applied a 100% ISR to all appliance measures resulting in a 100% realization rate and the evaluated gross energy savings for 2017 and 2018 shown in Table 3-36.

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

Year	Measure	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate
2017	Clothes Dryers	228	228	100%
	Clothes Washers	20,385	20,385	100%
2018	Clothes Washers	15,244	15,244	100%
<b>2017-2018 TOTAL</b>		<b>35,857</b>	<b>35,857</b>	<b>100%</b>

### 3.2.7.4 Evaluated Net Energy Savings

To determine net savings, ADM applied the 2017 program-level NTG value of 78.9% to 2017 appliance measures and the 2018 program-level NTG value of 81.7% to 2018 appliance measures. The program-level NTG value applied to the appliance measures does not include measures that ADM evaluated through a billing analysis. Table 3-37 shows the evaluated net savings and NTG for appliance measures in 2017 and 2018. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

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

Year	Measure	Evaluated Gross Savings (kWh/yr)	Evaluated Net Savings (kWh/yr)	NTG
2017	Clothes Dryers	228	180	78.9%
	Clothes Washers	20,385	16,093	78.9%
2018	Clothes Washers	15,244	12,453	81.7%
<b>2017-2018 TOTAL</b>		<b>35,857</b>	<b>28,727</b>	<b>80.1%</b>

## 3.2.8 Electronics

The electronics measure category included an advanced power strip measure in Program year 2018 only and consisted of three advanced power strips incentivized for a total of 630 kWh of savings in 2018. This represented less than 0.01% of overall claimed program savings in 2018.

### 3.2.8.1 Database Review

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

- Verification that the program tracking dataset does not include duplicate or erroneous data entries

- Confirmed data entries in the program tracking dataset include all necessary fields for savings calculations
- Verification that all energy savings are claimed in accordance with the applicable TRL document

ADM reviewed the two individual electronics measures in 2018. ADM verified that the UES values claimed by Pacific Power were supported by the applicable TRL documents. Further, ADM verified that the total claimed savings for the measure accurately reflected the quantity of the measure installed in 2018.

#### 3.2.8.2 *Verified Inputs to Savings Calculation*

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

#### 3.2.8.3 *Evaluated Gross Energy Savings*

ADM conducted a deemed savings review of the electronics measure claimed savings values, including the TRL files provided and the source savings documents. ADM concludes that the UES values in the TRL files for electronics measures are within the bounds of reasonable estimates and did not adjust the savings values for electronics measures. Thus, ADM applied a 100% ISR to the electronics measure resulting in a 100% realization rate and the evaluated gross energy savings for 2018 shown in Table 3-38.

*Table 3-38: 2018 Evaluated Gross Energy Savings and Realization Rates for Electronics Measures*

Measure	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
2018 Advanced Power Strips	630	630	100%
<b>2018 TOTAL</b>	<b>630</b>	<b>630</b>	<b>100%</b>

#### 3.2.8.4 *Evaluated Net Energy Savings*

To determine net savings, ADM applied the 2018 program-level NTG value of 81.7% to the 2018 electronics measure. The program-level NTG value applied to the electronics measure does not include measures that ADM evaluated through a billing analysis. Table 3-39 shows the evaluated net savings and NTG for the electronics measure in 2018. The net evaluation results presented in this report are not used in Pacific Power’s cost-effectiveness calculations as Washington standards utilize a NTG value of 1 for this purpose. ADM is presenting its net evaluation results in an effort to provide information that can be used for comparison and further program evaluation purposes.

Table 3-39: 2018 Net Energy Savings and NTG for Electronics Measures

Measure	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
2018 Advanced Power Strips	630	515	81.7%
<b>2018 TOTAL</b>	<b>630</b>	<b>515</b>	<b>81.7%</b>

## 4 Process Evaluation

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

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

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#### 4.1.1 Roles and Responsibilities

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

#### 4.1.2 Program Design and Goals

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

In Washington, there were goals and budget changes midway through PY2017 and in PY2018 administration funds were added to the budget to conduct pilot work. Program years 2016 and 2017 were the biennial period where there are two year targets and no changes were made during that time. In 2018, the next biennial period began, and some changes were made to align with the RTF.

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

- In PY2017, there was a push for the duct sealing direct install measure in the Washington territory. Program staff indicated they utilized a Utah contractor during the summer and targeted manufactured home parks. Going into PY2018, Pacific Power requested to pull back the focus on this measure and engage more with local contractors/trade allies and less units were completed in 2018. Program staff indicated local trade allies had different approaches with a broader scope of installing multiple measures compared to focusing on duct sealing. As a result, the program did not end up with as many completed units in PY2018 compared to PY2017. Staff believes this measure is close to hitting saturation soon. They believed there would be less opportunities over the next two years and that it will present a challenge to find a replacement that will be equivalent in savings.
- Program staff indicated there were some applications for whole homes in PY2018 that will be applied to PY2019. Program staff had anticipated more completed whole homes based on projections from builders, but they did not complete them in time for reporting.
- The implementation contract for CLEARResult ended March 31, 2019.

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

- There was an increase in non-lighting measures (e.g., heat pump conversions).
- There was an increase in whole homes participation.
- Between PY2017 and PY2018, there was a slight modification to implementation of the manufactured homes program and there were some changes to the requirements to align better with the sales process of new manufactured homes. The wholesaler now helps the customer submit their application and there is an extended timeframe to apply.
- There was an increase in unit sales within various product categories but a decrease in savings because they followed the RTF savings update for 2018. The ability to qualify products decreased and Pacific Power had to discontinue some measures because they were not cost effective.
- Pacific Power partnered with Craft3 to provide loans for home energy improvements to customers whose primary heat source fuel is through Pacific Power (<https://www.craft3.org/Borrow/home-energy/home-energy-loans-in-washington>). Staff indicated this began in September 2018 and they have seen an uptick in participation as a result of providing financing.

### **4.1.3 Tracking and Reporting**

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

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

Pacific Power staff indicated that they are collecting all the necessary information and that the information is kept current enough to effectively manage the program. No significant improvements were suggested. One staff member stated they would like to collect email addresses from customers.

### **4.1.4 Communication**

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

### **4.1.5 Marketing and Outreach**

Pacific Power provides a marketing budget to CLEAResult, which is designed to be measure-specific. CLEAResult's marketing team designed the marketing campaigns and then sent a proposal to Pacific Power for approval. Pacific Power ensured that marketing was aligned with company messaging and assesses the effectiveness of various campaigns. Pacific Power conducted email blasts and managed social media posts and CLEAResult provided content.

Marketing activities in Washington for 2017 and 2018 included:

- Bill inserts and direct mail to promote direct installs
- Email campaign for smart thermostat
- Social media (Facebook, Instagram, and Twitter)
- Point of purchase
- Pacific Power website (<https://www.pacificpower.net/savings-energy-choices/home.html>)
- Mass media advertisement
- Monthly newsletters (print or electronic)
- Cross promotion
- Outreach events (home shows)

Trade allies can play an active role in program outreach. In Washington, there is an expectation that trade allies do some canvassing to promote the direct install for manufactured homes. There is a strong relationship with the trade ally network and CLEAResult staff work to educate them on how to sell the measures/products.

Program staff did not express any immediate concerns about marketing. There are no planned changes to the marketing approach for the upcoming program year.

## **4.2 General Population Survey Results**

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This section presents key findings from surveys administered online by ADM Associates from April to May 2019 completed by 400 Pacific Power customers in Washington State. The surveys gathered information regarding these customers' energy efficient lighting purchases, incentive program awareness, measures installed and in-service rates, decision making and satisfaction. Survey efforts were designed to collect data for both the process evaluation and impact analyses.

### **4.2.1 Respondent LED Purchases**

Survey respondents were surveyed on multiple aspects of their LED purchases. Approximately 82% of survey respondents indicated that they or someone in their household purchased LED light bulbs in 2017 or 2018 and approximately 29% of respondents indicated that they or a member of their household purchased an LED fixture in 2017 or 2018. The remaining respondents (16%) reported that no one in their household purchased LED light bulbs or LED fixtures in 2017 or 2018 or they did not recall whether a purchase had been made.

Approximately half of survey respondents (51%) reported making their LED lighting purchase from Home Depot. About one-third of respondents (32%) reported purchasing

their LED lighting at Walmart. Costco and Lowe’s were also popular retailers among survey participants. Table 4-1 summarizes which retailers survey respondents reported purchasing LED lighting from in 2017 or 2018.

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

From which of the following retail stores did you purchase your LED lighting?	Response	Percent of Responses (n = 289)
	The Home Depot	51%
	Walmart	32%
	Costco	31%
	Lowe’s	22%
	Ace Hardware	16%
	Other	13%
	I do not recall	4%
	Target	3%
	Batteries Plus	1%

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

Respondents provided information regarding their decision to purchase an LED bulb or fixture. Survey respondents provided the reasons they purchased LED lighting (LED light bulbs and LED fixtures). Table 4-2 summarizes survey respondents’ reported reasons for purchasing LED lighting in 2017 or 2018. Respondents had a variety of reasons for purchasing LED lighting including to lower energy usage (25%) and to improve the lighting in a room (22%).

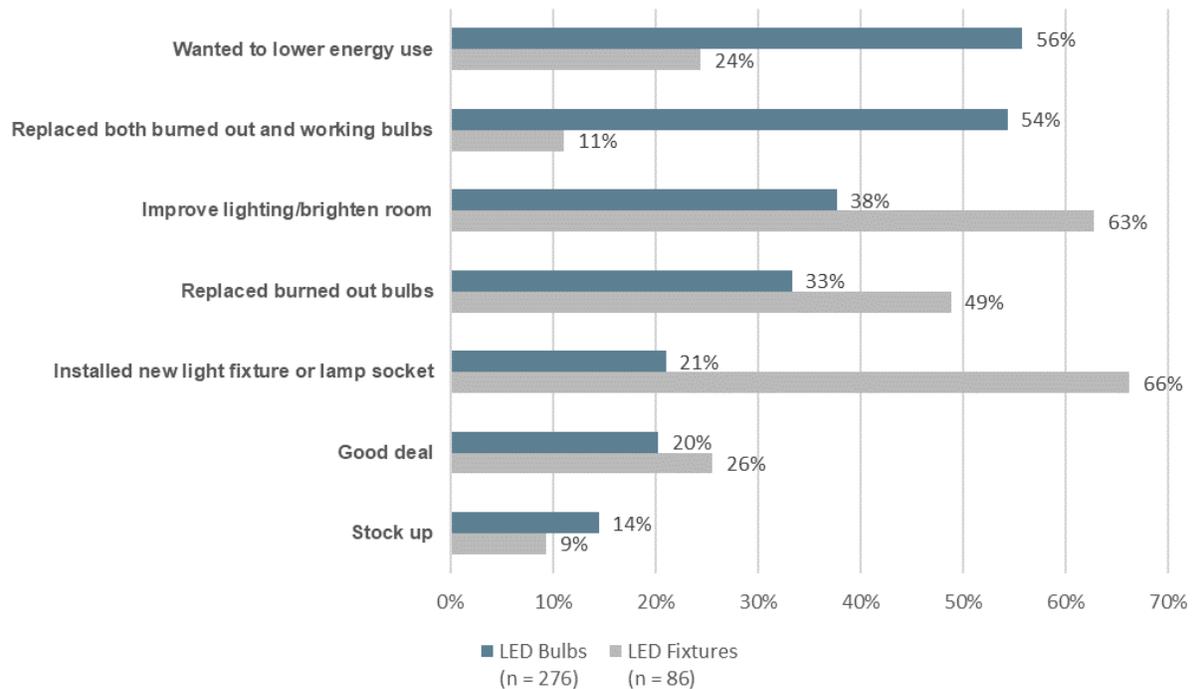
Table 4-2: Why did respondents purchase LED lighting?

Please select the reasons that best describe your decision to purchase LED lighting in 2017 or 2018.	Response	Percent of Responses (n = 247)
	Wanted to lower energy use	25%
	Improve lighting/brighten room	22%
	Replaced both burned out and working bulbs	22%
	Replaced burned out bulbs	19%
	Installed new light fixture or lamp socket	16%
	Good deal	11%
	Stock up	7%

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

The reasons respondents reported for buying LED bulbs differed from those they gave for purchasing LED fixtures. For instance, 56% of respondents purchased LED bulbs to lower energy use, whereas 24% of respondents said the same for fixtures. Additionally, only 38% of respondents purchased LED bulbs to improve the lighting in a room, while 66% of respondents did so for fixtures. Figure 4-1 displays the reasons respondents gave for purchasing either LED bulbs or LED fixtures.

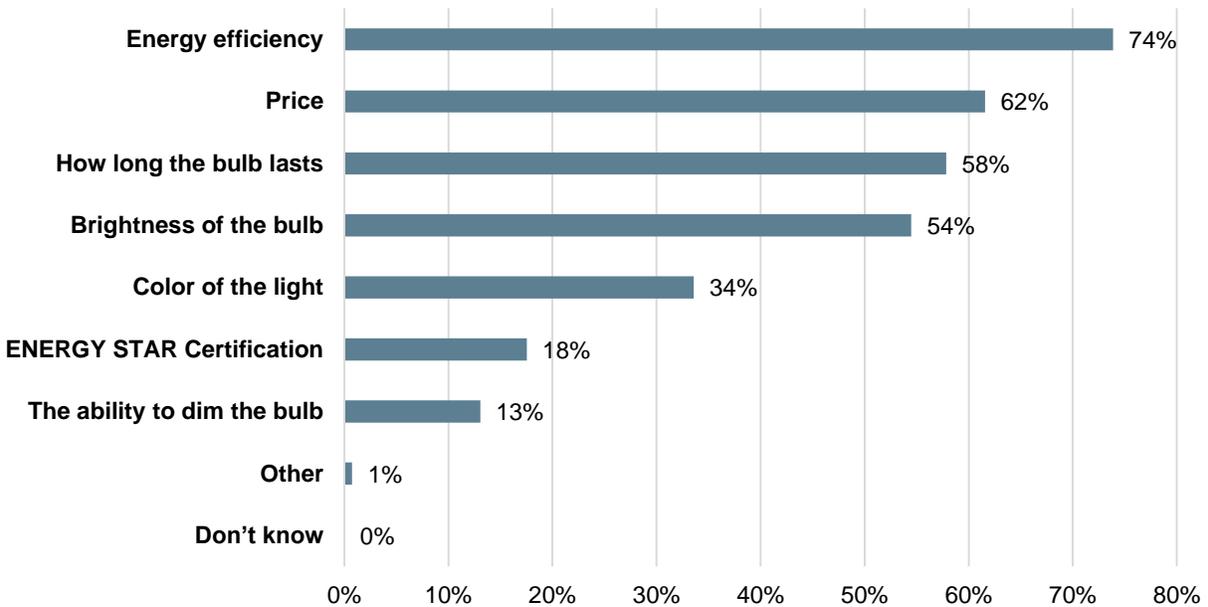
Figure 4-1: Why did respondents purchase LED Bulbs or LED Fixtures?



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

Respondents reported the most important characteristics they consider when they purchase light bulbs. About three-quarters of respondents reported that energy efficiency (74%) was an important characteristic. A significant portion of respondents also indicated that price (61%), the length of the bulb’s life (58%), brightness of the bulb (54%), color of the light (33%) are important characteristics in their decision to purchase a bulb. Figure 4-2 shows the reasons survey respondents indicated were important when they purchased new light bulbs.

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



n = 268

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

Approximately 41% of survey respondents indicated that at least one of the new LED bulbs they purchased was bought to replace a traditional incandescent bulb and the same percentage of respondents reported that at least one of the new LED fixtures they purchased was bought to replace a traditional incandescent bulb or fixture. Over one-third of respondents (37%) reported that at least one of the LED fixtures they purchased was to be “installed as a new fixture or socket”, while 13% of respondents reported the same for LED bulbs.

#### 4.2.2 Respondent Awareness of Incentives

ADM asked survey respondents about LED pricing and whether they recalled whether their LED bulb or LED fixture purchase was discounted. Most respondents reported that they did not recall whether the LED bulbs (79%) or LED fixtures (79%) they purchased were discounted and were not aware of any utility sponsored discount available for LED bulbs or fixtures (81%).

#### 4.2.3 Respondent Satisfaction

ADM asked survey respondents who were aware of the lighting program about their satisfaction with different aspects of the incentive program and with their utility provider overall. The majority of respondents (53%) reported they were either very satisfied (29%)

or satisfied (24%) with the incentive program overall. Most respondents (80%) were either very satisfied (40%) or satisfied (40%) with the quality of the product purchased. Approximately 44% of respondents indicated they were very satisfied (20%) or satisfied (24%) with the savings on electricity bills since installing the incentivized lighting. Respondents reported high levels of overall satisfaction with Pacific Power. Approximately 78% of respondents reported being satisfied or very satisfied with Pacific Power, while only four percent reported being dissatisfied or very dissatisfied.

#### **4.2.4 Survey Respondent Home Characteristics**

ADM gathered information from respondents regarding their home characteristics which is summarized in Table 4-3. Approximately 64% of respondents report living in single-family detached homes. The majority (75%) of respondents indicated that they owned their home. Respondents' reported approximate household income was roughly even across the possible survey response options. The majority of respondents reported that electricity was their primary fuel for home heating (61%), and water heating purposes (75%). The typical number of residents in respondents' homes were 2.7 (average) and 2 (median). Survey respondents reported their square footage of the home was on average about 1,844 square feet, and the median was 1,750 square feet.

*Table 4-3: General Population Home Characteristics*

<b>Home Characteristics</b>	<b>Percentage of Respondents</b>
Single Family, detached from any other house	64%
Apartment in a building with 4 or more units	9%
Single Family Home, factory manufactured/modular	7%
Apartment in building with 2 to 3 units	7%
Single Family Home, mobile home	5%
Single-family house attached to one or more other houses (e.g. duplex)	5%
I prefer not to answer	2%
Other	1%
Don't know	0%
<b>Own or Rent</b>	
Own	75%
Rent	24%
<b>Year Built</b>	
Before 1950	19%
1950 to 1959	7%
1960 to 1969	9%
1970 to 1979	17%
1980 to 1989	8%
1990 to 1999	10%
2000 to 2009	10%

Home Characteristics	Percentage of Respondents
2010 to 2018	8%
Don't know	12%
<b>What is the main fuel used for heating your home?</b>	
Electricity	61%
Natural Gas	27%
Other	6%
Propane	4%
Don't know	1%
<b>What fuel does your main water heater use?</b>	
Electricity	75%
Natural Gas	20%
Propane	2%
Other	0%
Don't know	3%
<b>What is your approximate household income?</b>	
Less than \$10,000	4%
\$10,000 to \$29,999	15%
\$30,000 to \$49,999	22%
\$50,000 to \$69,999	17%
\$70,000 to \$89,999	10%
\$90,000 to \$99,999	7%
\$100,000 to \$149,999	12%
\$150,000 or more	6%
Don't know	8%
Prefer not to answer	0%

### 4.3 Energy Kits Participant Survey Results

This section presents key findings from energy kit surveys, which were administered online by ADM. The surveys were completed by 82 customers who received energy kits in 2017 or 2018. Of these respondents, 9 reported that they had not received an energy kit or did not recall receiving an energy kit. The survey gathered information regarding program awareness, measures installed and in-service rates, decision making and overall satisfaction.

#### 4.3.1 Program Awareness

Participants provided information and feedback regarding how they learned about the energy kits and their experience enrolling in the program. Over half of respondents reported hearing about the program through either a utility bill insert (46%) or a message printed on their bill (7%). Approximately 28% of respondents reported learning about the program from the utility's website while another eight percent of respondents reported

that they learned of the program via newsletters produced by Pacific Power. A summary of survey responses appears in Table 4-4.

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

<b>How did you hear about these kits?</b>	<b>Percent of Responses (n = 72)</b>
Pacific Power bill insert	46%
Pacific Power Website	28%
Message printed on your bill	7%
Don't know	8%
Pacific Power newsletter	8%
Word of mouth	3%
Newspaper/magazine/print media	1%
Community event	1%
Social Networking site	1%

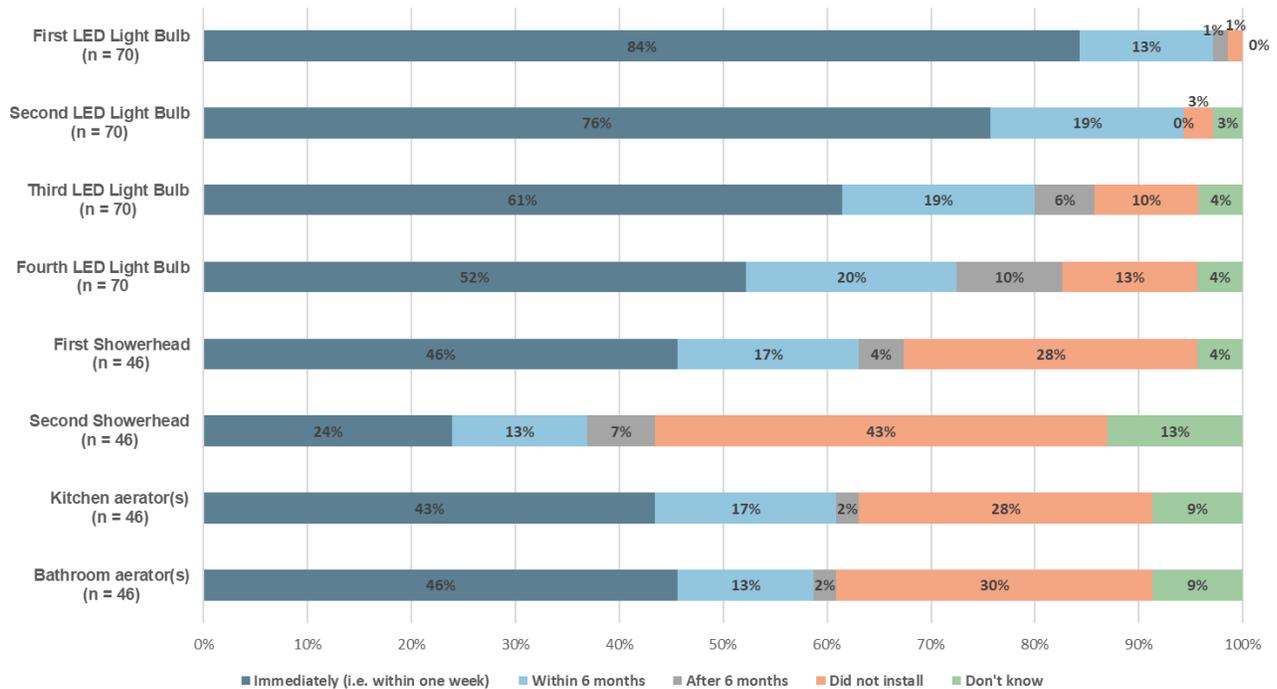
Note: The sum of percentages is not 100% because respondents could choose more than one response

### **4.3.2 Participant Experience and Installation of Measures**

Survey respondents provided feedback regarding installing the energy kit components. To verify the contents of each survey respondents' energy kit, respondents indicated if their home had an electric water heat. Next, according to their response, they indicated if they had installed the various energy kit measures. For each of the measures, most respondents reported that they installed them "immediately (within one week)." The one exception was high efficiency showerhead(s). Regarding the first high efficiency showerhead, slightly less than half of respondents (46%) reported installing it immediately. Approximately 43% of survey respondents that were asked about a second high efficiency showerhead reported that it had not been installed and 13% were not sure whether it had been installed.

Most respondents reported installing the first LED light bulb (84%), second LED light bulb (76%), third LED light bulb (61%) or fourth LED light bulb (52%) "immediately (within one week)." Only one percent of survey respondents reported that they had not installed their first LED light bulb and only three percent of respondents reported that they had not installed their second LED light bulb (6%). A larger portion of respondents reported that the third (10%) and fourth (13%) LED bulbs they received were not installed. About one-quarter (28%) of respondents that reported receiving kitchen aerators reported that they had not installed them and approximately 30% of respondents that reported receiving bathroom aerators reported that they had not installed them. Figure 4-3 displays respondents' timeline for installing various energy kit measures.

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



Energy kit recipients who reported that they had not installed certain measures provided the reasons that these measures were not installed. See Table 4-5 for complete results. Of the respondents who reported they did not install one or more of the LED bulbs from the energy kit, 35% indicated they were “waiting for their current lights to burn out.” Fourteen percent of respondents reported that they “did not know” why one or more of the LED bulbs they received was not installed. Regarding high efficiency showerheads that were not installed, the most frequently cited reason (35%) was the customer already had high efficiency showerheads installed throughout their house. Another 15% of respondents reported that the showerheads found in the kit did not integrate well with their home’s plumbing, and a further 23% were dissatisfied with the water pressure (15%) or appearance (8%) of the showerhead. Of the respondents who reported having uninstalled faucet aerators, two prominent reasons emerged. One was that they already had faucet aerators installed in all of their sinks (37%) and the other was that the faucet aerators did not integrate well with their plumbing (37%).

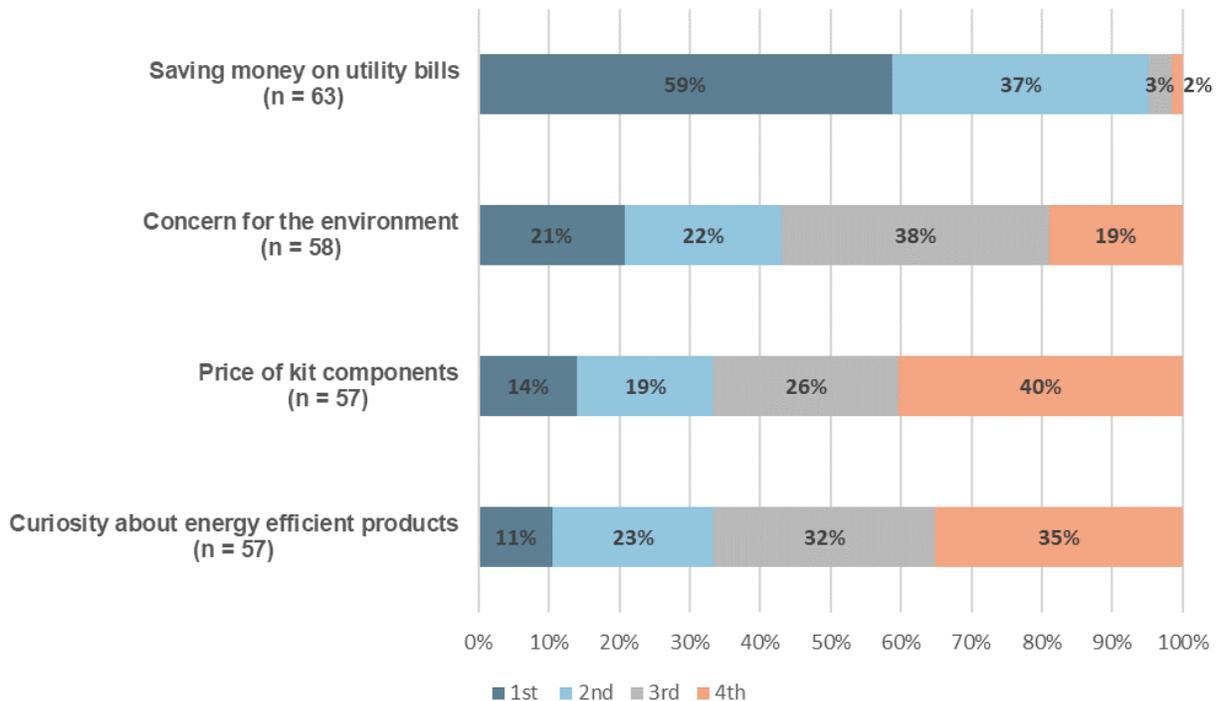
Table 4-5: Reasons for not Installing Energy Kit Components

Reason for not installing measure	Percentage of Responses
LEDs (n = 13)	
No time to install	0%
Misplaced LED	4%
Waiting for current lights to burn out	35%
Not the correct wattage	15%
Disliked the color tone/quality of the emitted light	15%
Did not fit into my fixtures	8%
Other	19%
Don't know	4%
Showerheads (n = 26)	
No time to install	0%
Misplaced	4%
High-efficiency shower-heads already installed in all showers	35%
Did not integrate well with current plumbing	15%
Disliked the pressure/water volume	15%
Disliked the way it looked	8%
Other	19%
Don't know	4%
Faucet Aerators (n = 19)	
No time to install	5%
Misplaced	0%
Faucet aerators already installed in all sinks	37%
Did not integrate well with current plumbing	37%
Disliked the pressure/water volume	0%
Disliked the way it looked	5%
Other	5%
Don't know	11%

### 4.3.3 Participant Motivations

Respondents provided feedback regarding what influenced them to request the energy kit. Nearly 60% of respondents ranked “saving money on utility bills” as their strongest motivation to request a kit, while a further 37% ranked it as their second strongest motivation. Another finding from the survey is that respondents are motivated to request energy kits due to having concerns about the environment. Approximately 43% of respondents ranked this motivation as being first or second most important to them. The motivation most commonly ranked as least compelling (40%) was the price of kit components. Figure 4-4 displays respondents’ ranking of different reasons for requesting an energy kit.

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



Most respondents also indicated that they did not have plans to purchase and install aerators or high-efficiency showerheads before participating in the program, but a most respondents did plan to purchase and install LED bulbs. A summary of participant responses as to whether they were already planning on purchasing energy kit components appears in Table 4-6.

Table 4-6: Were Respondents Already Planning on Purchasing Energy Kit Components?

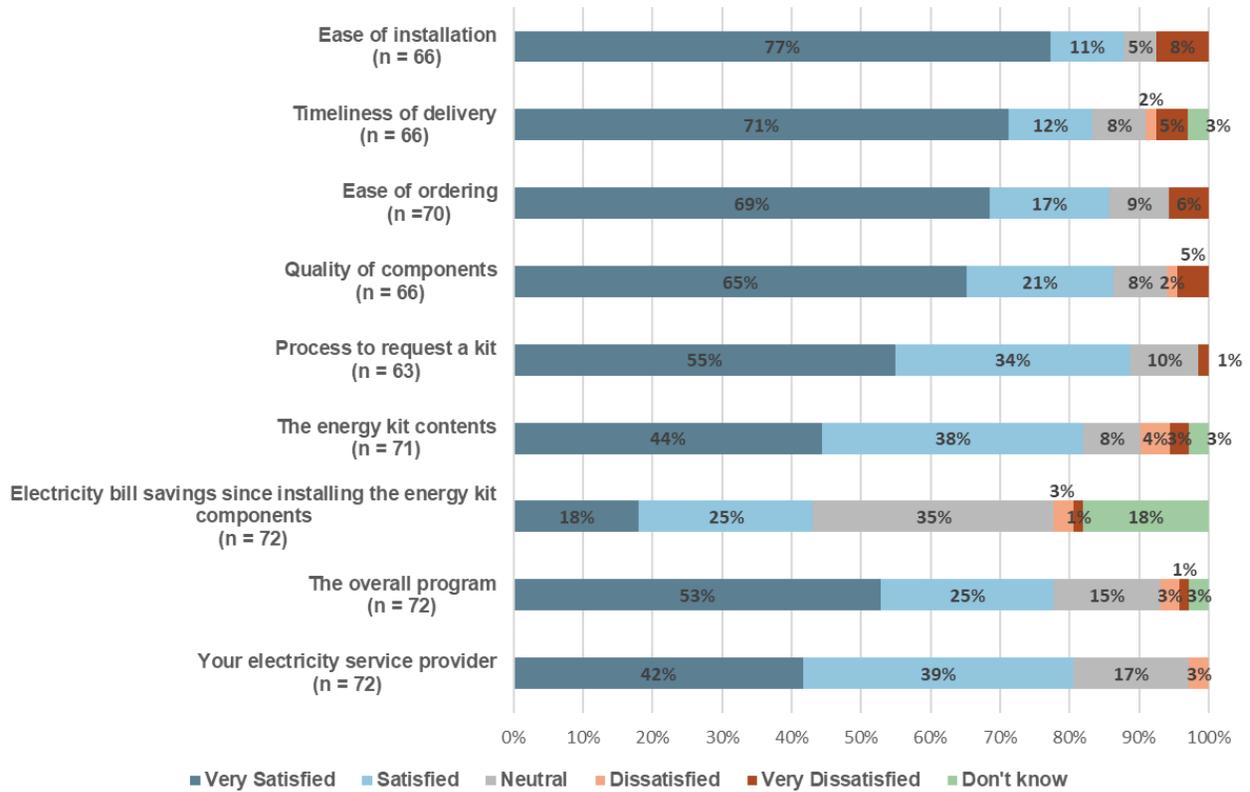
Before you learned that the Kits were available, were you planning to purchase and install the following energy efficient measures?	Measure	Yes	No	Don't Know
	Faucet Aerator(s)	13%	83%	4%
	Showerhead(s)	23%	73%	4%
	LED Light Bulbs	85%	10%	6%

#### 4.3.4 Participant Satisfaction

Respondents provided feedback regarding their level of satisfaction with specific aspects of the program, as well as their overall experience with the program. Respondents found that the most satisfying aspects (i.e. either satisfied or very satisfied) of the program were the process to request a kit (89%), the ease of installation (88%), and the quality of the kit components (86%). Overall satisfaction with the program was 78%, and overall satisfaction with Pacific Power was 81%. Figure 4-5 displays survey respondents'

satisfaction with the program as well as their satisfaction with specific aspects of their experience with the program.

Figure 4-5: Customer Satisfaction with Energy Kit Program



### 4.3.5 Home Characteristics

Respondents' home characteristics are summarized in Table 4-7. Respondents most often reported living in single-family, detached homes (84%) and most often owned their home (87.3%). The decade in which respondents' homes were built are spread fairly evenly across each time interval included in the survey, with the largest segments of respondents' homes being built before 1950 (19%), or between 2000 and 2009 (20%). Approximately 45% of respondents reported having an approximate household income of \$69,999 or less. Approximately 60% of respondents indicated electricity is their primary home heating fuel and 64% indicated electricity is their primary water heating fuel. The average home size was approximately three people. Survey respondents reported their square footage of the home was on average about 2,073 square feet.

Table 4-7: Energy Kit Participants Home Characteristics

Home Characteristics	Percentage of Respondents
Single Family, detached from any other house	83.5%
Single Family, factory manufactured/modular	3.8%
Single Family, mobile home	3.8%
Single Family attached to one or more other houses (e.g. duplex, row house)	6.3%
Apartment in building with 2 to 3 units	1.3%
Apartment in a building with 4 or more units	1.3%
<b>Own or Rent</b>	
Own	87.3%
Rent	12.7%
<b>Year Built</b>	
Before 1950	19.0%
1950 to 1959	11.4%
1960 to 1969	11.4%
1970 to 1979	12.7%
1980 to 1989	11.4%
1990 to 1999	7.6%
2000 to 2009	20.3%
2010 to 2018	2.5%
Don't know	3.8%
<b>What is the main fuel used for heating your home?</b>	
Electricity	59.5%
Natural Gas	39.2%
Propane	1.4%
<b>What fuel does your main water heater use?</b>	
Electricity	64.0%
Natural Gas	34.7%
Propane	1.3%
<b>What is your approximate household income?</b>	
Less than \$10,000	3.9%
\$10,000 to \$29,999	5.2%
\$30,000 to \$49,999	26.0%
\$50,000 to \$69,999	10.4%
\$70,000 to \$89,999	18.2%
\$90,000 to \$99,999	5.2%
\$100,000 to \$149,999	13.0%
\$150,000 or more	6.5%
Don't know	11.7%

#### 4.4 HVAC Participant Survey Results

This section presents key findings from HVAC program surveys administered online by ADM, completed by 68 respondents who reported receiving an incentive for an air source heat pump, a ductless heat pump, or duct sealing/insulation in 2017 or 2018 through

Pacific Power’s Home Energy Savings Program. The survey gathered information regarding program awareness, decision making and overall satisfaction.

#### **4.4.1 Program Awareness**

Respondents provided information regarding how they first learned about the incentive program as well as sources of information they utilized while they were making the decision to purchase the HVAC equipment. Over one-quarter (27%) of survey respondents reported that they learned about it from a Pacific Power representative, while 20% of respondents indicated that they learned of the program via word-of-mouth referrals. Table 4-8 summarizes how survey respondents first learned about the program.

*Table 4-8: How did respondents first learn about the program?*

<b>How did you first learn about the Program?</b>	<b>Percent of Responses (n = 64)</b>
Pacific Power representative	27%
Friend, neighbor, relative, or colleague	20%
Other	13%
Retailer/store	9%
Bill inserts	8%
I don't know	8%
Program website	6%
Message printed on your bill	5%
Newspaper/magazine/print media	3%
Internet advertisement	2%

Regarding where respondents found information about the incentives offered by Pacific Power when they were deciding to implement the energy saving equipment, responses varied by measure. Respondents who implemented a heat pump of either variety most commonly learned about incentives from an installation contractor, as 44% of air source heat pump respondents learned this way, and 50% of ductless heat pump respondents learned this way. However, installation contractors were not common sources of incentive information for respondents who received duct sealing/insulation (6%). Among these respondents, they most often reported learning about incentives from Pacific Power representatives (39%). Across all three measures, the program website was seldom reported as a source of incentive information, as no heat pump respondents reported learning from it, and only three percent of duct sealing/insulation respondents learned this way. A summary of responses to this question appears in Table 4-9.

Table 4-9: How did respondents get information about the incentive?

When you were deciding to implement the energy saving equipment, from where did you get information about the incentives offered by Pacific Power?	Duct sealing and/or insulation (n = 33)	High-efficiency air source heat pump (n = 9)	High-efficiency ductless heat pump (n = 14)
Retailer	0%	33%	21%
Installation contractor	6%	44%	50%
Friend, neighbor, relative or co-worker	27%	0%	14%
Program website	3%	0%	7%
Pacific Power representative	39%	0%	7%
Newspaper	6%	11%	0%
Television	3%	0%	0%
Other	12%	11%	14%
Did not look for any information	3%	0%	0%
I don't know	12%	0%	0%

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

#### 4.4.2 Participant Motivation

Survey respondents provided feedback regarding their decision-making process. Approximately two-thirds of survey respondents (64%) indicated they did not have plans to purchase duct sealing/insulation before they learned about Pacific Power's Program. 78% of respondents who received an air source heat pump already had plans to install one prior to learning about the program, and a similar number of ductless heat pump respondents (77%) had existing plans to install their heat pump as well.

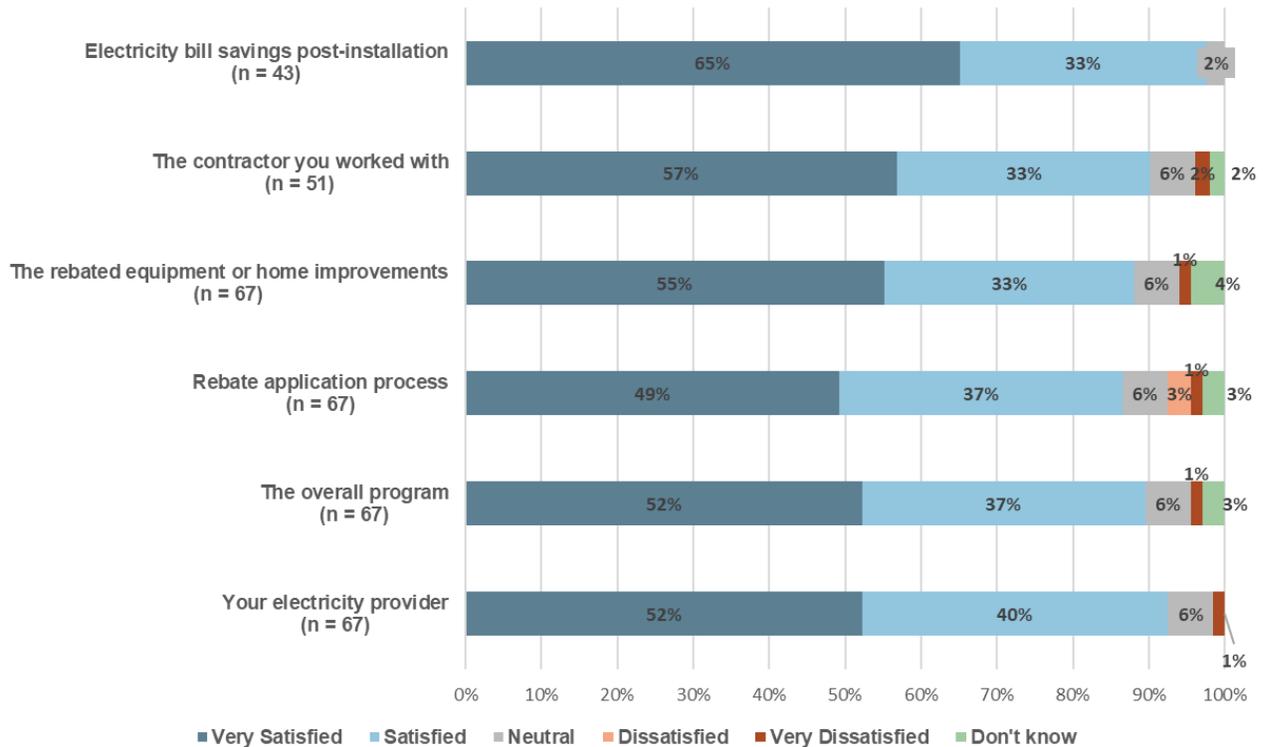
Respondents reported that the incentive was important or extremely important in driving their decision to install the duct sealing/insulation 94% of the time. However, the incentive was less influential for both forms of heat pumps, as the incentive was reported as important or extremely important 74% of the time for ductless heat pumps and 44% of the time for air source heat pumps.

#### 4.4.3 Participant Satisfaction

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

reported being dissatisfied or very dissatisfied with Pacific Power. Figure 4-6 displays survey respondents' overall satisfaction with Pacific Power and the Home Energy Savings Program, as well as their satisfaction with specific aspects of their experience with the program.

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



#### 4.4.4 Home Characteristics

Respondents' home characteristics are summarized in Table 4-10. All respondents reported living in a single-family home, and almost all of them (98%) reported owning their home. Electricity was the most common type of fuel used for heating homes (97%) and for fueling the homes' main water heaters (97%). Most respondents (59%) reported living in a home built before 1980. The average size of respondents' homes was 1,729 square feet, and the average number of inhabitants was slightly over two people.

Table 4-10: HVAC Participant Home Characteristics

Home Characteristics	Percentage of Respondents
Single Family, detached from any other house	46%
Single Family, factory manufactured/modular	28%
Single Family, mobile home	26%
<b>Own or Rent</b>	
Own	98%
Rent	2%
<b>Year Built</b>	
Before 1950	21%
1950 to 1959	4%
1960 to 1969	6%
1970 to 1979	28%
1980 to 1989	21%
1990 to 1999	6%
2000 to 2009	3%
2010 to 2018	4%
Don't know	7%
<b>What is the main fuel used for heating your</b>	
Electricity	97%
Natural Gas	1%
Other/Don't Know	1%
<b>What fuel does your main water heater use?</b>	
Electricity	97%
Natural Gas	1%
Don't know	1%
<b>What is your approximate household</b>	
Less than \$10,000	2%
\$10,000 to \$29,999	2%
\$30,000 to \$49,999	5%
\$50,000 to \$69,999	0%
\$70,000 to \$89,999	5%
\$90,000 to \$99,999	2%
\$100,000 to \$149,999	5%
\$150,000 or more	5%
Don't know/prefer not to answer	75%

## 5 Cost-Effectiveness

Pacific Power contracted with Navigant to calculate the Program cost-effectiveness based on the net savings assessed by ADM using a NTG ratio of 1. ADM provided the measure life and incremental cost inputs needed to calculate the cost-effectiveness of the Program. Measure life and incremental cost values were assigned on an individual measure basis and came from the TRL files provided by Pacific Power.

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

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

Parameter	2017	2018
Net Savings with NTG of 1 (kWh/year)	6,496,704	5,123,043
Discount Rate	6.7%	6.6%
Residential Line Loss	9.7%	9.7%
Residential Energy Rate (\$/kWh)	\$0.0906	\$0.0872
Inflation Rate	1.9%	2.2%
Total Program Costs	\$2,490,647	\$2,054,828

Table 5-2 (without NEIs) and Table 5-3 (including NEIs) show the cost-effectiveness results for the overall program for the combination of program years 2017 and 2018, based on the Washington standard NTG ratio of 1. The Washington Home Energy Savings Program was cost-effective during the 2017-2018 evaluation period, across all cost-effectiveness tests except for the RIM test. The overall program achieved a 1.46 benefit/cost ratio for the combined years using the Utility Cost Test (UCT).

*Table 5-2: 2017-2018 WA Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0702	\$7,437,941	\$7,315,687	-\$122,254	0.98
Total Resource Cost Test (TRC) No Adder	\$0.0702	\$7,437,941	\$6,650,625	-\$787,316	0.89
Utility Cost Test (UCT)	\$0.0429	\$4,545,475	\$6,650,625	\$2,105,150	1.46
Rate Impact Test (RIM)		\$14,683,301	\$6,650,625	-\$8,032,676	0.45
Participant Cost Test (PCT)		\$5,500,767	\$12,746,127	\$7,245,360	2.32
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000065915
Discounted Participant Payback (years)					2.86

*Table 5-3: 2017-2018 WA Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0702	\$7,437,941	\$12,383,868	\$4,945,927	1.66
Total Resource Cost Test (TRC) No Adder	\$0.0702	\$7,437,941	\$11,718,805	\$4,280,864	1.58
Utility Cost Test (UCT)	\$0.0429	\$4,545,475	\$6,650,625	\$2,105,150	1.46
Rate Impact Test (RIM)		\$14,683,301	\$6,650,625	-\$8,032,676	0.45
Participant Cost Test (PCT)		\$5,500,767	\$17,814,307	\$12,313,541	3.24
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000065915				
Discounted Participant Payback (years)	2.86				

Table 5-4 (without NEIs) and Table 5-5 (including NEIs) show the Washington Home Energy Savings Program cost-effectiveness results for 2017 and Table 5-6 and Table 5-7 show cost-effectiveness results for 2018, based on the Washington standard NTG ratio of 1. The 2017 program passes the cost-effectiveness for all tests except the RIM test. The 2018 program passes the cost-effectiveness for the Utility Cost Test (UCT) and Participant Cost Test (PCT).

*Table 5-4: 2017 WA Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0631	\$3,968,232	\$5,345,979	\$1,377,747	1.35
Total Resource Cost Test (TRC) No Adder	\$0.0631	\$3,968,232	\$4,859,981	\$891,749	1.22
Utility Cost Test (UCT)	\$0.0396	\$2,490,647	\$4,859,981	\$2,369,334	1.95
Rate Impact Test (RIM)		\$8,598,382	\$4,859,981	-\$3,738,401	0.57
Participant Cost Test (PCT)		\$2,934,176	\$7,564,326	\$4,630,150	2.58
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061621				
Discounted Participant Payback (years)	2.56				

*Table 5-5: 2017 WA Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0631	\$3,968,232	\$8,197,468	\$4,229,236	2.07
Total Resource Cost Test (TRC) No Adder	\$0.0631	\$3,968,232	\$7,711,470	\$3,743,238	1.94
Utility Cost Test (UCT)	\$0.0396	\$2,490,647	\$4,859,981	\$2,369,334	1.95
Rate Impact Test (RIM)		\$8,598,382	\$4,859,981	-\$3,738,401	0.57
Participant Cost Test (PCT)		\$2,934,176	\$10,415,815	\$7,481,639	3.55
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061621				
Discounted Participant Payback (years)	2.56				

*Table 5-6: WA 2018 Home Energy Savings Program Level Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0805	\$3,469,709	\$1,969,709	-\$1,500,001	0.57
Total Resource Cost Test (TRC) No Adder	\$0.0805	\$3,469,709	\$1,790,644	-\$1,679,065	0.52
Utility Cost Test (UCT)	\$0.0477	\$2,054,828	\$1,790,644	-\$264,184	0.87
Rate Impact Test (RIM)		\$6,084,920	\$1,790,644	-\$4,294,275	0.29
Participant Cost Test (PCT)		\$2,566,591	\$5,181,801	\$2,615,210	2.02
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000070172				
Discounted Participant Payback (years)	3.25				

*Table 5-7: WA 2018 Home Energy Savings Program Level Cost-Effectiveness Results (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0805	\$3,469,709	\$4,186,400	\$716,691	1.21
Total Resource Cost Test (TRC) No Adder	\$0.0805	\$3,469,709	\$4,007,335	\$537,626	1.15
Utility Cost Test (UCT)	\$0.0477	\$2,054,828	\$1,790,644	-\$264,184	0.87
Rate Impact Test (RIM)		\$6,084,920	\$1,790,644	-\$4,294,275	0.29
Participant Cost Test (PCT)		\$2,566,591	\$7,398,492	\$4,831,901	2.88
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000070172				
Discounted Participant Payback (years)	3.25				

Table 5-8 presents the benefit/cost ratio results for the Program for each cost-effectiveness test by program year.

Table 5-8: Washington Home Energy Savings Program Benefit/Cost Ratios by Program Year

Program Year	PTRC	TRC	UCT	RIM	PCT
2017 (without NEIs)	1.35	1.22	1.95	0.57	2.58
2017 (with NEIs)	2.07	1.94	1.95	0.57	3.55
2018 (without NEIs)	0.57	0.52	0.87	0.29	2.02
2018 (with NEIs)	1.21	1.15	0.87	0.29	2.88
2017-2018 (without NEIs)	<b>0.98</b>	<b>0.89</b>	<b>1.46</b>	<b>0.45</b>	<b>2.32</b>
2017-2018 (with NEIs)	<b>1.66</b>	<b>1.58</b>	<b>1.46</b>	<b>0.45</b>	<b>3.24</b>

Navigant also completed cost-effectiveness tests at the measure-category level for each individual program year. The benefit/cost ratio results by measure-category are presented in Table 5-9 and Table 5-10, based on the Washington standard NTG ratio of 1.

Table 5-9: Washington Home Energy Savings Program Benefit/Cost Ratios by Measure Category, 2017

Measure Group	PTRC	TRC	UCT	RIM	PCT
Appliances with NEIs	1.92	1.86	1.00	0.43	3.12
Appliances	0.60	0.55	1.00	0.43	1.37
Building Shell	0.43	0.39	1.00	0.38	1.03
Energy Kits with NEIs - DHW	6.81	6.51	3.07	0.58	50.17
Energy Kits - DHW	3.38	3.07	3.07	0.58	28.23
Energy Kits with NEIs - Lighting	3.11	2.95	1.60	0.50	11.24
Energy Kits - Lighting	1.76	1.60	1.60	0.50	7.38
HVAC with NEIs	1.03	0.94	1.23	0.55	2.06
HVAC	1.00	0.91	1.23	0.55	2.02
Lighting with NEIs	3.41	3.24	3.60	0.60	4.75
Lighting	1.83	1.66	3.60	0.60	2.98
Water Heating	0.90	0.82	0.93	0.41	2.60
Whole Home	0.94	0.86	1.25	0.42	2.49
<b>Total with NEIs</b>	<b>2.07</b>	<b>1.94</b>	<b>1.95</b>	<b>0.57</b>	<b>3.55</b>
<b>Total</b>	<b>1.35</b>	<b>1.22</b>	<b>1.95</b>	<b>0.57</b>	<b>2.58</b>

Table 5-10: Washington Home Energy Savings Program Benefit/Cost Ratios by Measure Category, 2018

Measure Group	PTRC	TRC	UCT	RIM	PCT
Appliances	0.37	0.34	0.68	0.28	1.29
Appliances with NEIs	1.70	1.66	0.68	0.28	3.01
Building Shell	0.36	0.33	1.10	0.40	0.82
Building Shell with NEIs	1.80	1.77	1.10	0.40	2.40
Electronics	0.33	0.30	0.28	0.15	3.85
Energy Kits - DHW	3.25	2.95	2.95	0.35	27.24
Energy Kits - DHW with NEIs	12.39	12.09	2.95	0.35	59.02
Energy Kits - Lighting	1.30	1.18	1.18	0.29	5.97
Energy Kits - Lighting with NEIs	3.06	2.94	1.18	0.29	8.84
HVAC	0.40	0.36	0.63	0.28	1.38
HVAC with NEIs	0.44	0.41	0.63	0.28	1.44
Lighting	0.74	0.67	1.02	0.27	3.00
Lighting with NEIs	1.99	1.92	1.02	0.27	4.65
Water Heating	0.53	0.48	0.60	0.26	2.36
Whole Home	0.76	0.69	1.16	0.39	1.95
Whole Home with NEIs	0.78	0.71	1.16	0.39	1.98
<b>Total with NEIs</b>	<b>1.21</b>	<b>1.15</b>	<b>0.87</b>	<b>0.29</b>	<b>2.88</b>
<b>Total</b>	<b>0.57</b>	<b>0.52</b>	<b>0.87</b>	<b>0.29</b>	<b>2.02</b>

Further information on the cost-effectiveness test results for each measure category is presented in Appendix E. Additionally, while Washington evaluation standards utilize a NTG ratio of 1 for cost-effectiveness, Navigant also calculated the Program cost-effectiveness based on the evaluated net savings provided by ADM using the measure specific NTG ratios resulting from ADM's evaluation. These cost-effectiveness results are also presented in Appendix E for comparison purposes.

## 6 Conclusions and Recommendations

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

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

Year	Measure Category	Claimed Savings (kWh)	Evaluated Gross Savings (kWh/yr)	Realization Rate	Evaluated Net Savings (kWh/yr)	Net to Gross
2017-2018	Appliances	35,857	35,857	100%	28,727	80%
	Building Shell	126,685	126,685	100%	101,459	80%
	Electronics	630	630	100%	515	82%
	Energy Kits	1,741,903	1,848,005	106%	1,753,572	95%
	HVAC	3,985,925	3,187,479	80%	3,170,009	99%
	Lighting	8,561,875	6,095,321	71%	4,609,613	76%
	Water Heating	144,998	144,998	100%	115,964	80%
	Whole Homes	180,772	180,772	100%	145,750	81%
<b>2017-2018 TOTAL</b>		<b>14,778,646</b>	<b>11,619,747</b>	<b>79%</b>	<b>9,925,609</b>	<b>85%</b>

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

- **Lighting Measure Category:**

Conclusion #1: ADM’s calculation of a 6% leakage rate for lighting in Washington is on the low end of leakage rates for lighting and is likely due to the relatively large and connected Pacific Power territory in Washington and the effective or strategic placement of participating retailer locations. The implementation contractor has indicated that the Retail Sales Allocation Tool (RSAT) may be a predictor of bulb leakage in Pacific Power territories and is used to determine allocations of bulbs to participating stores.

Recommendation #1: To understand further how the RSAT tool accounts for leakage and how the store allocations relate to the Program Tracking Data, ADM recommends that the next evaluation of subsequent program years includes a full life-cycle review of the lighting contracts, including the participation agreements with the implementation contractor and a sample of all associated invoices. This would allow the evaluation to follow the life-cycle of the bulbs from the original agreement to final installation.

Conclusion #2: The hours of use (HOU), installation rate (ISR), interactive effects factor (IEF) and baseline and efficient wattage inputs to the lighting savings engineering calculation are not specified in the Technical Resource Library (TRL) files. Instead, the TRL files point to the Regional Technical Forum (RTF) source files that include these inputs.

Recommendation #2: The TRL files should specify the inputs to the lighting savings engineering calculation. This would increase the efficiency of the impact evaluation process and would be consistent with other PacifiCorp states' TRL files.

- **Energy Kits Measure Category:**

Conclusion: The showerhead energy kits component had the lowest overall ISR of all energy kit components. This was driven by a 50% ISR for the second showerhead in the Best Kit – 2 Bathroom Energy Kits compared to a 70% ISR for the first showerhead.

Recommendation: ADM recommends that Pacific Power consider including only one showerhead in the Best Kit – 2 Bathroom Energy Kits, which could increase the overall ISR for showerheads.

- **HVAC Measure Category:**

- HVAC Conclusion: The heat pump HVAC measures accounted for approximately 18% of overall claimed savings in 2017-2018. Through a billing analysis, ADM estimated a net realization rate of approximately 74% for the heat pump measure category across both program years 2017 and 2018. The use of wood as a supplemental heating source was not considered in ADM's analysis and could impact the baseline conditions in the claimed savings values for the heat pump measures.

- HVAC Recommendation: In the next evaluation cycle, primary data should be collected regarding the use of wood as a supplemental heating source.

- **Whole Homes Measure Category:**

Conclusion: The whole homes measure category accounted for approximately 1% of overall claimed savings in 2017-2018. ADM conducted a deemed savings review for this measure category and verified the proper application of the TRL values for the whole homes measure. Some site-specific UES values for whole homes measures were on the upper end of the range of savings values that ADM would expect.

Recommendation: If the whole homes measure category is expected to grow in subsequent program years, ADM will request the REM/Rate™ modeling files to further verify savings.

## 7 Appendices

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The following appendices accompany this Final Evaluation Report:

**APPENDIX A: Lighting Tables**

**APPENDIX B: Energy Kits Individual Component Savings Calculations**

**APPENDIX C: NTG Analysis Approaches**

**APPENDIX D: Billing Analysis Methodology**

**APPENDIX E: Measure Category Cost-Effectiveness Results**

## 7.1 Appendix A: Lighting Tables

Table 7-1: TRL Input Values and Engineering Calculation Ex-Ante UES Savings for a Sample of 2018 Lighting Measures

Lighting Measures	Upgrade Wattage	Baseline Wattage	ΔWatts	ISR	HOU	IEF	Engineering Calculation Savings
Fixture - Bathroom Vanity - 1000 to 1999 Lumens - WA	15	55	39	1.00	1.20	0.88	15.18
Fixture - Bathroom Vanity - 2000 to 3999 Lumens - WA	30	107	77	1.00	1.20	0.88	29.48
Fixture - Ceiling & Wall Flush Mount - 1000 to 1999 Lumens - WA	15	45	30	1.00	1.92	0.89	18.52
Fixture - Ceiling & Wall Flush Mount - 2000 to 3999 Lumens - WA	30	87	57	1.00	1.92	0.89	35.96
Fixture - Ceiling & Wall Flush Mount - 4000 to 7999 Lumens - WA	56	163	107	1.00	1.92	0.89	67.28
Fixture - Ceiling & Wall Flush Mount - 500 to 999 Lumens - WA	9	25	17	1.00	1.92	0.89	10.42
Fixture - Exterior Porch - 4000 to 7999 Lumens - WA	56	156	100	1.00	3.70	1.00	135.61
Fixture - Exterior Porch - 500 to 999 Lumens - WA	9	24	16	1.00	3.70	1.00	21.00
Fixture - Exterior Security - 2000 to 3999 Lumens - WA	30	95	65	1.00	3.70	1.00	88.46
Fixture - Track - 1000 to 1999 Lumens - WA	15	65	50	1.00	2.31	0.88	37.03
Fixture - Track - 2000 to 3999 Lumens - WA	30	127	97	1.00	2.31	0.88	71.92
Fixture - Track - 250 to 499 Lumens - WA	5	20	15	1.00	2.31	0.88	11.27
Fixture - Track - 500 to 999 Lumens - WA	9	37	28	1.00	2.31	0.88	20.84

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

Lighting Measures	Claimed Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
LEDs - Specialty (Decorative and Directional) - Retail - WA	1,024,985	1,133,907	110.6%
ENERGY STAR Fixture - LED - Upstream - WA	445,210	369,938	83.1%
LEDs - General Purpose (Omnidirectional) - Retail - WA	3,753,597	2,261,120	60.2%
CFLs - General Purpose - Retail - WA	36,720	29,165	79.4%
CFLs - Specialty - Retail - WA	80,389	52,304	65.1%
<b>2017 TOTAL</b>	<b>5,340,901</b>	<b>3,846,435</b>	<b>72.0%</b>

Table 7-3: 2018 Washington Homes Energy Savings Program Claimed and Evaluated Gross Lighting Savings

Lighting Measures	Claimed Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Realization Rate
ENERGY STAR Fixture - LED - Upstream - WA	40,300	33,486	83.1%
Fixture - Bathroom Vanity - 1000 to 1999 Lumens - WA	273	357	130.6%
Fixture - Bathroom Vanity - 2000 to 3999 Lumens - WA	590	770	130.6%
Fixture - Ceiling & Wall Flush Mount - 1000 to 1999 Lumens - WA	54,393	44,269	81.4%
Fixture - Ceiling & Wall Flush Mount - 2000 to 3999 Lumens - WA	21,756	17,709	81.4%
Fixture - Ceiling & Wall Flush Mount - 4000 to 7999 Lumens - WA	33,842	27,547	81.4%
Fixture - Ceiling & Wall Flush Mount - 500 to 999 Lumens - WA	6,971	5,671	81.3%
Fixture - Exterior Porch - 4000 to 7999 Lumens - WA	408	172	42.2%
Fixture - Exterior Porch - 500 to 999 Lumens - WA	6,132	2,596	42.3%
Fixture - Exterior Security - 2000 to 3999 Lumens - WA	2,565	1,087	42.4%
Fixture - Track - 1000 to 1999 Lumens - WA	111	75	67.7%
Fixture - Track - 2000 to 3999 Lumens - WA	863	584	67.7%
Fixture - Track - 250 to 499 Lumens - WA	34	23	67.6%
Fixture - Track - 500 to 999 Lumens - WA	63	42	67.7%
LEDs - Decorative & Mini-Base - 250 to 1049 Lumens - WA	128,510	90,755	70.6%
LEDs - General Purpose & Three-Way - 1050 to 1489 Lumens - WA	58,579	40,006	68.3%
LEDs - General Purpose & Three-Way - 1490 to 2600 Lumens - WA	190,743	130,249	68.3%
LEDs - General Purpose & Three-Way - 250 to 1049 Lumens - WA	1,329,850	964,650	72.5%
LEDs - General Purpose (Omnidirectional) - Retail - WA	364,931	219,830	60.2%
LEDs - Globe - 250 to 1049 Lumens - WA	115,488	108,703	94.1%
LEDs - MR 500 to 999 Lumens (Pin Base) - WA	3,605	1,855	51.4%
LEDs - Non-MR Bi-Pin 500 to 999 Lumens (Pin Base) - WA	2,501	1,409	56.3%
LEDs - Reflectors & Outdoor - 1050 to 1489 Lumens - WA	95,571	51,131	53.5%
LEDs - Reflectors & Outdoor - 1490 to 2600 Lumens - WA	14,568	7,323	50.3%
LEDs - Reflectors & Outdoor - 250 to 1049 Lumens - WA	639,391	378,077	59.1%
LEDs - Specialty (Decorative and Directional) - Retail - WA	108,936	120,512	110.6%
<b>2018 TOTAL</b>	<b>3,220,974</b>	<b>2,248,886</b>	<b>69.8%</b>

Table 7-4: 2017 Washington Home Energy Savings Program Net Lighting Savings and NTG

Lighting Measures	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
LEDs - Specialty (Decorative and Directional) - Retail - WA	1,133,907	839,771	74.1%
ENERGY STAR Fixture - LED - Upstream - WA	369,938	343,968	93.0%
LEDs - General Purpose (Omnidirectional) - Retail - WA	2,261,120	1,674,585	74.1%
CFLs - General Purpose - Retail - WA	29,165	21,600	74.1%
CFLs - Specialty - Retail - WA	52,304	38,737	74.1%
<b>2017 TOTAL</b>	<b>3,846,435</b>	<b>2,918,662</b>	<b>75.9%</b>

Table 7-5: 2018 Washington Home Energy Savings Program Net Lighting Savings and NTG

Lighting Measures	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	NTG
ENERGY STAR Fixture - LED - Upstream - WA	33,486	31,135	93.0%
Fixture - Bathroom Vanity - 1000 to 1999 Lumens - WA	357	332	93.0%
Fixture - Bathroom Vanity - 2000 to 3999 Lumens - WA	770	716	93.0%
Fixture - Ceiling & Wall Flush Mount - 1000 to 1999 Lumens - WA	44,269	41,161	93.0%
Fixture - Ceiling & Wall Flush Mount - 2000 to 3999 Lumens - WA	17,709	16,466	93.0%
Fixture - Ceiling & Wall Flush Mount - 4000 to 7999 Lumens - WA	27,547	25,613	93.0%
Fixture - Ceiling & Wall Flush Mount - 500 to 999 Lumens - WA	5,671	5,272	93.0%
Fixture - Exterior Porch - 4000 to 7999 Lumens - WA	172	160	93.0%
Fixture - Exterior Porch - 500 to 999 Lumens - WA	2,596	2,414	93.0%
Fixture - Exterior Security - 2000 to 3999 Lumens - WA	1,087	1,010	93.0%
Fixture - Track - 1000 to 1999 Lumens - WA	75	70	93.0%
Fixture - Track - 2000 to 3999 Lumens - WA	584	543	93.0%
Fixture - Track - 250 to 499 Lumens - WA	23	21	93.0%
Fixture - Track - 500 to 999 Lumens - WA	42	39	93.0%
LEDs - Decorative & Mini-Base - 250 to 1049 Lumens - WA	90,755	67,213	74.1%
LEDs - General Purpose & Three-Way - 1050 to 1489 Lumens - WA	40,006	29,629	74.1%
LEDs - General Purpose & Three-Way - 1490 to 2600 Lumens - WA	130,249	96,462	74.1%
LEDs - General Purpose & Three-Way - 250 to 1049 Lumens - WA	964,650	714,420	74.1%
LEDs - General Purpose (Omnidirectional) - Retail - WA	219,830	162,806	74.1%
LEDs - Globe - 250 to 1049 Lumens - WA	108,703	80,505	74.1%
LEDs - MR 500 to 999 Lumens (Pin Base) - WA	1,855	1,373	74.1%
LEDs - Non-MR Bi-Pin 500 to 999 Lumens (Pin Base) - WA	1,409	1,043	74.1%
LEDs - Reflectors & Outdoor - 1050 to 1489 Lumens - WA	51,131	37,867	74.1%
LEDs - Reflectors & Outdoor - 1490 to 2600 Lumens - WA	7,323	5,424	74.1%
LEDs - Reflectors & Outdoor - 250 to 1049 Lumens - WA	378,077	280,004	74.1%
LEDs - Specialty (Decorative and Directional) - Retail - WA	120,512	89,251	74.1%
<b>2018 TOTAL</b>	<b>2,248,886</b>	<b>1,690,951</b>	<b>75.2%</b>

## 7.2 Appendix B: Energy Kits Individual Component Savings Calculations

Table 7-6: Energy Kits Individual Component Savings Calculation Inputs, Aerators

Energy Kit Component	Input to Savings Calculation	2017 and 2018 (pre-TRL change) Assumed Input Value to Savings Calculation <sup>1</sup>	2018 (post-TRL change) Assumed Input Value to Savings Calculation <sup>1</sup>	Input Value for Evaluated Savings	Source for Evaluated Savings Calculation
Kitchen Aerator	In-Service Rate (%)	76.0%	63.0%	69%	ADM Energy Kits surveys
	Average Baseline Flow Rate (GPM)	2.2	2.2	2.2	Federal rated max flow rate
	Average Post Measure Flow Rate (GPM)	1.5	1.5	1.5	Program materials
	Average time of hot water usage per person per day (minutes)	1.8073	4.5	1.8073	Aerators_v1_1
	Average number of persons per household (state-specific values)	2.51	2.37	2.59	Aerators_v1_1
	Average temperature differential between hot and cold water (degrees)	75	36.05	75	Aerators_v1_1
	Unit Conversion (BTU/gallon)	8.345	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3,412.14	3,412.14	3,412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	64.0%	98.0%	48.7%	Aerators_v1_1
	Efficiency of Electric Water Heaters (%)	100%	98%	100%	Aerators_v1_1
Average number of faucets in the home	1	1	1.08	Aerators_v1_1	
Bathroom Aerator	In-Service Rate (%)	76.0%	61.0%	67%	ADM Energy Kits surveys
	Average Baseline Flow Rate (GPM)	2.2	2.2	2.2	Federal rated max flow rate
	Average Post Measure Flow Rate (GPM)	0.5	0.5	0.5	Program materials
	Average time of hot water usage per person per day (minutes)	1.2936	1.6	1.2936	Aerators_v1_1
	Average number of persons per household (state-specific values)	2.51	2.37	2.59	Aerators_v1_1
	Average temperature differential between hot and cold water (degrees)	75	29.05	75	Aerators_v1_1
	Unit Conversion (BTU/gallon)	8.345	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3,412.14	3,412.14	3,412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	64.0%	98.0%	48.7%	Aerators_v1_1
	Efficiency of Electric Water Heaters (%)	100%	98%	100%	Aerators_v1_1
	Average number of faucets in the home	2.12	2.43	2.56	Aerators_v1_1

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

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

Energy Kit Component	Input to Savings Calculation	2017 and 2018 (pre-TRL change) Assumed Input Value to Savings Calculation <sup>1</sup>	2018 (post-TRL change) Assumed Input Value to Savings Calculation <sup>1</sup>	Input Value for Evaluated Savings	Source for Evaluated Savings Calculation
Showerhead	In-Service Rate (%)	76.0%	60.0%	61%	ADM Energy Kits surveys
	Average Baseline Flow Rate (GPM)	2.3	2.3	2.2	Federal rated max flow rate
	Average Post Measure Flow Rate (GPM)	1.5	1.35	1.35	Program materials
	Average gallons of hot water usage per person per day	7.13	7.76	7.76	ResShowerheads_v3.0
	Average number of persons per household (state-specific values)	2.34	2.37	2.35	ResShowerheads_v3.0
	Average temperature differential between hot and cold water	75	75	75	ResShowerheads_v3.0
	Unit Conversion (BTU/gallon)	8.345	8.345	8.345	N/A
	Unit Conversion (BTU/kWh)	3412.14	3412.14	3412.14	N/A
	Fraction of Homes with Electric Water Heaters (%)	64.0%	62.0%	62.0%	ResShowerheads_v3.0
	Efficiency of Electric Water Heaters	100%	100%	100%	ResShowerheads_v3.0
	Average number of showers in the home	1.78	1.78	1.78	ResShowerheads_v3.0

<sup>1</sup> All inputs to the UES values for the showerhead energy kit component are not specified in the TRL files or associated savings source documents, and thus ADM was not able to reverse engineer the exact claimed savings values for showerheads. ADM's ex-ante calculated savings were within 6% of the ex-ante claimed savings values.

## **7.3 Appendix C: NTG Analysis Approaches**

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### **7.3.1 General Population Survey and Lighting NTG Methodology**

Pacific Power customers who receive lighting discounts through the Home Energy Savings Program were surveyed by ADM through the General Population survey to determine a program attribution estimation for the NTG calculation. The attribution scoring system is broken down into two components: free-ridership score and spillover score. Each component is described individually in the subsequent subsections.

The objective of the net-to-gross analysis is to estimate the share of program activity that would have occurred in the absence of the program. To accomplish this, the Evaluators administered a survey to program participants that contained questions regarding the participants' plans to implement the lighting measures and the likelihood of implementing those measures had they not been provided through the program.

#### *7.3.1.1 Freeridership*

First, the percentage of light types replaced was found by using the question:

*Did the [LED BULB/LED FIXTURE] replace traditional incandescent, old LED, some other type of bulb/fixture, or a combination? Please provide an estimate of the number of LED light bulbs that replaced each bulb type.*

Each light type was divided by the total number reported replaced.

The importance score was calculated by averaging the responses to this question:

*How important was the discount on your decision to purchase [LED BULBS/LED FIXTURES] at [STORE NAME]?*

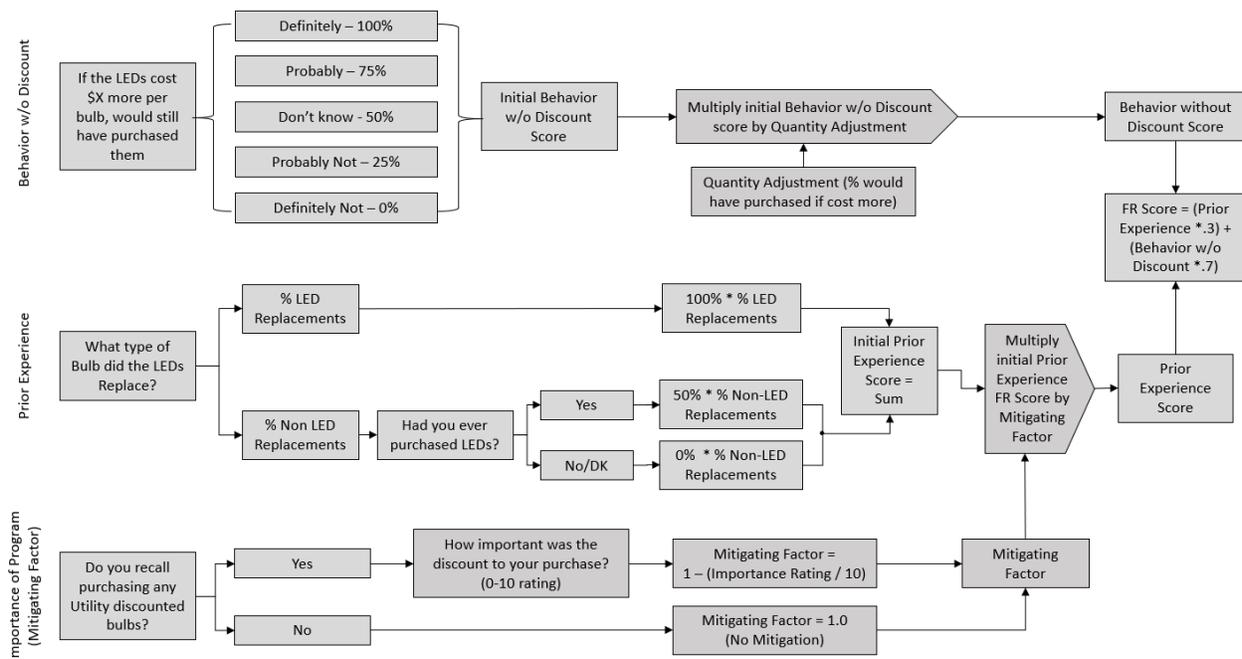
The total LED bulbs was calculated using the following questions:

*How many of those [LED Bulbs/LED Fixtures] would you estimate you installed within one week of purchase?*

*How many of those [LED Bulbs/LED Fixtures] did you save to install at a later date?*

*Approximately how many do you have left?*

Figure 7-1: Freeridership Methodology for Lighting



### 7.3.1.2 Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents were asked whether they implemented any additional energy saving measures for which they did not receive a program incentive. Respondents were also asked to provide information on the attributes of the measures implemented for use in estimating the associated energy savings.

Participants who report implementing one or more efficiency measures are then asked two questions for use in developing a spillover score:

SO1: On a scale of 1 to 5, where 1 represents “not important” and 5 represents “very important”, how important was your experience with the Home Energy Savings Program in your decision to purchase the items you just mentioned?

SO2: On a scale of 1 to 5, where 1 represents “very unlikely” and 5 represents “very likely” how likely would you have been to make the additional purchases you just mentioned even if you had not participated in the Home Energy Savings Program?

The response to these questions were used to develop a spillover score as follows:

Spillover = Average (SO1, 5 – SO2)

All of the associated measure savings were considered attributable to the program if the resulting score was equal or greater than 3.

### **7.3.2 Energy Kit Survey and NTG Methodology**

Pacific Power customers who receive energy kits through the Home Energy Savings Program were surveyed by ADM to determine a program attribution estimation for the NTG calculation. The attribution scoring system is broken down into two components: free-ridership score and spillover score. Each component is described individually in the subsequent subsection, followed by a paragraph discussing how the scores will be weighted to extrapolate the survey results to the program level.

The objective of the net-to-gross analysis is to estimate the share of program activity that would have occurred in the absence of the program. To accomplish this, the Evaluators administered a survey to program participants that contained questions regarding the participants' plans to implement the energy kit items and the likelihood of implementing those measures had they not been provided through the program. Program participants were asked questions regarding:

- Whether they had plans to purchase and install the energy kit item;
- When would they have implemented the energy kit item in the absence of the program;
- The likelihood of purchasing and installing the energy kit item had they not received it for free.

Participant responses to these questions will be used to calculate two scores corresponding to the presence of prior plans and the likelihood of installing the items in the absence of the program.

#### *7.3.2.1 Prior Plans Score*

The prior plans score was calculated as follows:

- Respondents who indicated that they did not have plans to install the energy kit item were scored as 0.
- Respondents who indicated that they did have plans to install the energy kit item were scored as 1.

This score is adjusted based on the timing of the planned installation. The timing adjustment is based on when they will have likely installed the items. For respondents that say they would have likely installed the items immediately, no timing adjustment is

made. Respondents who indicate that they would have likely installed the item within 6 months, the plans score is multiplied by 0.5. For those that would install after 6 months, the plan score is set to 0.

#### *7.3.2.2 Likelihood of Project Completion Score*

The score reflecting the likelihood of completing the project in the absence of the program was based on the following question:

- Using a scale where 1 is “very unlikely” and 5 is “very likely” how likely is it that you would have purchased and installed one of the below items had it not been in your energy kit?

A score was assigned to each response for this question as follows:

- Very likely: 1
- Slightly likely: 0.75
- Either: 0.5
- Slightly unlikely: 0.25
- Very unlikely: 0

#### *7.3.2.3 Final Freeridership Score*

The final free ridership score is equal to the following:

Free Ridership = Average (Plans Score, Likelihood Score) \* Previous experience adjustment

The previous experience adjustment was based on a question about whether the respondent had similar items currently installed in the home. The freeridership score for those that answer zero percent, “Not Applicable” or “Don’t know” to this question was multiplied by 0. The freeridership score for those that answer greater than zero percent to this question was multiplied by 0.5.

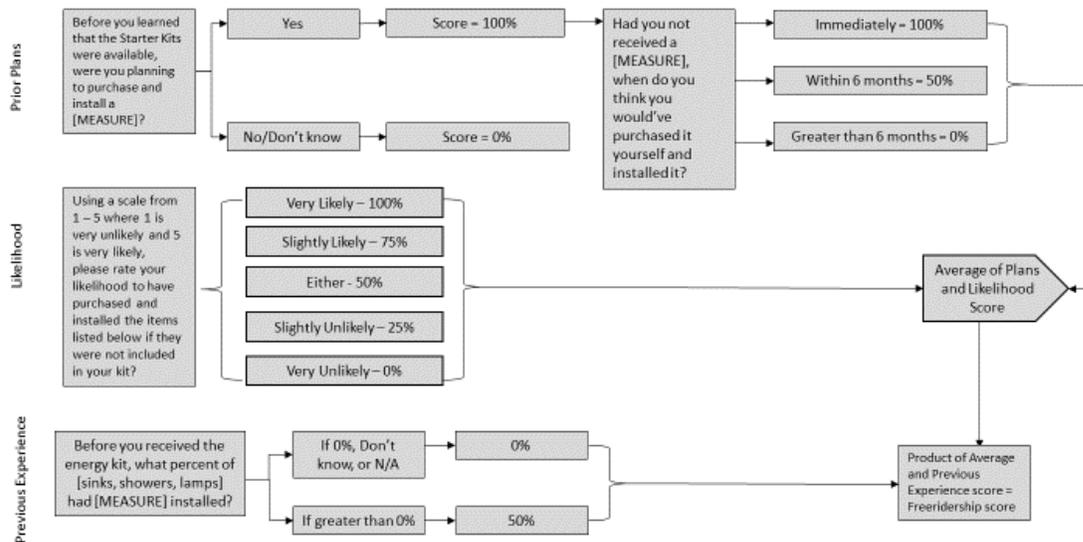
The free ridership questions are arranged as follows:

1. Indicator one: prior planning
2. Indicator two: stated likelihood in absence of program incentives
3. Mitigating factor one: reported prior experience with energy conservation measure

How these questions work together to determine a measure level free ridership score is displayed in Figure 7-2 on the following page. Note that the scoring algorithm requires the respondent to indicate a “burden of proof” that they are a free rider. They must state that

either 1) they had prior plans to install the measure or 2) they would have likely installed the measure in the absence of the program.

Figure 7-2: Freeridership Methodology for Energy Kit Component of Program



#### 7.3.2.4 Methodology for Estimating Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents were asked whether they implemented any additional energy saving measures for which they did not receive a program incentive. Respondents were also asked to provide information on the attributes of the measures implemented for use in estimating the associated energy savings.

Participants who report implementing on one or more efficiency measures are then asked two questions for use in developing a spillover score:

SO1: On a scale of 1 to 5, where 1 represents “not important” and 5 represents “very important”, how important was your experience with Home Energy Savings Program in your decision to purchase the items you just mentioned?

SO2: On a scale of 1 to 5, where 1 represents “very unlikely” and 5 represents “very likely” how likely would you have been to make the additional purchases you just mentioned even if you had not participated in the Home Energy Savings Program?

The response to these questions were used to develop a spillover score as follows:

Spillover = Average(SO1, 5 – SO2)

All of the associated measure savings were considered attributable to the program if the resulting score was equal or greater than 3.

#### *7.3.2.5 Determination of Program Level NTG*

The free ridership scores for each respondent will be weighted by the ex-ante kWh savings per energy kit type to determine the final weighted average free-ridership estimate per customer in the sample. This estimate will be applied to the program level verified gross savings to determine net savings.

### **7.3.3 HVAC Survey and NTG Methodology**

The following section presents the methodology that was used for estimating the net energy impacts resulting from the Home Energy Savings Program HVAC and appliance measures 2017 and 2018.

#### *7.3.3.1 Survey Data Collection*

A survey of program participants was administered to collect data for use in estimating participant free ridership and spillover. Responses to the free ridership questions were collected through an online survey.

#### *7.3.3.2 Methodology for Estimating Ex-Post Net Energy Savings*

The net savings analysis is used to determine what part of the gross energy savings achieved by program participants can be attributed to the effects of the program. The net savings attributable to program participants are the gross savings less free ridership, plus spillover. ADM estimated free ridership and participant spillover through a survey of program participants. Non-participant spillover was estimated through a survey of non-participants.

#### *7.3.3.3 Methodology for Estimating Freeridership*

Survey respondents were asked a series of questions designed to elicit information regarding the following factors:

- Financial ability and plans and intentions to implement the efficiency measure;
- The program influence on the decision to implement the efficiency measure;
- The program's influence on the timing of the measure installation.

The calculation of a free ridership score was based on the responses to questions about the participants' prior plans and intentions, program influence on measure selection, and program influence on timing of measure implementation.

#### 7.3.3.3.1 Financial Ability and Plans and Intentions

Two indicator variables were developed based on responses to the survey questions on plans and intentions. The first corresponds to financial ability. Respondents were considered to have not been financially able to install the efficient equipment if they answer "no" to the question below:

FR1: Would you have been able to afford to purchase the efficient [EFF\_MEASURE1] if the rebate was not available from the program?

The second indicator variable is related to whether the customer had plans to implement the efficiency measure. Respondents were considered to have had plans if they answer "yes" to the following question:

FR2: Were you planning to purchase [EFF\_MEASURE1] before you learned of [UTILITY] Home Energy Savings Program?

Respondents who were found to not have plans or the financial ability to implement the measures were deemed to not be free riders.

#### 7.3.3.3.2 Program Influence on Decision to Implement Energy Efficiency Measure

Participants were asked about the direct influence of the program on their decision to implement the energy efficiency measures. Specifically, participants were asked:

FR3: On a scale of 1-5 where 1 is "not at all likely" and 5 is "very likely", how likely is it that you would have purchased and installed the [EFF\_MEASURE1] if you had not received the financial or information assistance through the program?

A program influence score was developed based on this response in the following manner:

- A response of "1" = 0% Free Ridership
- A response of "2" = 25% Free Ridership
- A response of "3" = 50% Free Ridership

- A response of “4” = 75% Free Ridership
- A response of “5” = 100% Free Ridership

#### 7.3.3.3.3 Program Influence on Project Timing

To account for deferred free ridership due to the program’s effect on the timing of the implementation of the efficiency measure, respondents were asked the following two questions:

FR4: Did you purchase and install the [EFF\_MEASURE] sooner than you would have if the information and financial assistance from the program had not been available?

FR5: When might you have purchased or installed the same [EFF\_MEASURE] if you had not participated in the program?

If the survey participant responds “yes” to question FR4 then a timing adjustment was calculated based on the answer to FR5 as shown in Table 7-8.

*Table 7-8: Timing Adjustment Score*

Likely Timing of Project in Absence of the Program	Timing Score
Within 6 months	1
Between 6 months and 1 year	0.67
In more than 1 year to 2 years	0.33
In two years or more	0

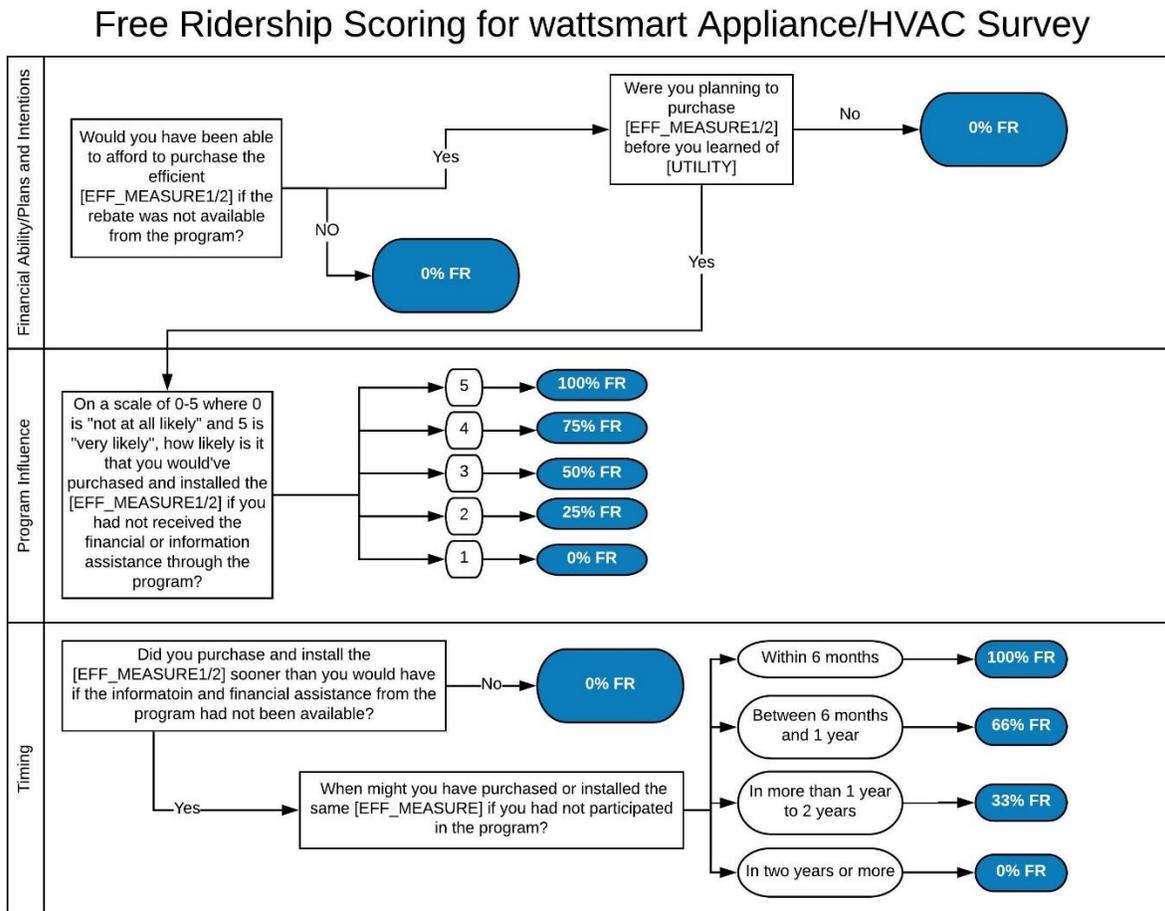
#### 7.3.3.3.4 Freeridership Scoring

For respondents that did not have plans or intentions, an overall free ridership score was developed based on the program influence score and timing score. An overall project free ridership score is based by combining the scores described above using the following equation:

$$\text{Free Ridership} = \text{Program Influence} * \text{Timing Score}$$

The flowchart illustrating the methodology used to calculate free ridership can be found in the diagram in Figure 7-3.

Figure 7-3: Freeridership Methodology for Home Energy Savings HVAC and Appliance Measures



#### 7.3.3.4 Methodology for Estimating Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents were asked whether they implemented any additional energy saving measures for which they did not receive a program incentive. Respondents were also asked to provide information on the attributes of the measures implemented for use in estimating the associated energy savings.

Participants who report implementing on one or more efficiency measures are then asked two questions for use in developing a spillover score:

SO1: On a scale of 1 to 5, where 1 represents “not important” and 5 represents “very important”, how important was your experience with Home Energy Savings Program in your decision to purchase the items you just mentioned?

SO2: On a scale of 1 to 5, where 1 represents “extremely likely” and 5 represents “extremely likely” how likely would you have been to make the additional purchases you just mentioned even if you had not participated in the Home Energy Savings Program?

The response to these questions were used to develop a spillover score as follows:

- $\text{Spillover} = \text{Average}(\text{SO1}, 5 - \text{SO2})$

All of the associated measure savings were considered attributable to the program if the resulting score was equal to or greater than 3.

## **7.4 Appendix D: Billing Analysis Methodology**

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### **7.4.1 Clean Data**

The analysis began with cleaning the billing and Program Tracking Data to develop a streamlined, simple format for analysis. The billing data contains a unique premise plus customer identifier called 'Concat Agreement Number' which consists of 14 digits. The Program Tracking Data has a similar column called 'Bill Account Number', also consisting of 14 digits. The tracking data account numbers do not always have a full 14 digits. This is the only valid column for mapping billing data of a premise to a specific measure installed in the Program Tracking Data at that premise. Both data sets minimally contain the first 8 digits of the Account Number which is also called the 'Customer Id'. This, combined with an address string (also located in both datasets), can be used to match full Account Numbers from the billing data to the incomplete account numbers in the tracking data.

The cleaning began by identifying any customer IDs in the billing data which have multiple account numbers tied to the same address and removing them from consideration as it would be impossible to say which account number is correct when mapping on customer ID and address alone. Account numbers are then assigned to the Program Tracking Data set based on matching customer IDs and addresses in the billing data.

Predefined analysis groups consisting of multiple versions of the same measure types were assigned to the measures in the Program Tracking Data in order to achieve larger population groups upon which to conduct the billing analysis.

### **7.4.2 Incorporate Weather Data**

Zip codes in the billing data were used to match line items with the nearest weather stations by calculating the Haversine distance between latitudinal and longitudinal coordinates.

An optimizing algorithm applied on integer sets of possible cooling degree day (CDD) and heating degree day (HDD) base conditions was used on the billing data and associated weather data to determine the appropriate average degree day bases by selecting the set of parameters that minimizes the root mean squared error of a piecewise regression on consumption. The optimal values were found to be 63 for a CDD base and 47 for a HDD base.

The cumulative CDD and HDD for a given line item in the billing data was assigned based on the listed billing cycle start and end dates. These values were divided by the number

of days in the billing cycle to get average cooling degree days per day (CDDD) and heating degree days per day (HDDD) values.

### **7.4.3 Regression Analysis**

Any account numbers found to be associated with more than one analysis group were removed from the regression calculation so as to not double count savings. The earliest and latest installation dates were then identified for each account number such that the pre period can be defined as any billing data points with Meter Read dates before the earliest installation of a measure and the post period is any billing data points with Meter Read dates after the latest installation listed.

A control group was developed using “Late Installs”, program participants who had a measure installed too late to be considered in the regression analysis due to not yet having sufficient post period data for analysis. The cutoff date separating treatment participants from the late installs was selected to be 2018-06-01. This date was selected based on a determination of acquiring a sufficient number of potential control group homes to be able to have a reasonably high probability of acquiring a representative control population. Because of the need to use late installs as a control group, billing data with meter read dates after the cutoff date have to be removed from the analysis to remove potential bias.

A propensity score was developed on the pre-period average consumption across the full set of premises and used to determine appropriate control group matches for each treatment home. If t-tests along with some other matching characteristic statistics indicate a poorly matching population, the analysis defaults to running multiple iterations across randomly selected matches to attempt to stabilize observable effects. Specifically, a set of 1000 randomly selected control group homes were selected for each treatment home. The regression analysis was then performed 1000 times for each set and each iteration is filtered down to ensure that matching between a treatment and control home is one-to-one and there are no duplicates.

A regression of the form:

$$kWhd = a_0 * post + a_1 * treat + a_2 * CDDD + a_3 * HDDD + a_4 * post * treat + a_5 * post * CDDD + a_6 * treat * CDDD + a_7 * post * HDDD + a_8 * treat * HDDD + a_9 * post * treat * CDDD + a_{10} * post * treat * HDDD + (1 | \frac{AcctNum}{Month})$$

with nested random effects terms included for the Account Number and the month was run for each iteration. The treatment effect was then calculated as:

$$Daily Savings due to Treatment = a_4 + a_9 * CDDD_{Avg} + a_{10} * HDDD_{Avg}$$

The treatment effect for each iteration was then averaged across the 1000 iterations to give the estimated measure impact for each analysis group.

## 7.5 Appendix E: Measure Category Cost-Effectiveness Results

The following tables show the cost-effectiveness results for each measure category in the Program for each program year (both without NEIs and including NEIs), based on the Washington standard NTG ratio of 1. The 2017 cost-effectiveness was tested using the 2015 IRP west residential whole house 64%, west residential lighting 45%, west residential heating 17%, and west water heating – 53% decrements. The 2018 cost-effectiveness was tested using the 2017 IRP decrement for all measure categories. There was a slight discrepancy of \$16,556 in the total amount of NEIs for the Building Shell measures in 2018 between what ADM calculated and the Program Tracking Data. The cost-effectiveness results, including NEIs, are based off of ADM’s calculations.

*Table 7-9: 2017 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results (without NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1329	\$27,532	\$16,590	-\$10,942	0.60
Total Resource Cost Test (TRC) No Adder	\$0.1329	\$27,532	\$15,082	-\$12,450	0.55
Utility Cost Test (UCT)	\$0.0726	\$15,052	\$15,082	\$30	1.00
Rate Impact Test (RIM)		\$35,190	\$15,082	-\$20,108	0.43
Participant Cost Test (PCT)		\$20,680	\$28,338	\$7,658	1.37
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000003558
Discounted Participant Payback (years)					7.60

*Table 7-10: 2017 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results (including NEIs)*

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1329	\$27,532	\$52,756	\$25,224	1.92
Total Resource Cost Test (TRC) No Adder	\$0.1329	\$27,532	\$51,248	\$23,716	1.86
Utility Cost Test (UCT)	\$0.0726	\$15,052	\$15,082	\$30	1.00
Rate Impact Test (RIM)		\$35,190	\$15,082	-\$20,108	0.43
Participant Cost Test (PCT)		\$20,680	\$64,504	\$43,824	3.12
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000003558
Discounted Participant Payback (years)					7.60

Table 7-11: 2017 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1553	\$211,837	\$91,984	-\$119,853	0.43
Total Resource Cost Test (TRC) No Adder	\$0.1553	\$211,837	\$83,622	-\$128,215	0.39
Utility Cost Test (UCT)	\$0.0615	\$83,921	\$83,622	-\$299	1.00
Rate Impact Test (RIM)		\$217,487	\$83,622	-\$133,865	0.38
Participant Cost Test (PCT)		\$187,219	\$192,869	\$5,650	1.03
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000007336				
Discounted Participant Payback (years)	n/a				

Table 7-12: 2017 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0227	\$128,568	\$434,155	\$305,588	3.38
Total Resource Cost Test (TRC) No Adder	\$0.0227	\$128,568	\$394,687	\$266,119	3.07
Utility Cost Test (UCT)	\$0.0227	\$128,568	\$394,687	\$266,119	3.07
Rate Impact Test (RIM)		\$677,101	\$394,687	-\$282,414	0.58
Participant Cost Test (PCT)		\$20,147	\$568,681	\$548,533	28.23
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000070021				
Discounted Participant Payback (years)	n/a				

Table 7-13: 2017 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0227	\$128,568	\$876,176	\$747,608	6.81
Total Resource Cost Test (TRC) No Adder	\$0.0227	\$128,568	\$836,707	\$708,139	6.51
Utility Cost Test (UCT)	\$0.0227	\$128,568	\$394,687	\$266,119	3.07
Rate Impact Test (RIM)		\$677,101	\$394,687	-\$282,414	0.58
Participant Cost Test (PCT)		\$20,147	\$1,010,701	\$990,554	50.17
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000070021				
Discounted Participant Payback (years)	n/a				

Table 7-14: 2017 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0422	\$1,459,724	\$2,664,070	\$1,204,346	1.83
Total Resource Cost Test (TRC) No Adder	\$0.0422	\$1,459,724	\$2,421,882	\$962,158	1.66
Utility Cost Test (UCT)	\$0.0195	\$673,573	\$2,421,882	\$1,748,309	3.60
Rate Impact Test (RIM)		\$4,029,954	\$2,421,882	-\$1,608,072	0.60
Participant Cost Test (PCT)		\$1,300,421	\$3,870,650	\$2,570,230	2.98
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000332101
Discounted Participant Payback (years)					2.28

Table 7-15: 2017 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0438	\$6,583	\$20,455	\$13,871	3.11
Total Resource Cost Test (TRC) No Adder	\$0.0438	\$6,583	\$19,401	\$12,817	2.95
Utility Cost Test (UCT)	\$0.0438	\$6,583	\$10,540	\$3,957	1.60
Rate Impact Test (RIM)		\$21,191	\$10,540	-\$10,650	0.50
Participant Cost Test (PCT)		\$2,291	\$25,759	\$23,468	11.24
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000002200
Discounted Participant Payback (years)					n/a

Table 7-16: 2017 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1043	\$1,981,001	\$1,986,872	\$5,872	1.00
Total Resource Cost Test (TRC) No Adder	\$0.1043	\$1,981,001	\$1,806,247	-\$174,753	0.91
Utility Cost Test (UCT)	\$0.0771	\$1,463,573	\$1,806,247	\$342,674	1.23
Rate Impact Test (RIM)		\$3,311,293	\$1,806,247	-\$1,505,045	0.55
Participant Cost Test (PCT)		\$1,303,891	\$2,634,183	\$1,330,292	2.02
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000219093
Discounted Participant Payback (years)					3.60

Table 7-17: 2017 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1043	\$1,981,001	\$2,044,751	\$63,750	1.03
Total Resource Cost Test (TRC) No Adder	\$0.1043	\$1,981,001	\$1,864,126	-\$116,874	0.94
Utility Cost Test (UCT)	\$0.0771	\$1,463,573	\$1,806,247	\$342,674	1.23
Rate Impact Test (RIM)		\$3,311,293	\$1,806,247	-\$1,505,045	0.55
Participant Cost Test (PCT)		\$1,303,891	\$2,692,062	\$1,388,171	2.06
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000219093
Discounted Participant Payback (years)					3.60

Table 7-18: 2017 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0422	\$1,459,724	\$2,664,070	\$1,204,346	1.83
Total Resource Cost Test (TRC) No Adder	\$0.0422	\$1,459,724	\$2,421,882	\$962,158	1.66
Utility Cost Test (UCT)	\$0.0195	\$673,573	\$2,421,882	\$1,748,309	3.60
Rate Impact Test (RIM)		\$4,029,954	\$2,421,882	-\$1,608,072	0.60
Participant Cost Test (PCT)		\$1,300,421	\$3,870,650	\$2,570,230	2.98
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000332101
Discounted Participant Payback (years)					2.28

Table 7-19: 2017 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0422	\$1,459,724	\$4,970,634	\$3,510,910	3.41
Total Resource Cost Test (TRC) No Adder	\$0.0422	\$1,459,724	\$4,728,446	\$3,268,721	3.24
Utility Cost Test (UCT)	\$0.0195	\$673,573	\$2,421,882	\$1,748,309	3.60
Rate Impact Test (RIM)		\$4,029,954	\$2,421,882	-\$1,608,072	0.60
Participant Cost Test (PCT)		\$1,300,421	\$6,177,214	\$4,876,793	4.75
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000332101
Discounted Participant Payback (years)					2.28

*Table 7-20: 2017 WA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0887	\$76,612	\$68,806	-\$7,806	0.90
Total Resource Cost Test (TRC) No Adder	\$0.0887	\$76,612	\$62,551	-\$14,061	0.82
Utility Cost Test (UCT)	\$0.0776	\$67,048	\$62,551	-\$4,497	0.93
Rate Impact Test (RIM)		\$150,978	\$62,551	-\$88,427	0.41
Participant Cost Test (PCT)		\$46,482	\$120,848	\$74,366	2.60
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000016854				
Discounted Participant Payback (years)	1.15				

*Table 7-21: 2017 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0724	\$76,374	\$71,906	-\$4,468	0.94
Total Resource Cost Test (TRC) No Adder	\$0.0724	\$76,374	\$65,369	-\$11,005	0.86
Utility Cost Test (UCT)	\$0.0496	\$52,329	\$65,369	\$13,040	1.25
Rate Impact Test (RIM)		\$155,188	\$65,369	-\$89,819	0.42
Participant Cost Test (PCT)		\$53,045	\$131,859	\$78,814	2.49
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000008215				
Discounted Participant Payback (years)	3.97				

*Table 7-22: 2018 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1288	\$20,236	\$7,543	-\$12,692	0.37
Total Resource Cost Test (TRC) No Adder	\$0.1288	\$20,236	\$6,858	-\$13,378	0.34
Utility Cost Test (UCT)	\$0.0638	\$10,029	\$6,858	-\$3,171	0.68
Rate Impact Test (RIM)		\$24,724	\$6,858	-\$17,866	0.28
Participant Cost Test (PCT)		\$15,607	\$20,095	\$4,488	1.29
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003155				
Discounted Participant Payback (years)	8.81				

Table 7-23: 2018 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1288	\$20,236	\$34,378	\$14,142	1.70
Total Resource Cost Test (TRC) No Adder	\$0.1288	\$20,236	\$33,692	\$13,456	1.66
Utility Cost Test (UCT)	\$0.0638	\$10,029	\$6,858	-\$3,171	0.68
Rate Impact Test (RIM)		\$24,724	\$6,858	-\$17,866	0.28
Participant Cost Test (PCT)		\$15,607	\$46,929	\$31,323	3.01
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000003155
Discounted Participant Payback (years)					8.81

Table 7-24: 2018 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1760	\$179,715	\$65,412	-\$114,302	0.36
Total Resource Cost Test (TRC) No Adder	\$0.1760	\$179,715	\$59,466	-\$120,249	0.33
Utility Cost Test (UCT)	\$0.0530	\$54,116	\$59,466	\$5,350	1.10
Rate Impact Test (RIM)		\$150,371	\$59,466	-\$90,905	0.40
Participant Cost Test (PCT)		\$163,733	\$134,389	-\$29,344	0.82
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000005085
Discounted Participant Payback (years)					n/a

Table 7-25: 2018 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1760	\$179,715	\$324,092	\$144,378	1.80
Total Resource Cost Test (TRC) No Adder	\$0.1760	\$179,715	\$318,146	\$138,431	1.77
Utility Cost Test (UCT)	\$0.0530	\$54,116	\$59,466	\$5,350	1.10
Rate Impact Test (RIM)		\$150,371	\$59,466	-\$90,905	0.40
Participant Cost Test (PCT)		\$163,733	\$393,069	\$229,336	2.40
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000005085
Discounted Participant Payback (years)					n/a

Table 7-26: 2018 WA Home Energy Savings Program Electronics Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1053	\$292	\$97	-\$195	0.33
Total Resource Cost Test (TRC) No Adder	\$0.1053	\$292	\$89	-\$204	0.30
Utility Cost Test (UCT)	\$0.1158	\$321	\$89	-\$233	0.28
Rate Impact Test (RIM)		\$580	\$89	-\$491	0.15
Participant Cost Test (PCT)		\$101	\$389	\$288	3.85
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000000243
Discounted Participant Payback (years)					n/a

Table 7-27: 2018 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0124	\$107,360	\$348,412	\$241,052	3.25
Total Resource Cost Test (TRC) No Adder	\$0.0124	\$107,360	\$316,738	\$209,378	2.95
Utility Cost Test (UCT)	\$0.0124	\$107,360	\$316,738	\$209,378	2.95
Rate Impact Test (RIM)		\$917,669	\$316,738	-\$600,931	0.35
Participant Cost Test (PCT)		\$30,884	\$841,194	\$810,309	27.24
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000148716
Discounted Participant Payback (years)					0.00

Table 7-28: 2018 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0124	\$107,360	\$1,329,938	\$1,222,578	12.39
Total Resource Cost Test (TRC) No Adder	\$0.0124	\$107,360	\$1,298,264	\$1,190,904	12.09
Utility Cost Test (UCT)	\$0.0124	\$107,360	\$316,738	\$209,378	2.95
Rate Impact Test (RIM)		\$917,669	\$316,738	-\$600,931	0.35
Participant Cost Test (PCT)		\$30,884	\$1,822,720	\$1,791,835	59.02
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000148716
Discounted Participant Payback (years)					n/a

Table 7-29: 2018 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0307	\$4,387	\$5,713	\$1,325	1.30
Total Resource Cost Test (TRC) No Adder	\$0.0307	\$4,387	\$5,193	\$806	1.18
Utility Cost Test (UCT)	\$0.0307	\$4,387	\$5,193	\$806	1.18
Rate Impact Test (RIM)		\$17,742	\$5,193	-\$12,549	0.29
Participant Cost Test (PCT)		\$2,685	\$16,040	\$13,355	5.97
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000003106
Discounted Participant Payback (years)					n/a

Table 7-30: 2018 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0307	\$4,387	\$13,405	\$9,018	3.06
Total Resource Cost Test (TRC) No Adder	\$0.0307	\$4,387	\$12,886	\$8,499	2.94
Utility Cost Test (UCT)	\$0.0307	\$4,387	\$5,193	\$806	1.18
Rate Impact Test (RIM)		\$17,742	\$5,193	-\$12,549	0.29
Participant Cost Test (PCT)		\$2,685	\$23,733	\$21,048	8.84
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000003106
Discounted Participant Payback (years)					n/a

Table 7-31: 2018 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1317	\$2,288,877	\$905,825	-\$1,383,053	0.40
Total Resource Cost Test (TRC) No Adder	\$0.1317	\$2,288,877	\$823,477	-\$1,465,400	0.36
Utility Cost Test (UCT)	\$0.0752	\$1,307,952	\$823,477	-\$484,475	0.63
Rate Impact Test (RIM)		\$2,934,517	\$823,477	-\$2,111,040	0.28
Participant Cost Test (PCT)		\$1,697,029	\$2,342,669	\$645,640	1.38
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000325903
Discounted Participant Payback (years)					8.34

Table 7-32: 2018 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1317	\$2,288,877	\$1,009,663	-\$1,279,215	0.44
Total Resource Cost Test (TRC) No Adder	\$0.1317	\$2,288,877	\$927,315	-\$1,361,562	0.41
Utility Cost Test (UCT)	\$0.0752	\$1,307,952	\$823,477	-\$484,475	0.63
Rate Impact Test (RIM)		\$2,934,517	\$823,477	-\$2,111,040	0.28
Participant Cost Test (PCT)		\$1,697,029	\$2,446,507	\$749,477	1.44
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000325903
Discounted Participant Payback (years)					8.34

Table 7-33: 2018 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0502	\$668,817	\$495,890	-\$172,927	0.74
Total Resource Cost Test (TRC) No Adder	\$0.0502	\$668,817	\$450,809	-\$218,008	0.67
Utility Cost Test (UCT)	\$0.0332	\$442,500	\$450,809	\$8,309	1.02
Rate Impact Test (RIM)		\$1,684,159	\$450,809	-\$1,233,350	0.27
Participant Cost Test (PCT)		\$506,615	\$1,521,958	\$1,015,342	3.00
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000436039
Discounted Participant Payback (years)					1.14

Table 7-34: 2018 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0502	\$668,817	\$1,330,584	\$661,767	1.99
Total Resource Cost Test (TRC) No Adder	\$0.0502	\$668,817	\$1,285,503	\$616,686	1.92
Utility Cost Test (UCT)	\$0.0332	\$442,500	\$450,809	\$8,309	1.02
Rate Impact Test (RIM)		\$1,684,159	\$450,809	-\$1,233,350	0.27
Participant Cost Test (PCT)		\$506,615	\$2,356,651	\$1,850,036	4.65
Lifecycle Revenue Impacts (\$/kWh)					\$0.0000436039
Discounted Participant Payback (years)					1.14

Table 7-35: 2018 WA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0870	\$46,181	\$24,424	-\$21,756	0.53
Total Resource Cost Test (TRC) No Adder	\$0.0870	\$46,181	\$22,204	-\$23,977	0.48
Utility Cost Test (UCT)	\$0.0696	\$36,907	\$22,204	-\$14,703	0.60
Rate Impact Test (RIM)		\$86,496	\$22,204	-\$64,292	0.26
Participant Cost Test (PCT)		\$29,674	\$69,989	\$40,315	2.36
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000012229				
Discounted Participant Payback (years)	1.95				

Table 7-36: 2018 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0815	\$153,844	\$116,391	-\$37,453	0.76
Total Resource Cost Test (TRC) No Adder	\$0.0815	\$153,844	\$105,810	-\$48,034	0.69
Utility Cost Test (UCT)	\$0.0484	\$91,255	\$105,810	\$14,555	1.16
Rate Impact Test (RIM)		\$268,662	\$105,810	-\$162,851	0.39
Participant Cost Test (PCT)		\$120,261	\$235,079	\$114,817	1.95
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000012535				
Discounted Participant Payback (years)	n/a				

Table 7-37: 2018 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0815	\$153,844	\$119,818	-\$34,026	0.78
Total Resource Cost Test (TRC) No Adder	\$0.0815	\$153,844	\$109,237	-\$44,607	0.71
Utility Cost Test (UCT)	\$0.0484	\$91,255	\$105,810	\$14,555	1.16
Rate Impact Test (RIM)		\$268,662	\$105,810	-\$162,851	0.39
Participant Cost Test (PCT)		\$120,261	\$238,505	\$118,244	1.98
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000012535				
Discounted Participant Payback (years)	n/a				

While Washington evaluation standards utilize a NTG ratio of 1 for cost-effectiveness, Navigant also calculated the Program cost-effectiveness based on the evaluated net savings provided by ADM using the measure specific NTG ratios resulting from ADM's evaluation. These cost-effectiveness results are presented below at both the program level and the measure category level. Using the evaluated net savings provided by ADM, the 2017 and 2018 combined program passes the cost-effectiveness for all tests except

the RIM test. Also using the net evaluated savings provided by ADM, the 2017 program passes the cost-effectiveness for all tests except the RIM test and the 2018 program passes the cost-effectiveness for the UCT and PCT tests.

*Table 7-38: 2017-2018 WA Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0745	\$6,854,000	\$6,402,200	-\$451,800	0.93
Total Resource Cost Test (TRC) No Adder	\$0.0745	\$6,854,000	\$5,820,182	-\$1,033,818	0.85
Utility Cost Test (UCT)	\$0.0494	\$4,545,475	\$5,820,182	\$1,274,707	1.28
Rate Impact Test (RIM)		\$13,342,219	\$5,820,182	-\$7,522,037	0.44
Participant Cost Test (PCT)		\$5,500,767	\$12,746,127	\$7,245,360	2.32
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061725				
Discounted Participant Payback (years)	3.40				

*Table 7-39: 2017-2018 WA Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0745	\$6,854,000	\$11,470,380	\$4,616,380	1.67
Total Resource Cost Test (TRC) No Adder	\$0.0745	\$6,854,000	\$10,888,362	\$4,034,362	1.59
Utility Cost Test (UCT)	\$0.0494	\$4,545,475	\$5,820,182	\$1,274,707	1.28
Rate Impact Test (RIM)		\$13,342,219	\$5,820,182	-\$7,522,037	0.44
Participant Cost Test (PCT)		\$5,500,767	\$17,814,307	\$12,313,541	3.24
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000061725				
Discounted Participant Payback (years)	3.40				

*Table 7-40: 2017 WA Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0671	\$3,582,181	\$4,618,206	\$1,036,025	1.29
Total Resource Cost Test (TRC) No Adder	\$0.0671	\$3,582,181	\$4,198,369	\$616,188	1.17
Utility Cost Test (UCT)	\$0.0467	\$2,490,647	\$4,198,369	\$1,707,722	1.69
Rate Impact Test (RIM)		\$7,679,116	\$4,198,369	-\$3,480,748	0.55
Participant Cost Test (PCT)		\$2,934,176	\$7,564,326	\$4,630,150	2.58
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000057374				
Discounted Participant Payback (years)	3.07				

*Table 7-41: 2017 WA Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0671	\$3,582,181	\$7,469,695	\$3,887,514	2.09
Total Resource Cost Test (TRC) No Adder	\$0.0671	\$3,582,181	\$7,049,858	\$3,467,677	1.97
Utility Cost Test (UCT)	\$0.0467	\$2,490,647	\$4,198,369	\$1,707,722	1.69
Rate Impact Test (RIM)		\$7,679,116	\$4,198,369	-\$3,480,748	0.55
Participant Cost Test (PCT)		\$2,934,176	\$10,415,815	\$7,481,639	3.55
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000057374				
Discounted Participant Payback (years)	3.07				

*Table 7-42: WA 2018 Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0848	\$3,271,819	\$1,783,994	-\$1,487,825	0.55
Total Resource Cost Test (TRC) No Adder	\$0.0848	\$3,271,819	\$1,621,813	-\$1,650,006	0.50
Utility Cost Test (UCT)	\$0.0532	\$2,054,828	\$1,621,813	-\$433,015	0.79
Rate Impact Test (RIM)		\$5,663,103	\$1,621,813	-\$4,041,290	0.29
Participant Cost Test (PCT)		\$2,566,591	\$5,181,801	\$2,615,210	2.02
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000066038				
Discounted Participant Payback (years)	3.78				

*Table 7-43: WA 2018 Home Energy Savings Program Level Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0848	\$3,271,819	\$4,000,686	\$728,866	1.22
Total Resource Cost Test (TRC) No Adder	\$0.0848	\$3,271,819	\$3,838,504	\$566,685	1.17
Utility Cost Test (UCT)	\$0.0532	\$2,054,828	\$1,621,813	-\$433,015	0.79
Rate Impact Test (RIM)		\$5,663,103	\$1,621,813	-\$4,041,290	0.29
Participant Cost Test (PCT)		\$2,566,591	\$7,398,492	\$4,831,901	2.88
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000066038				
Discounted Participant Payback (years)	3.78				

The cost-effectiveness results presented below are at the measure category level and based off of the evaluated net savings provided by ADM

*Table 7-44: 2017 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1417	\$23,178	\$13,097	-\$10,081	0.57
Total Resource Cost Test (TRC) No Adder	\$0.1417	\$23,178	\$11,907	-\$11,272	0.51
Utility Cost Test (UCT)	\$0.0920	\$15,052	\$11,907	-\$3,145	0.79
Rate Impact Test (RIM)		\$30,951	\$11,907	-\$19,044	0.38
Participant Cost Test (PCT)		\$20,680	\$28,338	\$7,658	1.37
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003370				
Discounted Participant Payback (years)	10.16				

*Table 7-45: 2017 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1417	\$23,178	\$49,263	\$26,085	2.13
Total Resource Cost Test (TRC) No Adder	\$0.1417	\$23,178	\$48,073	\$24,894	2.07
Utility Cost Test (UCT)	\$0.0920	\$15,052	\$11,907	-\$3,145	0.79
Rate Impact Test (RIM)		\$30,951	\$11,907	-\$19,044	0.38
Participant Cost Test (PCT)		\$20,680	\$64,504	\$43,824	3.12
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003370				
Discounted Participant Payback (years)	10.16				

*Table 7-46: 2017 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1601	\$172,423	\$72,619	-\$99,803	0.42
Total Resource Cost Test (TRC) No Adder	\$0.1601	\$172,423	\$66,017	-\$106,405	0.38
Utility Cost Test (UCT)	\$0.0779	\$83,921	\$66,017	-\$17,903	0.79
Rate Impact Test (RIM)		\$189,368	\$66,017	-\$123,350	0.35
Participant Cost Test (PCT)		\$187,219	\$192,869	\$5,650	1.03
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000006759				
Discounted Participant Payback (years)	n/a				

*Table 7-47: 2017 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0238	\$127,538	\$411,970	\$284,432	3.23
Total Resource Cost Test (TRC) No Adder	\$0.0238	\$127,538	\$374,518	\$246,980	2.94
Utility Cost Test (UCT)	\$0.0240	\$128,568	\$374,518	\$245,950	2.91
Rate Impact Test (RIM)		\$649,071	\$374,518	-\$274,553	0.58
Participant Cost Test (PCT)		\$20,147	\$568,681	\$548,533	28.23
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000068072				
Discounted Participant Payback (years)	n/a				

*Table 7-48: 2017 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0238	\$127,538	\$853,991	\$726,452	6.70
Total Resource Cost Test (TRC) No Adder	\$0.0238	\$127,538	\$816,539	\$689,001	6.40
Utility Cost Test (UCT)	\$0.0240	\$128,568	\$374,518	\$245,950	2.91
Rate Impact Test (RIM)		\$649,071	\$374,518	-\$274,553	0.58
Participant Cost Test (PCT)		\$20,147	\$1,010,701	\$990,554	50.17
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000068072				
Discounted Participant Payback (years)	n/a				

*Table 7-49: 2017 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0453	\$6,466	\$11,002	\$4,536	1.70
Total Resource Cost Test (TRC) No Adder	\$0.0453	\$6,466	\$10,002	\$3,535	1.55
Utility Cost Test (UCT)	\$0.0461	\$6,583	\$10,002	\$3,418	1.52
Rate Impact Test (RIM)		\$20,444	\$10,002	-\$10,442	0.49
Participant Cost Test (PCT)		\$2,291	\$16,898	\$14,607	7.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000002157				
Discounted Participant Payback (years)	n/a				

*Table 7-50: 2017 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0453	\$6,466	\$19,862	\$13,396	3.07
Total Resource Cost Test (TRC) No Adder	\$0.0453	\$6,466	\$18,862	\$12,396	2.92
Utility Cost Test (UCT)	\$0.0461	\$6,583	\$10,002	\$3,418	1.52
Rate Impact Test (RIM)		\$20,444	\$10,002	-\$10,442	0.49
Participant Cost Test (PCT)		\$2,291	\$25,759	\$23,468	11.24
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000002157				
Discounted Participant Payback (years)	n/a				

*Table 7-51: 2017 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1045	\$1,974,483	\$1,976,941	\$2,458	1.00
Total Resource Cost Test (TRC) No Adder	\$0.1045	\$1,974,483	\$1,797,219	-\$177,264	0.91
Utility Cost Test (UCT)	\$0.0774	\$1,463,573	\$1,797,219	\$333,645	1.23
Rate Impact Test (RIM)		\$3,302,057	\$1,797,219	-\$1,504,838	0.54
Participant Cost Test (PCT)		\$1,303,891	\$2,634,183	\$1,330,292	2.02
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000219063				
Discounted Participant Payback (years)	3.62				

*Table 7-52: 2017 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1045	\$1,974,483	\$2,034,819	\$60,336	1.03
Total Resource Cost Test (TRC) No Adder	\$0.1045	\$1,974,483	\$1,855,098	-\$119,385	0.94
Utility Cost Test (UCT)	\$0.0774	\$1,463,573	\$1,797,219	\$333,645	1.23
Rate Impact Test (RIM)		\$3,302,057	\$1,797,219	-\$1,504,838	0.54
Participant Cost Test (PCT)		\$1,303,891	\$2,692,062	\$1,388,171	2.06
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000219063				
Discounted Participant Payback (years)	3.62				

Table 7-53: 2017 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0437	\$1,146,059	\$2,021,488	\$875,429	1.76
Total Resource Cost Test (TRC) No Adder	\$0.0437	\$1,146,059	\$1,837,716	\$691,657	1.60
Utility Cost Test (UCT)	\$0.0257	\$673,573	\$1,837,716	\$1,164,143	2.73
Rate Impact Test (RIM)		\$3,220,384	\$1,837,716	-\$1,382,668	0.57
Participant Cost Test (PCT)		\$1,300,421	\$3,870,650	\$2,570,230	2.98
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000285550				
Discounted Participant Payback (years)	3.06				

Table 7-54: 2017 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0437	\$1,146,059	\$4,328,051	\$3,181,993	3.78
Total Resource Cost Test (TRC) No Adder	\$0.0437	\$1,146,059	\$4,144,280	\$2,998,221	3.62
Utility Cost Test (UCT)	\$0.0257	\$673,573	\$1,837,716	\$1,164,143	2.73
Rate Impact Test (RIM)		\$3,220,384	\$1,837,716	-\$1,382,668	0.57
Participant Cost Test (PCT)		\$1,300,421	\$6,177,214	\$4,876,793	4.75
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000285550				
Discounted Participant Payback (years)	3.06				

Table 7-55: 2017 WA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)

Cost-Effectiveness Test	Levelized \$/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0980	\$66,827	\$54,321	-\$12,506	0.81
Total Resource Cost Test (TRC) No Adder	\$0.0980	\$66,827	\$49,383	-\$17,444	0.74
Utility Cost Test (UCT)	\$0.0983	\$67,048	\$49,383	-\$17,665	0.74
Rate Impact Test (RIM)		\$133,309	\$49,383	-\$83,926	0.37
Participant Cost Test (PCT)		\$46,482	\$120,848	\$74,366	2.60
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000015996				
Discounted Participant Payback (years)	1.47				

*Table 7-56: 2017 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0783	\$65,207	\$56,768	-\$8,439	0.87
Total Resource Cost Test (TRC) No Adder	\$0.0783	\$65,207	\$51,607	-\$13,600	0.79
Utility Cost Test (UCT)	\$0.0629	\$52,329	\$51,607	-\$722	0.99
Rate Impact Test (RIM)		\$133,534	\$51,607	-\$81,926	0.39
Participant Cost Test (PCT)		\$53,045	\$131,859	\$78,814	2.49
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000007493				
Discounted Participant Payback (years)	5.17				

*Table 7-57: 2018 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1354	\$17,378	\$6,162	-\$11,216	0.35
Total Resource Cost Test (TRC) No Adder	\$0.1354	\$17,378	\$5,602	-\$11,776	0.32
Utility Cost Test (UCT)	\$0.0781	\$10,029	\$5,602	-\$4,427	0.56
Rate Impact Test (RIM)		\$22,034	\$5,602	-\$16,432	0.25
Participant Cost Test (PCT)		\$15,607	\$20,095	\$4,488	1.29
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000002901				
Discounted Participant Payback (years)	11.31				

*Table 7-58: 2018 WA Home Energy Savings Program Appliances Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1354	\$17,378	\$32,997	\$15,618	1.90
Total Resource Cost Test (TRC) No Adder	\$0.1354	\$17,378	\$32,437	\$15,058	1.87
Utility Cost Test (UCT)	\$0.0781	\$10,029	\$5,602	-\$4,427	0.56
Rate Impact Test (RIM)		\$22,034	\$5,602	-\$16,432	0.25
Participant Cost Test (PCT)		\$15,607	\$46,929	\$31,323	3.01
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000002901				
Discounted Participant Payback (years)	11.31				

*Table 7-59: 2018 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1795	\$149,739	\$53,437	-\$96,302	0.36
Total Resource Cost Test (TRC) No Adder	\$0.1795	\$149,739	\$48,579	-\$101,160	0.32
Utility Cost Test (UCT)	\$0.0649	\$54,116	\$48,579	-\$5,537	0.90
Rate Impact Test (RIM)		\$132,748	\$48,579	-\$84,170	0.37
Participant Cost Test (PCT)		\$163,733	\$134,389	-\$29,344	0.82
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000004708				
Discounted Participant Payback (years)	n/a				

*Table 7-60: 2018 WA Home Energy Savings Program Building Shell Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1795	\$149,739	\$312,117	\$162,378	2.08
Total Resource Cost Test (TRC) No Adder	\$0.1795	\$149,739	\$307,259	\$157,520	2.05
Utility Cost Test (UCT)	\$0.0649	\$54,116	\$48,579	-\$5,537	0.90
Rate Impact Test (RIM)		\$132,748	\$48,579	-\$84,170	0.37
Participant Cost Test (PCT)		\$163,733	\$393,069	\$229,336	2.40
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000004708				
Discounted Participant Payback (years)	n/a				

*Table 7-61: 2018 WA Home Energy Savings Program Electronics Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1207	\$274	\$80	-\$194	0.29
Total Resource Cost Test (TRC) No Adder	\$0.1207	\$274	\$72	-\$201	0.26
Utility Cost Test (UCT)	\$0.1417	\$321	\$72	-\$249	0.23
Rate Impact Test (RIM)		\$533	\$72	-\$460	0.14
Participant Cost Test (PCT)		\$101	\$389	\$288	3.85
Lifecycle Revenue Impacts (\$/kWh)	\$0.000000228				
Discounted Participant Payback (years)	n/a				

*Table 7-62: 2018 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0128	\$105,782	\$330,608	\$224,827	3.13
Total Resource Cost Test (TRC) No Adder	\$0.0128	\$105,782	\$300,553	\$194,771	2.84
Utility Cost Test (UCT)	\$0.0130	\$107,360	\$300,553	\$193,193	2.80
Rate Impact Test (RIM)		\$876,262	\$300,553	-\$575,709	0.34
Participant Cost Test (PCT)		\$30,884	\$841,194	\$810,309	27.24
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000142474				
Discounted Participant Payback (years)	n/a				

*Table 7-63: 2018 WA Home Energy Savings Program Energy Kits - DHW Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0128	\$105,782	\$1,312,134	\$1,206,353	12.40
Total Resource Cost Test (TRC) No Adder	\$0.0128	\$105,782	\$1,282,079	\$1,176,297	12.12
Utility Cost Test (UCT)	\$0.0130	\$107,360	\$300,553	\$193,193	2.80
Rate Impact Test (RIM)		\$876,262	\$300,553	-\$575,709	0.34
Participant Cost Test (PCT)		\$30,884	\$1,822,720	\$1,791,835	59.02
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000142474				
Discounted Participant Payback (years)	n/a				

*Table 7-64: 2018 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0313	\$4,250	\$5,421	\$1,171	1.28
Total Resource Cost Test (TRC) No Adder	\$0.0313	\$4,250	\$4,928	\$678	1.16
Utility Cost Test (UCT)	\$0.0323	\$4,387	\$4,928	\$541	1.12
Rate Impact Test (RIM)		\$17,060	\$4,928	-\$12,132	0.29
Participant Cost Test (PCT)		\$2,685	\$16,040	\$13,355	5.97
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003002				
Discounted Participant Payback (years)	n/a				

*Table 7-65: 2018 WA Home Energy Savings Program Energy Kits - Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0313	\$4,250	\$13,113	\$8,863	3.09
Total Resource Cost Test (TRC) No Adder	\$0.0313	\$4,250	\$12,621	\$8,370	2.97
Utility Cost Test (UCT)	\$0.0323	\$4,387	\$4,928	\$541	1.12
Rate Impact Test (RIM)		\$17,060	\$4,928	-\$12,132	0.29
Participant Cost Test (PCT)		\$2,685	\$23,733	\$21,048	8.84
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000003002				
Discounted Participant Payback (years)	n/a				

*Table 7-66: 2018 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1319	\$2,278,693	\$900,389	-\$1,378,304	0.40
Total Resource Cost Test (TRC) No Adder	\$0.1319	\$2,278,693	\$818,535	-\$1,460,158	0.36
Utility Cost Test (UCT)	\$0.0757	\$1,307,952	\$818,535	-\$489,417	0.63
Rate Impact Test (RIM)		\$2,924,755	\$818,535	-\$2,106,220	0.28
Participant Cost Test (PCT)		\$1,697,029	\$2,342,669	\$645,640	1.38
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000325158				
Discounted Participant Payback (years)	8.40				

*Table 7-67: 2018 WA Home Energy Savings Program HVAC Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.1319	\$2,278,693	\$1,004,226	-\$1,274,466	0.44
Total Resource Cost Test (TRC) No Adder	\$0.1319	\$2,278,693	\$922,373	-\$1,356,320	0.40
Utility Cost Test (UCT)	\$0.0757	\$1,307,952	\$818,535	-\$489,417	0.63
Rate Impact Test (RIM)		\$2,924,755	\$818,535	-\$2,106,220	0.28
Participant Cost Test (PCT)		\$1,697,029	\$2,446,507	\$749,477	1.44
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000325158				
Discounted Participant Payback (years)	8.40				

*Table 7-68: 2018 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0542	\$543,129	\$372,863	-\$170,266	0.69
Total Resource Cost Test (TRC) No Adder	\$0.0542	\$543,129	\$338,966	-\$204,162	0.62
Utility Cost Test (UCT)	\$0.0442	\$442,500	\$338,966	-\$103,534	0.77
Rate Impact Test (RIM)		\$1,376,111	\$338,966	-\$1,037,145	0.25
Participant Cost Test (PCT)		\$506,615	\$1,521,958	\$1,015,342	3.00
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000366672				
Discounted Participant Payback (years)	1.52				

*Table 7-69: 2018 WA Home Energy Savings Program Lighting Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0542	\$543,129	\$1,207,557	\$664,428	2.22
Total Resource Cost Test (TRC) No Adder	\$0.0542	\$543,129	\$1,173,660	\$630,531	2.16
Utility Cost Test (UCT)	\$0.0442	\$442,500	\$338,966	-\$103,534	0.77
Rate Impact Test (RIM)		\$1,376,111	\$338,966	-\$1,037,145	0.25
Participant Cost Test (PCT)		\$506,615	\$2,356,651	\$1,850,036	4.65
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000366672				
Discounted Participant Payback (years)	1.52				

*Table 7-70: 2018 WA Home Energy Savings Program Water Heating Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0940	\$40,748	\$19,953	-\$20,795	0.49
Total Resource Cost Test (TRC) No Adder	\$0.0940	\$40,748	\$18,139	-\$22,609	0.45
Utility Cost Test (UCT)	\$0.0852	\$36,907	\$18,139	-\$18,768	0.49
Rate Impact Test (RIM)		\$77,417	\$18,139	-\$59,278	0.23
Participant Cost Test (PCT)		\$29,674	\$69,989	\$40,315	2.36
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000011275				
Discounted Participant Payback (years)	2.42				

*Table 7-71: 2018 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (without NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0855	\$131,827	\$95,083	-\$36,745	0.72
Total Resource Cost Test (TRC) No Adder	\$0.0855	\$131,827	\$86,439	-\$45,388	0.66
Utility Cost Test (UCT)	\$0.0592	\$91,255	\$86,439	-\$4,816	0.95
Rate Impact Test (RIM)		\$236,182	\$86,439	-\$149,744	0.37
Participant Cost Test (PCT)		\$120,261	\$235,079	\$114,817	1.95
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000011526				
Discounted Participant Payback (years)	n/a				

*Table 7-72: 2018 WA Home Energy Savings Program Whole Homes Measure Category Cost-Effectiveness Results Using Evaluated Net Savings (including NEIs)*

<b>Cost-Effectiveness Test</b>	<b>Levelized \$/kWh</b>	<b>Costs</b>	<b>Benefits</b>	<b>Net Benefits</b>	<b>Benefit/Cost Ratio</b>
Total Resource Cost Test (PTRC) + Conservation Adder	\$0.0855	\$131,827	\$98,509	-\$33,318	0.75
Total Resource Cost Test (TRC) No Adder	\$0.0855	\$131,827	\$89,866	-\$41,962	0.68
Utility Cost Test (UCT)	\$0.0592	\$91,255	\$86,439	-\$4,816	0.95
Rate Impact Test (RIM)		\$236,182	\$86,439	-\$149,744	0.37
Participant Cost Test (PCT)		\$120,261	\$238,505	\$118,244	1.98
Lifecycle Revenue Impacts (\$/kWh)	\$0.0000011526				
Discounted Participant Payback (years)	n/a				