Opinion Dynamics
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PACIFICORP WASHINGTON LOW-INCOME WEATHERIZATION

EVALUATION FOR PROGRAM YEARS 2022-2023

JUNE 30, 2026

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I. EXECUTIVE SUMMARY

This report presents findings from the process and impact evaluation of Pacific Power's Low-Income Weatherization Program (referred to as the "Program" throughout this report) in operation in the state of Washington during program years 2022 and 2023. Opinion Dynamics conducted the evaluation on behalf of Pacific Power.

Four Washington nonprofit agencies known for serving low-income communities implement the Program:

- Opportunities Industrialization Center of Washington (OIC),
- Yakima Valley Farm Workers Clinic/Northwest Community Action Center (NCAC),
- Yakama Nation Housing Authority (YNHA), and
- Blue Mountain Action Council (BMAC).

These agencies receive funding from Pacific Power to target low-income customers with building weatherization services.[1] The agencies focus on existing single-family (including manufactured) homes and multifamily properties. Multifamily properties qualify for the Program if low-income Pacific Power customers occupy at least 66% of the tenant units.[2] Through the Program, participants receive energy efficiency measures at no cost. Agency staff begin by conducting an energy audit on participant homes to assess the condition of the home and identify what energy-saving measures are needed. The Program offers a variety of energy efficiency measures such as insulation, weatherstripping, faucet aerators, showerheads, smart thermostats,[3] and LED light bulbs. Measures are typically directly installed by agency staff, although the homeowner may self-install some smaller measures, such as LED bulbs. In 2023, the Program also began allowing the installation of ducted and ductless heat pump systems to replace permanently installed electric heat, space heaters, or any fuel source other than natural gas with adequate combustion air, as determined by implementation agency staff. This change was intended to encourage electrification and reduce the use of wood heat, solid fuels, and natural-draft equipment in applications where combustion safety and indoor air quality cannot be adequately maintained.

The core objectives for this evaluation were to (1) document and measure energy and non-energy impacts of the Program, and (2) identify areas of potential improvement in program delivery, customer experience, and energy savings. For the process evaluation, we conducted a program materials review, interviewed agency staff, and analyzed participant responses to a telephone survey. To quantify energy impacts, we conducted a consumption analysis with a comparison group to estimate the ex-post net annual energy savings attributable to the Program. To quantify non-energy benefits, such as reduced external payments and arrearages, we conducted an analysis comparing participant bill payment history with a comparison group of low-income customers. We also completed an economic impacts assessment using the Regional Input-Output Modeling System (RIMS-II), developed by the US Bureau of Economic Analysis. This report also includes the results from the Program's cost-effectiveness tests conducted by a third-party consultant, ICF International (ICF).

I.I PROCESS RESULTS

The process evaluation examined Program operations from multiple perspectives. Pacific Power and the implementing agencies have worked together for several years to deliver the Program. Over this time, all parties have developed expertise in implementing the Program despite the complex funding environment surrounding low-income weatherization services. The agencies combine funds from Pacific Power with those from government organizations to

[1] Weatherization refers to the process of making a building more energy efficient.
[2] "Low income" qualifications are based on 200% of federal poverty guidelines or 60% of the state median income, whichever is greater.
[3] Smart thermostats were added as a measure offering in July 2023.

reach more low-income customers, demonstrating a best practice in low-income energy efficiency program delivery.[4] It is common for utilities to work with nonprofit agencies to promote their energy efficiency programs for low-income customers since these organizations generally have well-established relationships with eligible communities already.

The agencies served qualifying participants relatively quickly, with just under half of the surveyed participants (5 of 11) reporting they received services within three months of submitting their application. Two survey participants waited six months or longer for services. All the agencies maintain a waitlist for weatherization services, and prioritize households with disabled, elderly, and minor (under 18) residents. Although agency staff feel the Program is operating smoothly, deferrals and walkaways due to building health and safety (H&S) concerns remain an issue. YNHA specifically noted that they have a housing assistance funding program that assists with remediation services to help prevent subsequent deferrals due to necessary home repairs required before weatherization.[5] During interviews, agency staff noted issues with increased administrative burden during the evaluation period (2022–2023)

While not a formal element of the Program, agency staff commonly provide participants with guidance on ways to save energy at home. Coupling energy efficiency education with home audits and measure installation is one way agency staff can use home visits to help induce behavioral changes that may further reduce energy costs. It is also considered a best practice of energy efficiency programs designed to serve low-income participants.[6] Nine of eleven survey respondents reported learning ways to save energy from the agency staff, and seven of those nine participants who received energy education found it extremely helpful.

The Program aims to improve the health, comfort, and aesthetics of participant households. In the telephone survey, we asked Program participants if their home air quality, appearance, and comfort were better, the same, or worse after they had participated in the Program. Nine of eleven surveyed participants reported an improvement in comfort, seven in air quality, and four in home appearance. None of the respondents reported that these home characteristics had worsened since participation. Additionally, seven of the surveyed participants indicated that the weatherization staff discussed ways to improve health and safety in the home.

The Program is meeting participant needs and delivering positive experiences. Nine of eleven surveyed participants reported that they were "completely satisfied" with the Program, and all surveyed participants said they would recommend the Program to others, consistent with the high levels of satisfaction observed in prior evaluations (Table 1).

Table 1. 2013–2023 Surveyed Participant Satisfaction and Willingness to Recommend Program

Program Year	Survey Completes	Percent "Completely Satisfied" With Program	Percent "Yes" Would Recommend Program
2013–2015	41	78%	93%
2018–2019	31	77%	90%
2020–2021	18	94%	100%
2022–2023	11	91%	100%

[4] Drehobl, Ariel and Castro-Alvarez, Fernando, "Low Income Energy Efficiency Programs: A Baseline Assessment of Programs Serving the 51 Largest Cities," ACEEE, November 2017.

[5] Funded by different source from LIW Program; not funded by Pacific Power.

[6] Kushler, Martin, York, Dan and Witte, Patti, "Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low Income Energy Efficiency Programs," ACEEE Report Number U053, September 2005.

I.2 IMPACT RESULTS

Opinion Dynamics conducted a consumption analysis using a two-way fixed effect, difference-in-differences (D-in-D) regression model to determine ex-post net energy savings. Table 2 presents the ex-post net savings for each program year and the full evaluation period (2022–2023). Overall, the Program achieved 36% of its ex-ante gross savings for the evaluation period. The low realization rate is primarily attributable to changes in the per-home measure mix and a higher share of multifamily buildings served; approximately 35% of participants were in multifamily buildings during the evaluation period compared to none during the prior 2020–2021 evaluation.

Table 2. Ex-Ante Gross and Ex-Post Net Energy Savings (kWh)

Program Year	Participation	Ex-Ante Gross Energy Savings (kWh)	Ex-Post Net Energy Savings (kWh)	Realization Rate
2022	142	261,515	89,148	34%
2023	95	154,807	59,641	39%
Total	**237**	**416,322**	**148,789**	**36%**

During the 2022–2023 evaluation period, average annual ex-post net energy savings per participant were 628 kWh overall, representing a 4.4% reduction in annual energy consumption, and 1,000 kWh for heat pump customers, representing an 8.5% reduction (Table 3). These savings are lower than estimates from prior Program evaluations; however, savings for heat pump participants are comparable to those observed in the previous evaluation (Table 4).

Table 3. Estimated Annual Savings from Consumption Analysis

Input	All Participants	Heat Pump Participants
Average Annual Baseline Energy Consumption per Participant (kWh)	14,361	11,762
Average per Participant Ex Post Net Annual Savings (kWh)	628	1,000
Average per Participant Savings Percentage	4.4%	8.5%

Note: Ex-post savings do not control for free ridership because the comparison group includes future-treated customers. However, free ridership is not typical in low-income program evaluations because most income-eligible participants do not have the disposable income to complete weatherization without program assistance.

Table 4. 2013–2019 Ex-Ante Gross and Ex-Post Net Energy Savings (kWh)

Program Year	Participation	Ex-Ante Gross Energy Savings (kWh)	Ex-Post Net Energy Savings (kWh)	Realization Rate	Average Annual Ex-Post Net Energy Savings (kWh)
2013	139	255,760	155,958	61%	1,122
2014	107	156,456	120,054	77%	
2015	98	144,648	109,956	76%	
2018	109	182,237	111,230	61%	1,020
2019	81	149,617	82,657	55%	
2020	40	69,527	41,375	60%	1,034
2021	57	116,769	58,959	50%	

Because Program impacts were measured using a consumption analysis, net energy savings reflect both measure installations and participant behavior changes. More than three-quarters of surveyed participants (9 of 11) recalled receiving tips on how to save energy from the agency staff, all of which reported taking actions based on the recommendations they received.

I.3 NON-ENERGY BENEFIT RESULTS

To determine non-energy benefits, we conducted three analyses: an external payment analysis, an arrearage analysis, and an economic impacts analysis.

I.3.I EXTERNAL PAYMENT ANALYSIS

External assistance payments are provided by nonprofit agencies to help low-income customers pay their Pacific Power electric bills. Program theory indicates that customers who receive weatherization services should require less external payment assistance after participation. We compared the change in external assistance payments between Program participants and a comparison group to determine if this occurred during the evaluation period.[7]

Table 5 presents the average monthly change in external assistance payments for each year of the evaluation period. In 2022, average monthly external payment assistance increased by 123% for Program participants, compared to a 114% increase for the comparison group. In contrast, in 2023, external payment assistance declined by 72% for Program participants and by 75% for the comparison group.

According to Program staff, customers in Washington were eligible to receive two forms of COVID-19-related bill assistance that likely influenced observed trends in external payment assistance. First, the state's COVID-19 Arrearage (Forgiveness) Grant was deployed in 2020 and remained available through September 2022, providing up to $2,500 in debt assistance to eligible customers who self-attested to COVID-19–related financial hardship.[8] In addition, the state of Washington appropriated $100 million in Coronavirus State Fiscal Recovery Funds to reduce utility arrearages accrued between March 1, 2020 and December 31, 2021, which Pacific Power applied as a one-time account credit on December 12, 2022 with amounts varying by customer arrearage. Because these supports were time-limited and applied directly to outstanding balances, the phase-out of assistance may help explain increases in arrearages observed in 2022 among both participants and the comparison group.

Table 5. Payment Assistance Amounts Summary for Participants and Comparison Group

Program Year	Participant Group				Comparison Group				Net Difference Amount
	Pre	Post	Change	% Change	Pre	Post	Change	% Change	
2022	$ 143.65	$ 320.93	$ 177.29	123%	$ 140.65	$ 300.50	$ 159.85	114%	$ 17.43
2023	$ 345.46	$ 96.86	$ (248.60)	-72%	$ 353.42	$ 87.71	$ (265.70)	-75%	$ 17.10
Total	**$ 244.55**	**$ 208.90**	**$ (35.66)**	**26%**	**$ 247.03**	**$ 194.11**	**$ (52.93)**	**19%**	**$ 17.27**

Note: Results displayed in parentheses indicate a negative value.

Despite an average monthly net decrease of $35.66 in external payment assistance after participation in the Program for the participation group, a larger monthly net decrease of $52.93 was observed for the comparison group indicating no non-energy benefit attributable to the Program through the external payment analysis.

[7] The comparison group included Program participants from the 2024 and 2025 program years.

[8] 119_Residential_COVID-19_Bill_Payment_Assistance_Program_Optional_for_Qualifying_Customers.pdf

I.3.2 ARREARAGE ANALYSIS

Similarly, the Program theory indicates that customers who receive weatherization services should have lower arrears after participation. To determine if this occurred for the evaluation period, we examined the change in 2022–2023 Program participant arrearages (i.e., the unpaid ending monthly balance on a customer's bill) before and after participation to that of a comparison group.[9]

On average, Program participants' arrearages increased by $49 per month, while a $12 increase was observed for the comparison group (Table 6). Given that arrearages increased for both groups, with a notably larger increase among participants, no non-energy benefit was attributable to the Program.

Table 6. Arrearage Summary for Participant and Comparison Groups

	Participant Group				Comparison Group				Net Difference in Arrearages
	Pre	Post	Change in Debt	% Change	Pre	Post	Change in Debt	% Change	
Monthly Arrearage	$ (4)	$ 45	$ 49	1097%	$ 73	$ 85	$ 12	16%	$ 37

Note: Negative values (indicated using parentheses) represent payments that exceeded the account balance, where an overage credit remained.

Because the two COVID-19-related bill assistance programs that extended into the evaluation period were time-limited and applied directly to outstanding customer account balances, the expiration of these supports may contribute to the increases in arrearages observed in 2022 for both participants and the comparison group.

I.3.3 ECONOMIC IMPACTS

Consistent annual funding for the Program provides energy-saving services for low-income households, leading to other community-level benefits such as reliable job opportunities. We used the RIMS-II, maintained by the US Department of Commerce, Bureau of Economic Analysis, to conduct an economic impact assessment of the Program. RIMS-II captures the underlying economic relationships that characterize the counties included in Pacific Power's service territory, such as local supply conditions, import/export dynamics, and industry interdependencies. The system also incorporates data on industry output, employment, and earnings to estimate the impact of changes.

The results from this analysis are expressed in changes in employment (job-years), labor income earned, value added, and output in the region. Each impact represents the sum of direct, indirect, and induced effects due to the Program. The impacts are expressed as the present value of the impacts generated over the lives of installed measures and not just the impacts from the implementation of weatherization in 2022 and 2023. The measure of the Program's impact on output (i.e., the last column in Table 7) serves as a non-energy benefit and an input to the Program's cost-effectiveness analysis.

[9] The comparison group included Program participants from the 2024 program year.

Table 7. 2022–2023 Economic Impacts Summary for Pacific Power Washington's LIW Program

Impact Type	Employment (Job-Years)	Labor Income	Economic Value Added	Economic Output
Total Effect	14.1	$859,749	$870,625	$1,965,963

Note: Using the RIMS-II model, we provide the economic impacts of the Program in terms of economic output (sales), economic value added (gross domestic product), employment (full- and part-time jobs), and earnings in all industries in the local economy.

The model's estimated impacts can be compared to spending to contextualize the results. Considering the 2022–2023 Program expenditures ($3,088,803 in 2023 dollars), each dollar of Program spending on weatherization resulted in $0.64 additional total output in the region.[10]

1.4 COST-EFFECTIVENESS RESULTS

Apex Analytics estimated the cost-effectiveness of Pacific Power's evaluated savings for the Program. The Program passes the PacifiCorp Total Resource Cost Test (PTRC) and Total Resource Cost Test (TRC) when non-energy benefits (NEB) are included (Table 8).

Table 8. 2022–2023 Program Benefit/Cost Ratios by NEB Inclusion

NEB Status	PTRC	TRC	UCT	RIM	PCT[a]
Program with NEBs	1.22	1.21	0.15	0.13	n/a
Program without NEBs	0.17	0.15	0.15	0.13	n/a

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

1.5 CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation results, our team offers the following conclusions and recommendations:

- **Conclusion:** Pacific Power is adhering to best practices by delivering the Program through trusted, community-based agencies with established relationships in low-income communities. These agencies are well positioned to braid utility, state, and federal funding to maximize the Program's reach and are delivering a high-quality participant experience. However, consistent with other low-income weatherization programs, agency staff report that unresolved structural and H&S issues continue to delay or prevent service delivery for some otherwise eligible households. Because utility funds must be directed toward cost-effective measures that generate direct energy savings, agencies are often required to defer customers when H&S barriers cannot be addressed through complementary funding sources.
  - **Recommendation:** Pacific Power should work with implementation agencies to strengthen and formalize pathways for addressing H&S-related deferrals. This may include providing clearer, more consistent guidance on the most common deferral triggers, standardizing how deferral reasons are tracked, and formalizing referral processes. Improved coordination around H&S barriers would help reduce delays, minimize walkaways, and increase the number of homes that successfully receive weatherization services.
- **Conclusion:** Participants report high levels of satisfaction with their Program experience, consistent with findings from prior evaluations. Nearly all surveyed participants (9 of 11) reported being completely satisfied with the Program, and all indicated they would recommend the Program to others. Participants most frequently cited the professionalism of agency staff, the quality of completed work, and the overall ease of participation as key drivers of satisfaction. These findings indicate that the Program is effectively meeting participant needs and delivering a positive, trusted customer experience.

[10] We calculate this by dividing the output in Table 7 by the total local spending.

- **Conclusion:** Although the Program does not formally offer energy education, most surveyed Program participants (9 of 11) recalled receiving energy-saving tips from agency staff. All of these respondents took at least some of the energy-saving actions recommended by agency staff, with most (7 of 9) rating the education as "extremely helpful."
  - **Recommendation:** Pacific Power should consider adding energy education to the basic services that agency staff provide to all Program participants. Rather than leaving the option up to individual agency staff, Program staff should make education a required service to ensure the information is available to all participants.
- **Conclusion:** Although overall per-participant energy savings for the Program in 2022–2023 were lower than those observed in previous evaluation periods, the impact evaluation demonstrates that participants who received heat pumps achieved substantially deeper savings. Average ex-post net annual savings were 628 kWh per participant (a 4.4% reduction in annual electricity use), while heat pump participants achieved approximately 1,000 kWh in annual savings, corresponding to an 8.5% reduction in consumption. These results indicate that heat pump installations are a key driver of higher per-household savings and represent a significant opportunity to maximize energy savings within the Low-Income Weatherization Program.
  - **Recommendation:** Pacific Power should strategically promote and prioritize heat pump installations within the Program, where feasible, to increase per-participant savings and overall program impact. This could include reinforcing heat pumps as a preferred high-impact measure during initial home audits and aligning funding decisions to support greater deployment of heat pumps. Emphasizing heat pump adoption will help the Program achieve deeper, more consistent energy savings while supporting broader electrification and customer bill reduction goals.

2. INTRODUCTION

This report presents findings from the process and impact evaluation of Pacific Power's Low-Income Weatherization Program (referred to as the "Program" throughout this report) in operation in the state of Washington during program years 2022 and 2023. Opinion Dynamics conducted the evaluation on behalf of Pacific Power.

The Program provides energy efficiency measures to eligible residential participants through a partnership with four local weatherization agencies in Washington:

- Opportunities Industrialization Center of Washington (OIC),[11]
- Yakima Valley Farm Workers Clinic/Northwest Community Action Center (NCAC),[12]
- Blue Mountain Action Council (BMAC),[13] and
- Yakama Nation Housing Authority (YNHA).

Partnering with agencies historically serving Washington's low-income communities allows Pacific Power to have streamlined access to the participants targeted by the Program.

Pacific Power provides the agencies 50% of the cost of eligible weatherization measures installed. The agencies also access funds from the Washington State Matchmaker Program.[14] When these funds are depleted, the utility covers 100% of the cost of eligible measures and services. All measures installed under the Program must also be eligible under the Matchmaker program, and importantly, reimbursements to the agencies are calculated after property owner contributions are deducted. Pacific Power also reimburses the agencies for administrative costs based on 15% of Pacific Power's installed measure costs. To cover any remaining costs required to provide weatherization services to low-income customers, the implementing agencies leverage federal government funding from the United States Department of Energy (DOE) and the United States Department of Health and Human Services (DHHS). The Washington Department of Commerce, Community Services and Housing Division (WADOC) administers the federal funding to the agencies. WADOC also provides administrative oversight of the weatherization services agencies provide.

Leveraging utility, state, and federal funding sources allows the agencies to provide comprehensive weatherization services to more low-income households than they may have otherwise. Other exemplary utility-funded low-income energy efficiency programs also leverage state and federal funding sources and implement programs through social service agencies.

Figure 1 displays Pacific Power's Washington Program funding sources and roles of oversight and implementation.

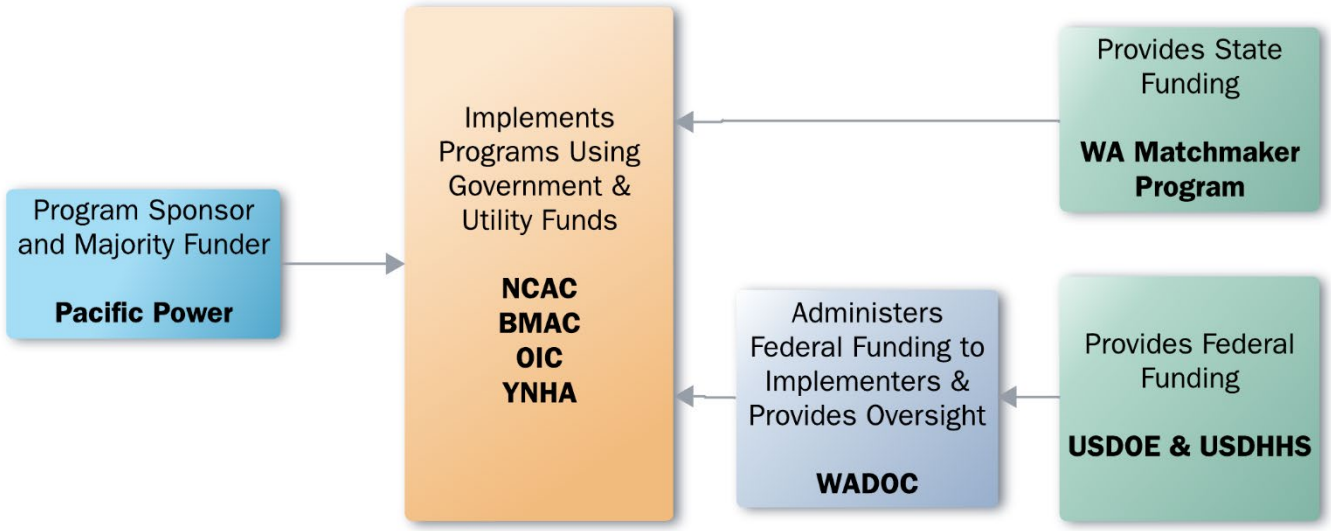
[11] OIC serves Yakima County – North of Union Gap.

[12] NCAC serves Yakima County – South of Union Gap.

[13] BMAC serves Columbia, Garfield, and Walla Walla counties.

[14] The Matchmaker Program increases resources for low-income home weatherization by leveraging local matching dollars and resources from utilities, rental owners, and other sources. It provides a dollar for dollar match up to a state budget amount, to help increase the reach of low-income weatherization programs operated by local agencies and utilities.

Figure 1. Funding and Oversight for Pacific Power's Low-Income Weatherization Program



2.1 PROGRAM IMPLEMENTATION

Program implementation involves the following steps, which are detailed in the 2023 Washington Annual Report on Conservation Acquisition:[15]

- Income verification based on WADOC guidelines to ensure that participants qualify for Program participation [16]
- Energy audit using a DOE-approved tool to determine eligible measures that are cost-effective to install
- Installation of measures that have a Savings Investment Ratio of 1.0 or greater based on the DOE energy audit tool
- Post-inspections of all projects
- Billing notification to Pacific Power within 90 days of job completion, including the measures installed, the associated cost of each project, and the associated invoice

The Program is available to low-income residential customers in existing single-family (including manufactured) and multifamily homes in all territories served by Pacific Power in Washington. Duplexes and fourplexes are eligible if low-income tenants occupy one-half of the property. Larger multifamily properties are eligible if low-income qualifying tenants occupy at least 66% of the units. "Low income" qualifications follow Federal guidelines, and Program eligibility is based on 200% of federal poverty guidelines or 60% of State Median Income (SMI),[17] whichever is greater.[18]

[15] 2023 Washington Annual Report on Conservation Acquisition, June 2024, Pacific Power. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/environment/dsm/washington/WA_Annual_Conservation_Acquisition_23.pdf.

[16] The Washington Department of Commerce Weatherization Manual, Policies and Procedures and Supporting Documents, Section 1.2.1 describes the current income eligibility guidelines in detail. The Department of Commerce provides annual updates of the federal poverty guidelines to the implementing agencies.

[17] As of February 1, 2022, the Program income guideline was updated to 80% of Area Median Income based on Washington State Legislature's low-income definition (RCW 19.405.020). https://app.leg.wa.gov/RCW/default.aspx?cite=19.405.020.

[18] Note that the maximum eligibility for Low-Income Home Energy Assistance Program (LIHEAP) funding is 60% State Median Income (SMI).

Agencies directly install measures for participants based on heating fuel type and need. Measures vary by household and are classified as either "major" or "supplemental." Major measures include ductless heat pumps, floor, wall, and ceiling insulation, and supplemental measures include, but are not limited to, weather stripping, attic ventilation, and faucet aerators. Major measures and a portion of supplemental measures are only available where an electric heating system heats at least 51% of the home. In 2023, the Program also began allowing the installation of ducted and ductless heat pump systems to replace permanently installed electric heat, space heaters, or any fuel source other than natural gas with adequate combustion air, as determined by implementation agency staff. This change was intended to encourage electrification and reduce the use of wood heat, solid fuels, and natural-draft equipment in applications where combustion safety and indoor air quality cannot be adequately maintained.

2.2 EVALUATION OBJECTIVES

Program evaluation objectives are listed in Table 9, along with the evaluation activity used to address each objective.

Table 9. Evaluation Objectives by Evaluation Activities

Objective	Process Evaluation	Impact Evaluation	Non-Energy Benefit Analysis
Document and measure effects of the Program	✓	✓	
Verify measure installation and savings		✓	
Review Program operations	✓		
Document all other funding used by agencies to provide no-charge services to participants	✓		
Quantify NEBs through payment, arrearage, and economic impact analyses			✓
Provide data to support Program cost-effectiveness assessments		✓	✓
Identify areas of potential improvement	✓	✓	
Document compliance with regulatory requirements	✓		
Survey participants and agency staff	✓		

3. DATA SOURCES AND METHODOLOGY

This section reviews data sources and methodologies used to conduct the research and discusses results from the process and impact evaluations, NEB analyses, and cost-effectiveness tests.

3.1 PROGRAM TRACKING DATA

We requested and received Program tracking data for program years 2022, 2023, 2024, and 2025 to support both impact and process evaluations. These data are tracked at the measure level; therefore, Program participants who received more than one measure are listed multiple times.

We received the following key variables in the Program tracking data:

- Customer name, address, and phone number
- Project ID
- Bill account number (customer identifier)
- Implementation agency
- Cost recovery date
- Project creation date
- Project last update date
- Measure category, type, subtype, and name
- Measure-level Kilowatt-hour (kWh) savings/year
- Direct install costs
- Measure costs

For the Washington evaluation, we used the Program tracking data to identify Program participants, and the measures installed to develop the participant telephone survey sample. Program tracking data were also used to support the non-energy benefit analyses and consumption analysis.

3.2 PROCESS EVALUATION

For the process evaluation, we interviewed agency staff who implement the Program and surveyed customers who participated in the Program during the evaluation period.

3.2.1 AGENCY INTERVIEWS

We interviewed staff from the four weatherization agencies that implement the Program: NCAC, YNHA, BMAC, and OIC. Each interview was conducted with a single representative from the organization. The agency interviews helped inform our review of Program operations, compliance with regulatory requirements, as well as major accomplishments and challenges related to Program implementation.

3.2.2 PARTICIPANT SURVEY

We fielded a telephone survey with customers who participated in the Program between 2022 and 2023. We used information gathered through the participant telephone survey to verify the installation of measures, estimate lighting in-service rates,[19] and inform process-related findings.

Of the 237 customers who participated in the Washington Program between 2022–2023, we received valid phone numbers for 216 customers. We used a census approach to invite these 216 participants to take the survey. A total of 11 participants completed the survey, yielding a response rate of 11% and a cooperation rate of 58% (Table 10).[20] Surveys were fielded in both English and Spanish.

Table 10. Washington Participant Telephone Survey

Number of 2022–2023 Participants (Population Frame)	Unique Telephone Number	Final Survey Responses	Survey Response Rate	Survey Cooperation Rate
237	216	11	11%	58%

Up to four attempts were made to reach each Program participant. Final dispositions for survey outreach are listed in Table 11.

Table 11. 2022–2023 Participant Survey Disposition

Survey Disposition	Sample
Complete	**11**
Answering machine	104
Callback	28
Business number	16
Language barrier	15
Disconnected	13
No answer	13
Refused	8
Busy	3
Wrong number	2
Call blocked	2
Do not call list	1
Total	**216**

3.3 IMPACT EVALUATION

Opinion Dynamics performed an electricity consumption analysis using a two-way fixed effects difference-in-differences (D-in-D) regression model to determine the overall ex-post net Program savings. Our methodology compared pre- and

[19] In-service rates represent the rate at which measures that were originally installed remain installed at the time of the survey (i.e., have not since been removed).

[20] Response rate is calculated using American Association for Public Opinion Research (AAPOR) Response Rate 3. Survey cooperation rate indicates the percentage of customers who completed the survey who were actually reached by the survey vendor.

post-participation energy usage, using 2022 and 2023 participants as the treatment cohort and 2024 and 2025 participants as a comparison group to establish a baseline. In addition, the analysis evaluated differences in pre- and post-participation usage between Program participants who received a heat pump system and those who did not, to assess the impact of heat pumps on overall savings. Notably, the model controls for weather-driven variation in electricity consumption, household characteristics, and seasonal usage patterns.

Below, we describe the process for data collection, data cleaning, model specification, and analysis as part of the consumption analysis.

3.3.1 PARTICIPANT CONSUMPTION DATA

We received electricity consumption data for 2022, 2023, 2024, and 2025 for Program participants between January 2021 and December 2025. We retained all months of pre- and post-participation consumption data for the 2022 and 2023 participants and removed all the post-participation data for the 2024 and 2025 Program participants, who served as a comparison group.

3.3.2 CONSUMPTION DATA PREPARATION

We merged the consumption data with the participant tracking data and performed further cleaning, including the following steps:

- **Duplicate records.** We identified duplicate records and made adjustments to arrive at a single bill per period.
- **Missing data.** Identified and removed readings with missing usage values or reading type.
- **Average usage of zero across the evaluation period.** Removed customers with an average usage of zero over the evaluation period (i.e., 2022 and 2023).
- **Abnormal billing periods.** Removed observations where the billing period was longer than 90 days and short billing periods of 10 days or less.
- **Negative usage values.** Flagged, identified, and removed negative usage values.
- **Extreme usage values.** We identified outliers in the consumption data and removed observations in the top 1% of monthly usage values. Additionally, we excluded customers whose average monthly consumption was also in the top 1%. This process included a manual review of a selected sample of accounts with the highest occurrence of outliers to determine which specific outliers needed to be removed.
- **Overlapping bills.** Removed overlapping bills.
- **Insufficient billing history.** Dropped all accounts with fewer than eight months of observations preceding or following the intervention, as well as summer and winter sufficiency.
- **Extreme changes in consumption.** We also excluded customers whose consumption changed by at least 60% from the 12 months prior to intervention to the 12 months after intervention.

The largest drops were associated with insufficient pre- and post-period consumption data (Table 12). After data cleaning, we retained 69% of the treatment group participants and 84% of the comparison group participants.[21]

[21] The difference in the rate of attrition was primarily due to missing consumption data, with 11% of treatment group customers lacking billing data, compared to only 3% in the comparison group.

Table 12. Consumption Data Cleaning Checks

Reason for Drop	Treatment Accounts Remaining		Comparison Accounts Remaining	
	N	%	N	%
Original Counts of Participating Sites	237	100%	116	100%
Unable to Merge with Consumption Data	210	89%	113	97%
Exact Duplicates	210	89%	113	97%
Exact Duplicates by Bill Period	210	89%	113	97%
Missing or Infinite Usage Values	210	89%	113	97%
Average Usage is Zero	210	89%	113	97%
Long Bills and Short Bills (More Than 90 Days or Less Than 10 Days)	210	89%	113	97%
Negative Average Daily Consumption (ADC)	210	89%	113	97%
Overall Customer ADC Outliers	207	87%	112	97%
Bill ADC Outliers	207	87%	112	97%
Overlapping Bills	207	87%	112	97%
Data Sufficiency Drops	166	70%	102	88%
Customers With a Consumption Change of 60% or More From Pre to Post Periods	164	69%	98	84%

3.3.3 WEATHER DATA PREPARATION

To include weather patterns in our model, we collected hourly weather data from numerous weather stations across the Washington territory. We selected data from the site closest to each account's geographic location. We obtained these data from the National Centers for Environmental Information (NCEI).

The daily data are based on hourly average temperature readings from each day. We calculated Cooling Degree Days (CDD) and Heating Degree Days (HDD) for each day (based on average daily temperatures, using the industry standard formula).[22] We merged daily weather data into the consumption dataset so that the HDDs and CDDs are calculated for each billing period (including start and end dates).[23] We then calculated average daily HDD and average daily CDD, based on the number of days within each billing period.

3.3.4 COMPARISON GROUP SELECTION

We constructed a comparison group of future participants who did not participate during the evaluation period but participated between January 1, 2024, and November 16, 2025. Future participants provide the baseline for estimating the impacts of the Program on the energy consumption of participants who received treatment during the evaluation

[22] A "degree-day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree-days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65°F (HDD) and 75°F (CDD). (The "mean" temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by two.) If the mean temperature for the day is five degrees higher than 75°F, then there have been five cooling degree-days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55°F, then there have been 10 heating degree-days (65 minus 55). "Degree Days," National Weather Service, https://www.weather.gov/ffc/degdays.

[23] Daily weather data are merged based on the given dates of the billing period. Assigning weather this way provides a more accurate representation of the weather experienced during the billing period than does using weather for the calendar month of the bill.

period. This approach provides an unbiased estimate of the energy impacts after accounting for differences between customer characteristics, seasonal trends, and weather conditions. The only difference between current and future participants is the timing of when they joined the Program.

3.3.5 COMPARISON GROUP EQUIVALENCY ASSESSMENT

To ensure future participants can serve as a comparison group, we verified the equivalency of the treatment and comparison groups. We conducted equivalency checks based on the treatment and comparison groups' pre-period energy usage and weather. We used 2021 as the reference year for equivalency checks, as this should be conducted for a period when neither the treatment or comparison group received treatment.

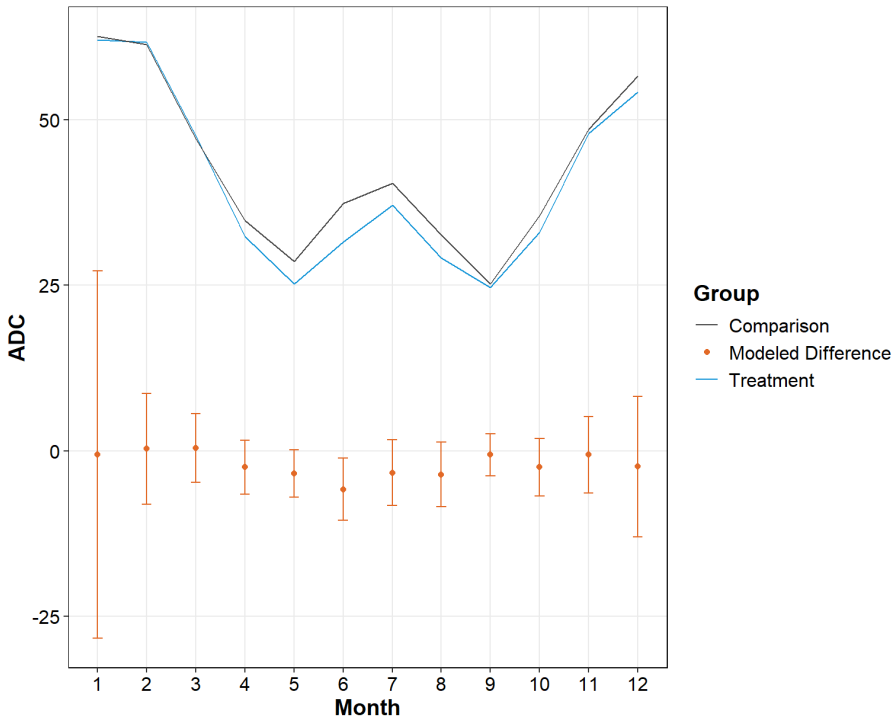
Figure 2 summarizes the average daily consumption (ADC) in 2021 among 2022-2023 treatment participants and 2024–2025 comparison participants. The treatment and comparison groups followed similar consumption patterns, with statistically significant differences observed in only one of the 12 months.

Figure 3 and Figure 4 show weather data as HDD and CDD, respectively. Figure 3 highlights slight CDD differences, with the comparison group having higher CDD in June and July, which helps explain the statistically significant difference observed in consumption between the two groups.

Figure 4 shows minimal HDD differences, with the treatment group having slightly higher HDD in months 1, 2, 3, 4, 5, and 6.[24]

Overall, the differences observed in weather are minor, whereas those in winter electricity consumption are more significant, but the fixed effects D-in-D regression model is designed to control for such differences that do not change over time.

Figure 2. Participant and Comparison Group Usage During their Pre-Participation (2021)



[24] In this context, January serves as month 1 and December serves as month 12.

Figure 3. Average CDD Experienced by Treatment and Comparison Groups

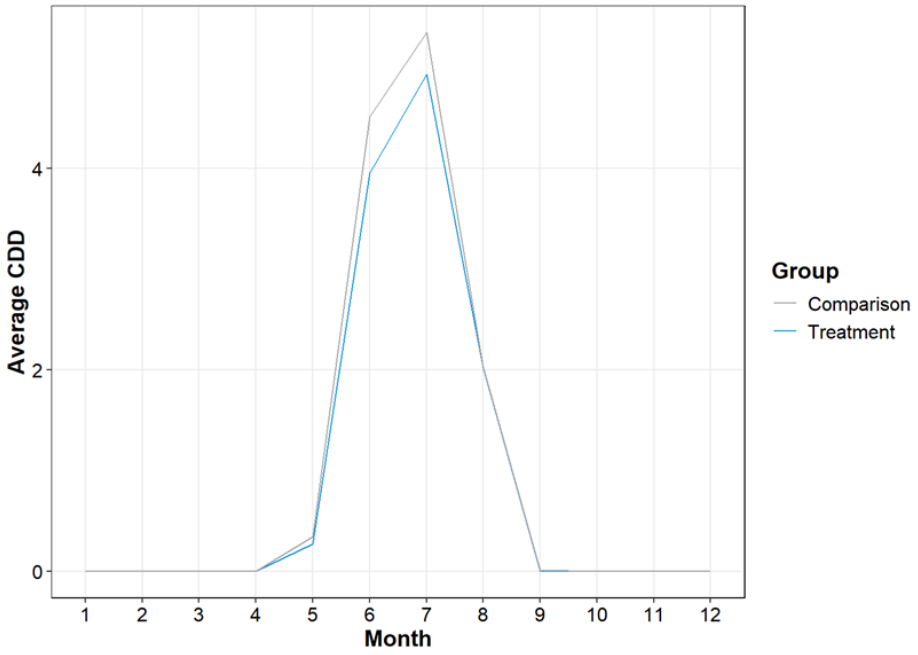
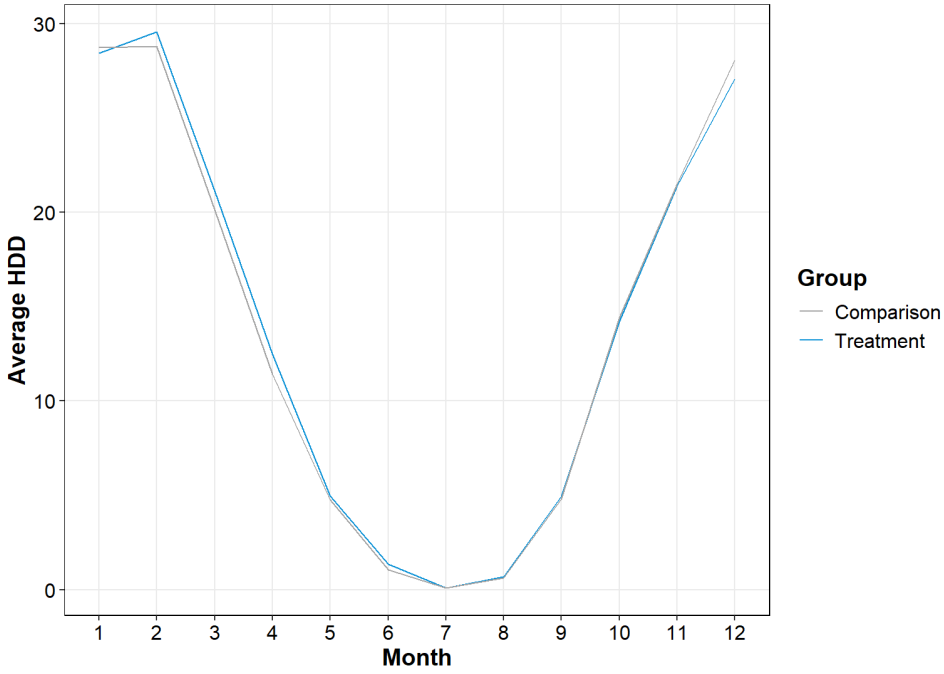


Figure 4. Average HDD Experienced by Treatment and Comparison Groups



3.3.6 MODELING SPECIFICATIONS

To estimate Program savings, we ran a two-way fixed effects D-in-D regression model. This is the industry standard for estimating energy impacts for efficiency programs where the start of treatment varies between participants. The model compares treatment customers to future participants during the evaluation period, as well as future participants who are treated after the evaluation period ends, while controlling for weather, The model compares treatment customers to future participants during the evaluation period, as well as future participants who are treated after the evaluation

period ends, while controlling for weather. The model compares differences in average consumption between participants (using participant fixed effects) and differences in average consumption over time unrelated to weather (using month-year-of-sample fixed effects). We used the model to estimate energy impacts for all customers and for the subset of customers who received a heat pump, enabling a focused assessment of the energy savings attributable to heat pump equipment.

Equation 1 contains the final model specification.

Equation 1. Model Specification

$$kWh_{it} = \gamma_i + \tau_t + \beta_1 Treat_{1,it} + \beta_2 Treat_{2,it} + \beta_3 Treat_{3,it} + \beta_{CDD} CDD_{it} + \beta_{HDD} HDD_{it} + \varepsilon_{it}$$

Where:

kWh_{it}= Average daily consumption for account *i* in time period (month-year) *t*

γ_i = Account-specific intercept for account *i*

τ_t = Month-year fixed effect

$Treat\ 1_{it}$ = Indicator variable for the first participation year period (coded "1" in the first year after participation, coded "0" otherwise)

$Treat\ 2_{it}$ = Indicator variable for the second participation year period (coded "1" in the second year after participation, coded "0" otherwise)

$Treat\ 3_{it}$ = Indicator variable for the third participation year period (coded "1" in the third year after participation, coded "0" otherwise)

CDD_{it} = Average daily cooling degree days for account *i* at time *t*

HDD_{it} = Average daily heating degree days for account *i* at time *t*

β_x = Model coefficients

ε_{it} = Error term

3.4 NON-ENERGY BENEFITS

Low-income weatherization programs often create benefits for participants beyond energy savings. To measure these NEBs, we conducted an external payment analysis, an arrearage analysis, and an economic impact assessment.

3.4.1 EXTERNAL PAYMENT ANALYSIS

The external payment analysis relied on monthly external assistance payments received by participants and the comparison group from 2021 to 2025. Nonprofit agencies provide external assistance payments that go towards helping low-income customers pay their Pacific Power electric bills.

We established pre- and post-participation periods for each customer based on their cost recovery date (i.e., received Program services). In contrast, all months between the start of the evaluation period (i.e., January 2022) and the cost recovery date were considered the pre-participation period. All months between the cost recovery date and the end of the evaluation period (i.e., December 2023) were defined as the post-participation period. To determine the pre- and post-period for comparison group customers, we estimated the average cost recovery date across all participants from

the evaluation period. We compared changes to external assistance payments between Program participants and the comparison group of future participation over the evaluation period.

3.4.2 ARREARAGE ANALYSIS

We also received arrearage data that provided customers' monthly unpaid account balances from 2021 to 2025. This range of data allowed us to establish a 12-month pre- and post-participation period for each customer, based on their cost recovery date in the Program tracking data, to understand how Program services have impacted customers' arrearages. To determine the pre- and post-period for comparison group customers, we estimated the average cost recovery date across all participants from the evaluation period.

We compared participant and comparison group unpaid account balances to inform our understanding of how Program participation and subsequent energy savings have impacted customer arrearages. During the evaluation period, many Pacific Power customers earning up to 200% of the Federal Poverty Level (FPL) received up to $2,500 in payment assistance through the COVID-19 Arrearage (Forgiveness) Grant initiated by Order 01 in Docket U-200281.[25] In addition, the state of Washington appropriated $100 million in Coronavirus State Fiscal Recovery Funds to reduce utility arrearages accrued between March 1, 2020 and December 31, 2021, which Pacific Power applied as a one-time account credit on December 12, 2022 with amounts varying by customer arrearage. These initiatives were intended to provide customers with financial support during the extended economic shutdown and to help them keep their arrearages manageable.

We excluded 201 participant group customers and 49 comparison group customers from the analysis due to insufficient arrearage data; cases with less than 12 months of pre- and post-participation data available.

3.4.3 ECONOMIC IMPACT ASSESSMENT

We used the Regional Input Output Modeling System II (RIMS-II), maintained by the US Department of Commerce, Bureau of Economic Analysis, to generate economic impacts attributable to the Program. RIMS-II captures the underlying economic relationships that characterize the counties included in Pacific Power's service territory, such as local supply conditions, import/export dynamics, and industry interdependencies. The system also incorporates data on industry output, employment, and earnings to estimate the impact of changes. The RIMS-II model accounts for the baseline scenario when calculating the economic effects of the Program. All effects are net of what would have happened had the Program not been in operation.

Using the RIMS-II model, we provide the economic impacts of the Program in terms of output (sales), value added (gross domestic product), employment (full- and part-time jobs), and earnings in all industries in the local economy.

Table 13 presents a summary of the four model input categories used to estimate the economic impacts of the Program: Program spending, Program costs, participant energy savings, and revenue loss for Pacific Power due to the energy savings experienced by Program participants. Program costs include several subcategories, including agency administration costs, weatherization costs, contributions of state and federal funds used to support weatherization, and the cost of the Program to ratepayers, represented by tariff collections. The values in the table represent the total amount of benefits or costs accrued over multiple years. To account for this, we converted all values to 2023 dollars using the Consumer Price Index published by the US Bureau of Labor Statistics and conducted the economic impact analysis as if all Program activity occurred in a single year.

[25] 119_Residential_COVID-19_Bill_Payment_Assistance_Program_Optional_for_Qualifying_Customers.pdf

The present value of energy savings experienced by Program participants represents the Program spending that diverts back to the local economy and is equal to the revenue loss to Pacific Power as these residents use less energy.

Table 13. Inputs for RIMS-II Economic Impact Model in 2023 Dollars

Input Category	Description	Amount	Sector
Program Spending Categories	Agency Administration[a]	$235,342	Construction
	Agency Weatherization[b]	$1,627,784	Construction
	State/Federal Government Contributions	$1,225,676	Construction
Program Costs	Costs to Ratepayers: Tariff Collections[c]	$1,627,784	Household
Energy Savings for Participants	Present Value of Participants' Avoided Energy Costs[d]	$2,005,962	Household
Revenue Loss for Pacific Power	Reduction in Pacific Power Revenue[e]	($2,005,962)	Utilities

[a] Agency Administration refers to the weatherization agency's costs to administer the Program, including labor costs.
[b] Agency Weatherization represents Pacific Power's direct reimbursement for measures installed.
[c] These represent the Program costs covered by the tariffs collected from ratepayers.
[d] Energy savings for participants are quantified as net benefits from the Participant Cost Test (PCT).
[e] Revenue loss occurs when participants receive energy efficiency measures and purchase less energy, which the utility experiences as lost revenue over the installed measures' lifetimes. This is modeled as the full present value of participants' energy savings.

3.5 COST-EFFECTIVENESS

Opinion Dynamics calculated inputs for cost-effectiveness testing through the consumption and non-energy benefit analyses. We provided these inputs to Apex Analytics, who conducted the final cost-effectiveness modeling.

4. RESULTS

This section details the results from the process and impact evaluations, non-energy benefit analyses, and cost-effectiveness testing conducted for the 2022 and 2023 program years.

4.1 PROCESS EVALUATION

The following sections present findings from the agency interviews and Program participant survey.

4.1.1 AGENCY INTERVIEWS

We conducted four agency interviews in December 2025, one with a representative from each of the following agencies: YNHA, NCAC, BMAC, and OIC of Washington State. We used these interviews to gain a deeper understanding of the Program's operations and identify key improvement areas. We present each agency's perspective in the subsections below. Of all Program participants, 38% received NCAC services, 37% received OIC services, 17% received BMAC services, and 7% received YNHA services.

YAKAMA NATION HOUSING AUTHORITY

YNHA receives funding from Pacific Power and the Bonneville Power Administration, along with state and federal sources, to cover the total costs of energy efficiency and weatherization services. With its available funds, YNHA typically serves between 15–20 households annually. The agency was unable to estimate the proportion of annual Program participants who are typically Pacific Power customers. However, they reported weatherizing a 40-unit apartment complex served by Pacific Power during the evaluation period.

Customers submit applications directly to the agency and are placed on the waitlist to receive weatherization services once their income eligibility has been approved and their home has been evaluated. YNHA prioritizes homes with elderly or disabled residents, children under 18, and those with a high energy burden. Typically, customers can expect to be on the waitlist for up to 12 months before receiving services. At the time of the interview, there were approximately 15 customers on the waitlist. YNHA uses the DOE's priority list to determine which measures each home receives. The agency has contractors on staff who perform the weatherization services; no subcontractors are used.

To help avoid customer deferrals, YNHA offers a housing assistance funding program that provides support for remediation services, including health and safety repairs.[26] Once the necessary repairs are completed, the house gets reassessed for weatherization services.

YAKIMA VALLEY FARM WORKERS CLINIC/NORTHWEST COMMUNITY ACTION CENTER

NCAC typically serves around 30 homes per year, with about 70% of these being Pacific Power customers. NCAC receives funding from Pacific Power and Cascade Natural Gas, as well as state and federal sources, to cover the total costs of energy efficiency and weatherization services.

The agency processes applications through an online system, which enables potential customers to apply directly for weatherization services and facilitates Program data management. Once customers pass income requirements and their homes are evaluated, NCAC places them in a working queue. At the time of the interview, the queue consisted of 28 participants, who had either recently applied for the Program or their applications were in the pre-audit process. The

[26] Funded by different source from the Program; not funded by Pacific Power.

time it takes to start the audit process depends on the funding sources available for that project. Projects typically take between eight and ten months to complete following the application submission.

Regarding Program implementation challenges, NCAC noted that many projects require health and safety upgrades before weatherization work can begin. As funding sources to address these repairs are limited, the agency has to defer or "walk away" from some of these projects.

NCAC mentioned that balancing pools of funding for individual projects can get complicated when trying to maximize the types of services the Program can deliver, since funding is specific and limited across all sources. Relatedly, the agency also noted challenges with invoice coding, reporting that the process can be quite time-consuming when juggling the numerous funding sources, posing a significant administrative burden at times. This burden worsened during the evaluation period due to numerous staffing changes that occurred in 2022 and 2023.

BLUE MOUNTAIN ACTION COUNCIL

BMAC receives funding from Pacific Power and Bonneville Power, as well as additional state and federal funding sources, to cover the total costs of energy efficiency and weatherization services. BMAC serves around 25-30 homes annually, with approximately 80% of these being Pacific Power customers.

Customers are generally referred to the Program through word-of-mouth or by service provider partners in the community. BMAC maintains a customer waitlist and distinguishes individuals by their electricity provider, prioritizing households with elderly, disabled, or Native American residents, as well as those high-energy burdened. The agency shared that customers typically receive Program services within three months of being referred to the Program, although it can take another two or three months of back-and-forth with Program and/or state auditors before each project is fully closed. Like other agencies, BMAC has also dealt with deferrals and walkaways as a result of health and safety repairs that are required prior to implementing weatherization services. During the evaluation period, the agency reported receiving repair funds to help address health and safety upgrades, which enabled the Program to weatherize additional homes.

BMAC noted that subcontractor availability varied seasonally in 2022 and 2023, affecting the consistency of service delivery. Agency staff also shared that new reporting requirements require extensive, and at times burdensome, documentation for each measure, which slows the approval process. In addition, BMAC indicated that approvals from the Department of Labor and Industries further extend project timelines, as cases cannot be closed until responses are received, increasing overall job costs.

OPPORTUNITIES INDUSTRIALIZATION CENTER OF WASHINGTON

Like the other three agencies, the OIC of Washington receives funding from Pacific Power and other utilities, as well as additional state and federal funding sources, to cover the total costs of energy efficiency and weatherization services. The agency serves approximately 100 homes annually, with most (~70) being Pacific Power customers.

Customers who receive energy assistance are added to the agency's randomized waitlist. This list includes over 1,000 homes, through which the agency individually pre-screens each applicant to determine their eligibility. The list is refreshed at the end of every year. The agency initiates home audits on a quarterly basis, typically completing projects within three months of when the audit is conducted.

The OIC representative indicated the primary challenges encountered during the 2022 and 2023 evaluation period included transitioning back into the office after the easing of social distancing restrictions, the consequent inability to reply to communications properly, and persisting funding limitations. The agency also noted challenges with serving

rental properties, whereas they occasionally encounter landlords who do not want to participate in the Program, as well as renters who worry their rent will increase as a result of improved energy efficiency in their home.

4.1.2 PARTICIPANT SURVEY

We used the participant survey to collect data about participants' experience with the Program and their household characteristics. Four of the eleven respondents resided in single-family homes, while the remaining seven lived in manufactured or mobile homes, or trailers. Most participants who completed the survey owned their homes (8 of 11). Of the remaining three respondents, one rented their home, one owned the residence but rented the lot it is located on, and the final individual provided an unclear response.

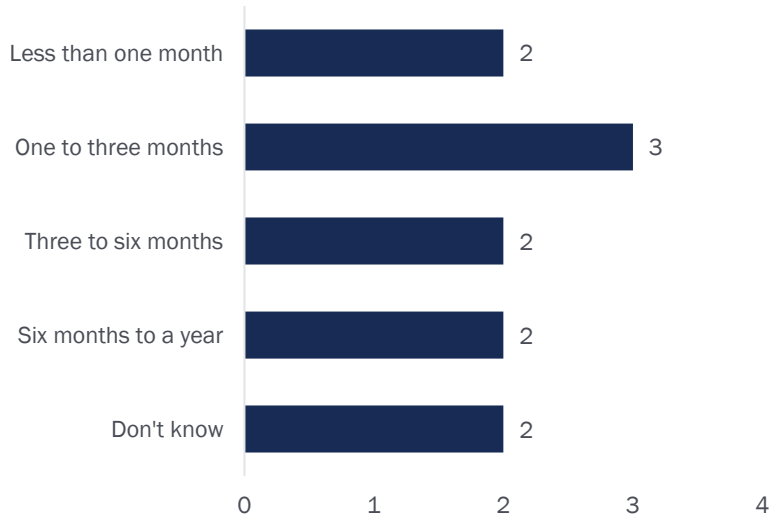
PROGRAM AWARENESS

When asked how they learned about the Program, most respondents (8 of 11) reported through word of mouth from family, friends, and neighbors. Consistent with findings from the previous evaluation, word of mouth continues to be the predominant source of customer awareness. Aside from word of mouth, one participant reported learning about the Program through each of the following sources: their electric bill, a TV ad, and social media.

As observed in past evaluations, Pacific Power participants have challenges identifying Pacific Power as a funding source for the Program. Most participants (9 of 11) could not identify any funding sources, while one respondent identified a source associated with the implementation agency. Only one participant correctly identified Pacific Power as a funding source; a similar number observed during the previous evaluation (i.e., 2 of 18).

Nearly half of the surveyed participants (5 of 11) received weatherization services within three months of submitting their application (Figure 5). Notably, most respondents received Program services more quickly than the typical timeline reported by agency staff (i.e., at least six months).

Figure 5. Time Between Application Process to Receiving Weatherization Services (n=11)

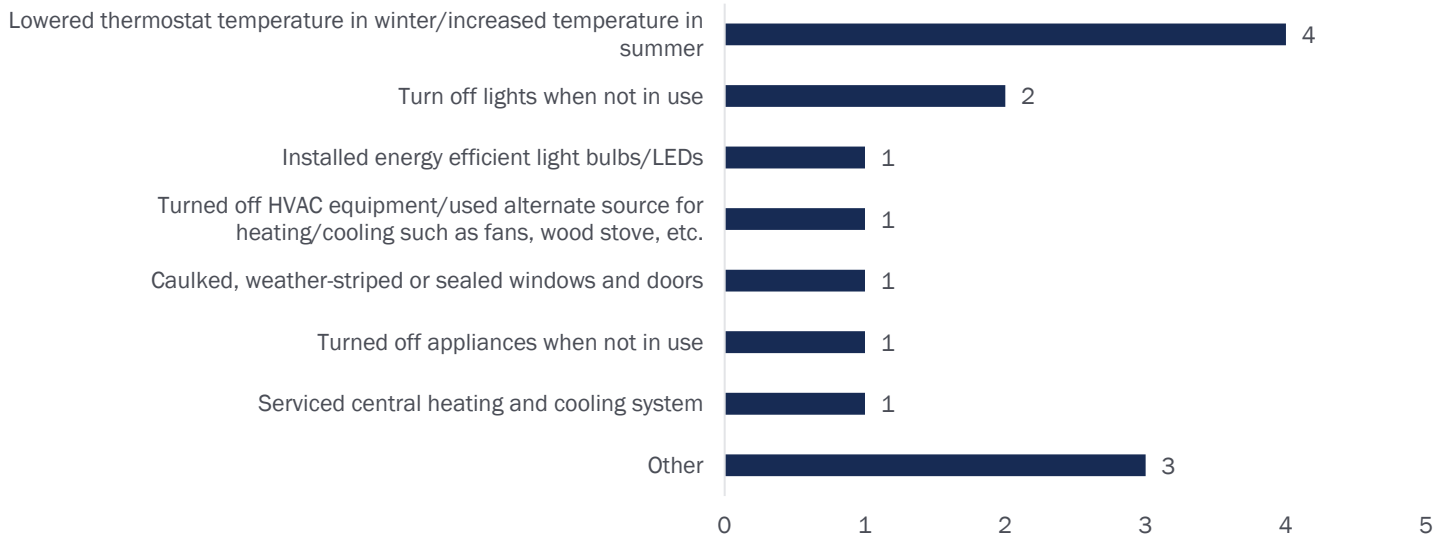


ENERGY EDUCATION

The Program does not formally offer energy education; however, nine of the eleven survey respondents received information from agency staff about ways to save energy in their homes. At the time of the survey, all nine of these respondents said they had taken at least some of the recommended energy-saving actions.

Figure 6 lists the primary energy-saving actions taken by participants. Other actions included replacing windows, doors, and the furnace (one mention), keeping doors closed (one mention), and general maintenance of home equipment (one mention).

Figure 6. Energy Actions Taken (n=8)



Note: Multiple responses allowed. Analysis excludes one respondent who did not recall what energy-saving actions they had taken.

To gauge participant feedback on the education they received from agency staff, we asked survey respondents to rate the helpfulness of the information using a scale from 0 to 10, where 0 indicated "not at all helpful" and 10 "extremely helpful." Participants provided positive feedback about the energy education they received, with most (7 of 9) indicating the information they received was "extremely helpful."[27] The remaining two participants reported the information was moderately helpful (i.e., rating of 5 and 6).

In addition to energy education related to conserving usage, approximately two-thirds of respondents (7 of 11) reported that weatherization staff also discussed ways to improve the health and safety of their home.

PROGRAM DELIVERY AND SATISFACTION

Participant feedback was largely positive, with most participants (9 of 11) sharing they were "completely satisfied" with the Program (Figure 7). Participants most commonly cited professionalism of the work crew and quality of the completed work as reasons for their satisfaction. Examples of positive feedback shared by participants are provided below:

- "It was good, complete and fast work. I don't see anything wrong. Great job. I'm happy with the results."
- "They did exactly what they said they would do with efficiency and accuracy."
- "There was nothing negative about it. It was all positive."

[27] As indicated with a score of 8 or higher on a 1-10 rating scale.

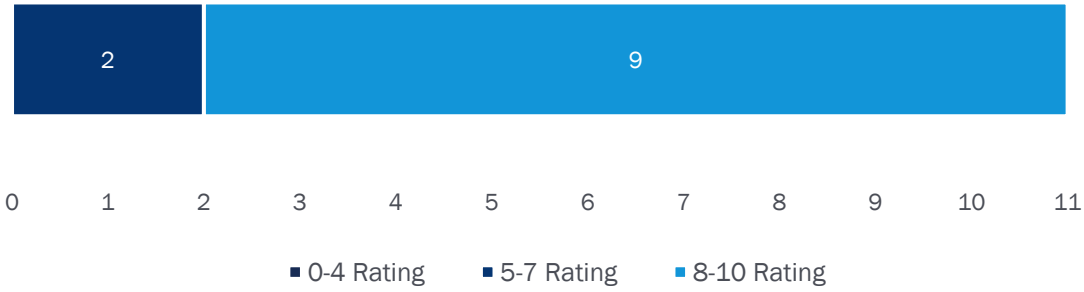
- “I’m happy.”
- “It was a great help. Great service.”
- “They were very competent in what they were doing.”

One participant also noted an observed decrease in their electric bill as a reason for their satisfaction with the Program.

The two participants who were not completely satisfied with the Program (score of 7 or lower) shared that their low scores were driven by dissatisfaction with the work completed and lack of communication from the work crew.

- “Because I heard other stories where they got more services, I feel like it was incomplete.”
- “There wasn't very much communication as to what was going to happen. It was just right before they were to complete the evaluation, they provided me with the updates that they could do to my home. I didn't agree with those updates, and the overall communication wasn't what I expected.”

Figure 7. Program Satisfaction (n=11)



Note: Scale from 0 to 10, where 0 is “Completely Dissatisfied” and 10 is “Completely Satisfied”

Notably, all 11 respondents said they would recommend the Program to others.

Also reflecting high Program satisfaction, most respondents (8 of 11) did not offer any suggestions for improvement. Table 14 presents the verbatim improvement suggestions provided by the remaining three survey respondents.

Table 14. Program Improvement Recommendations from Surveyed Participants (n=3)

Verbatim Recommendations for Program Improvements	
Better Communication	Just better communication between the clients and the staff.
Increase Accessibility	I think it needs to be available. I don't believe it's available anymore.
Additional measures	Windows

To assess participant experience with the application process, respondents were asked to rate how easy or difficult the process was using a scale from 0 to 10, where 0 represented “extremely difficult” and 10 “extremely easy.” Participants were pleased with the application process, with most stating the process was “extremely easy” (7 of 11). The four remaining respondents indicated the application process was at least somewhat easy, providing scores between five and seven. All surveyed participants indicated they were pleased with the weatherization staff, with nearly all (10 of 11) indicating that agency staff were courteous and respectful towards them and their family members.

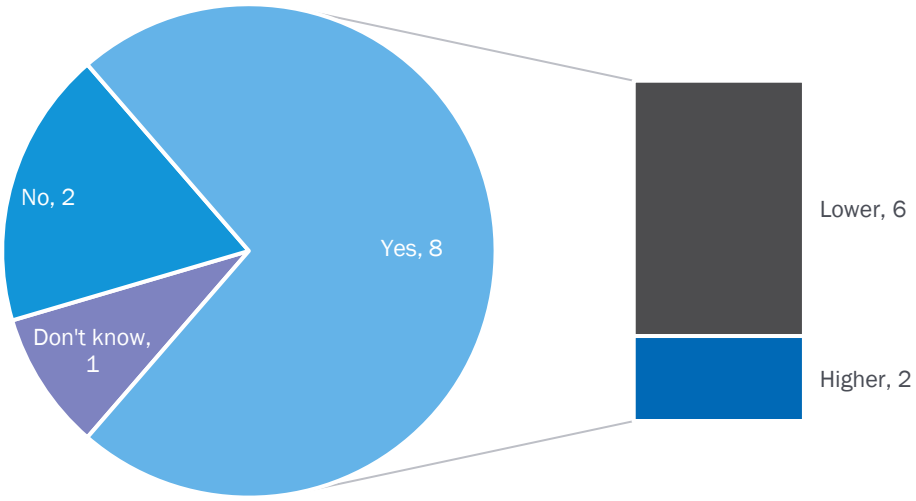
PERCEIVED PROGRAM IMPACT

Most participants (8 of 10) identified in Program tracking data as having received LED bulbs through the Program recalled receiving them. Among those, half (4 of 8) reported greater satisfaction with the new LED bulbs compared to their previous lighting, while the other half (4 of 8) reported no difference. When asked whether the LEDs remained installed, two participants indicated that some of the bulbs provided by the Program were not currently installed. Both respondents reported that they had never installed some of the bulbs, with one sharing that they had also removed some of the bulbs that were initially installed.

Both participants (2 of 2) identified in Program tracking data as having received a new showerhead recalled receiving it. One respondent reported higher satisfaction with the new showerhead compared to their previous model, while the other reported lower satisfaction.

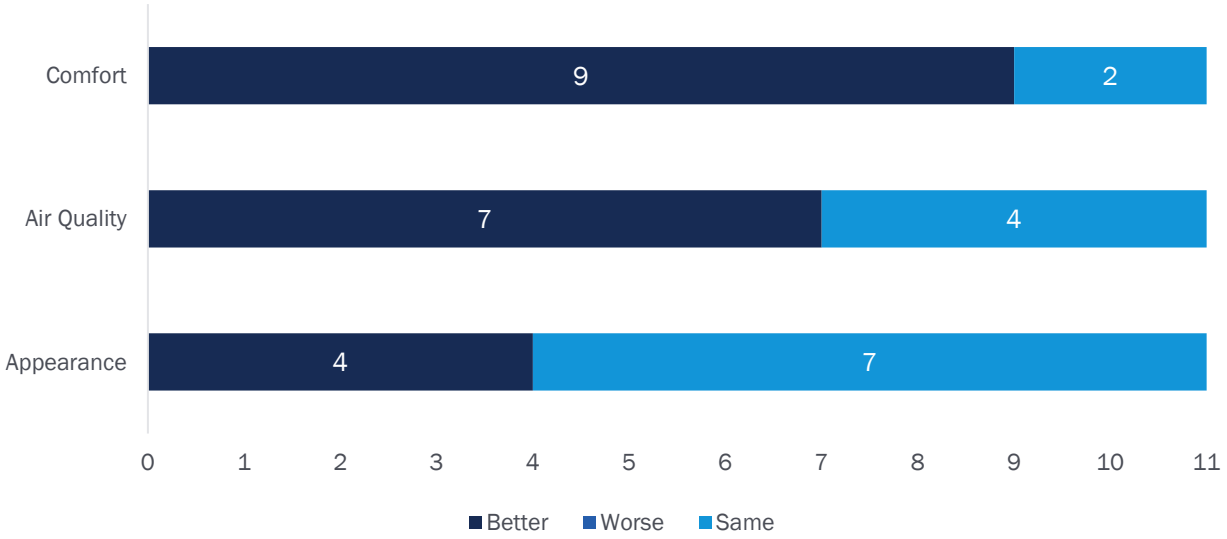
We asked participants whether they noticed a change in their electric bill after receiving weatherization services. Nearly all reported a change (8 of 11), most of which (6 of 8) stated their bill had decreased since participating in the Program. Interestingly, the remaining two respondents who observed a change reported that their bill had increased since their participation (Figure 8).

Figure 8. Post-Weatherization Change Noticed in Electric Bill (n=11)



We also explored non-energy benefits of the Program by asking Program participants whether the air quality, appearance, and comfort of their homes improved, stayed the same, or worsened after they received services. Most respondents reported an improvement in their home's comfort (9 of 11) and just under two-thirds reported an improvement in their home's air quality (7 of 11) after participating in the Program (Figure 9). Over one-third of participants (4 of 11) indicated that services completed by the Program improved the appearance of their home.

Figure 9. Impact of Measures on Home Characteristics (n=11)



4.2 IMPACT EVALUATION

A list of the various measures installed, from the most common (infiltration) to the least common (refrigerator), is presented in Table 15. Other common measures include ceiling, pipe, floor insulation, and ground covering.

Table 15. Washington Participation Counts and Measures for Program Years 2022–2023

Measures	2022	2023	Total	Percent
Total Number of Homes Weatherized	142	95	237	100%
Air Sealed/Infiltration	104	88	192	81%
Ceiling Insulation	112	77	189	80%
Pipe Insulation	86	85	171	72%
Floor Insulation	86	80	166	70%
Ground Cover	81	72	153	65%
LED Bulbs	60	82	142	60%
Attic Ventilation	58	60	118	50%
Weather Stripping	40	45	85	36%
Duct Sealing and/or Insulation	41	39	80	34%
Faucet Aerators	47	29	76	32%
Low-Flow Showerhead	28	28	56	24%
Heat Pump – Ductless	30	12	42	18%
Wall Insulation	14	17	31	13%
Thermal Doors	10	17	27	11%
Window Replacement	10	12	22	9%
Thermostat	8	10	18	8%
Water Heater Replacement	7	8	15	6%
Compact Fluorescent (CFL) Bulbs	7	7	14	6%
Refrigerator	3	2	5	2%

4.2.1 PROGRAM SAVINGS

In Table 16, we present the annual ex-ante gross and ex-post net energy savings for the Program.[28] The Program claimed 416,322 kWh in gross energy savings for the 2022 and 2023 program years, but achieved 148,789 kWh in net energy savings. The realization rate is 36% for the 2022–2023 evaluation period. The relatively low realization rate is primarily attributable to changes in the per-home measure mix and an increased share of multifamily participants.

Table 16. Ex-Ante Gross and Ex-Post Net Energy Savings (kWh)

Program Year	Total Participation	Heat Pump Participation	Ex-Ante Gross Energy Savings (kWh)	Ex-Post Net Energy Savings (kWh)	Realization Rate
2022	142	30	261,515	89,148	34%
2023	95	12	154,807	59,641	39%
Total	**237**	**42**	**416,322**	**148,789**	**36%**

Note: Gross and net savings are comparable because free ridership is not typical in low-income programs.

4.2.2 ANNUAL PARTICIPANT SAVINGS

Table 17 shows the average annual baseline consumption per participant, the average per household annual savings, and savings as a percentage of baseline consumption for the evaluation period.[29]

Table 17. Estimated Annual Savings from Consumption Analysis

Input	All Participants	Heat Pump Participants
Average Annual Baseline Energy Consumption per Participant (kWh)	14,361	11,762
Average per Participant Ex Post Net Annual Savings (kWh)	628	1,000
Average per Participant Savings Percentage	4.4%	8.5%

Note: Ex-post savings do not control for free ridership because the comparison group includes future-treated customers. However, free ridership is not typical in low-income program evaluations because most income-eligible participants do not have the disposable income to complete weatherization without program assistance.

On average, each participant saved 628 kWh in the year after Program measures were installed, with heat pump participants saving 1,000 kWh. This represents a reduction in annual energy usage of 4.4% overall and 8.5% for heat pump participants. Notably, per-participant energy savings calculated for 2022 and 2023 are three percentage-points lower than savings derived during the previous evaluation (2020–2021).

Energy savings can vary based on several factors, including the mix of measures installed, weather conditions, and participant characteristics such as home type and primary heating fuel. Among 2022 and 2023 participants included in the analysis sample, 36% resided in single-family homes or duplexes, 31% resided in apartments, and 33% resided in mobile homes. In contrast, participants included in the prior evaluation resided exclusively in single-family homes, duplexes, or mobile homes, with no multifamily properties represented. The inclusion of a substantial share of

[28] The evaluation team retrieved ex-ante gross energy savings by year from Pacific Power's *Washington Annual Report on Conservation Acquisition* for the years 2022 and 2023. Program ex-post net savings were calculated by multiplying the average per participant ex-post net annual savings (kWh) by the number of total number of participants for 2022 and 2023.

[29] The average annual savings per participant were estimated by using the coefficient of the first year after the intervention term multiplied by the number of days in a year.

multifamily residences in the 2022–2023 program years is a primary factor contributing to the lower estimated average kWh savings observed during the evaluation period.

Table 18 shows an estimate of the average daily per-participant savings associated with the Program. These values reflect savings under actual weather conditions observed in the post-period. Overall Program savings represent a 4.5% reduction relative to baseline consumption of 39 kWh per day for all participants. In comparison, savings for participants who received a heat pump represent an 8.5% reduction relative to an estimated baseline consumption of approximately 32 kWh per day.

Table 18. Modeled Savings Estimates

Participants	Average Daily Savings Estimate (kWh)	Average Daily Modeled Baseline (kWh)	Standard Error	90% Confidence Interval Lower Bound	90% Confidence Interval Upper Bound	Average Daily Savings Percentage
All	1.72	39.34	0.65	3.00	0.45	4.4%
Heat Pump	2.74	32.22	1.37	5.43	0.06	8.5%

Electricity consumption among all Program participants declined by an average of 1.72 kWh per day during the first year post-treatment, an impact that is statistically significant at the p<.01 level (Table 19). Among participants who received a heat pump, electricity consumption declined by an average of 2.74 kWh per day in the first year post-treatment. Estimated impacts for the second and third post-treatment years indicate statistically significant reductions in electricity consumption of similar magnitude for Program participants overall. However, impacts estimated for heat pump participants in the second and third post-participation years are based on a limited number of observations and are not statistically different from zero. As expected, both cooling degree day (CDD) and heating degree day (HDD) coefficients are positive and statistically significant, representing a positive relationship between weather and energy consumption. Table 19 details the final model output.

Table 19. Final Model Coefficients

Overall Participants				
Variable	**Parameter Estimate**	**Standard Error**	**Statistic**	**P Value**
first_post_year_flag	-1.72	0.65	-2.65	0.01
second_post_year_flag	-2.20	1.04	-2.11	0.04
third_post_year_flag	-2.77	1.63	-1.70	0.09
avg_CDD	1.17	0.25	4.73	0.00
avg_HDD	1.19	0.07	16.36	0.00
Adjusted R-squared	-1.72	0.65	-2.65	0.01
Number of treatment customers	-2.20	1.04	-2.11	0.04
Heat Pump Participants				
first_post_year_flag	-2.74	1.37	-2.00	0.05
second_post_year_flag	-2.30	2.01	-1.14	0.26
third_post_year_flag	-1.34	2.78	-0.48	0.63
avg_CDD	-0.01	0.81	-0.02	0.99
avg_HDD	0.65	0.21	3.16	0.00
Adjusted R-squared	-2.74	1.37	-2.00	0.05

Overall Participants				
Variable	**Parameter Estimate**	**Standard Error**	**Statistic**	**P Value**
Number of treatment customers	-2.30	2.01	-1.14	0.26

4.3 NON-ENERGY BENEFITS

The Program is expected to provide additional benefits beyond energy savings. We conducted an external payment analysis, an arrearage analysis, and an economic impacts assessment to determine these non-energy benefits.

4.3.1 EXTERNAL PAYMENT ANALYSIS

To complete the external payment analysis, we compared changes to external assistance payments between 2022–2023 Program participants and a comparison group of future Program participants during the evaluation period.

Table 20 below presents the annual change in external assistance payments, both annually and overall, for the evaluation period.

Notably, customers in Washington were eligible to receive two forms of COVID-19-related bill assistance that likely influenced observed trends in external payment assistance. First, the state's COVID-19 Arrearage (Forgiveness) Grant was deployed in 2020 and remained available through September 2022, providing up to $2,500 in debt assistance to eligible customers who self-attested to COVID-19–related financial hardship.[30] In addition, the state of Washington appropriated $100 million in Coronavirus State Fiscal Recovery Funds to reduce utility arrearages accrued between March 1, 2020 and December 31, 2021, which Pacific Power applied as a one-time account credit on December 12, 2022 with amounts varying by customer arrearage. Because these supports were time-limited and applied directly to outstanding balances, the phase-out of assistance may help explain increases in arrearages observed in 2022 among both participants and the comparison group.

On average, comparison group customers required $17.27 less in external payment assistance than Program participants. Assistance payments increased by an average of 26% for the participant group, including a 123% increase among 2022 participants and a 72% decrease among 2023 participants. Overall, Program participants required more payment assistance following participation than did comparison group customers; resulting in no non-energy benefit attributable to the Program.

Table 20. Payment Assistance Amounts Summary for Participants and Comparison Group

Program Year	Participant Group				Comparison Group				Net Difference Amount
	Pre	Post	Change	%Change	Pre	Post	Change	%Change	
2022	$ 143.65	$ 320.93	$ 177.29	123%	$ 140.65	$ 300.50	$ 159.85	114%	$ 17.43
2023	$ 345.46	$ 96.86	$ (248.60)	-72%	$ 353.42	$ 87.71	$ (265.70)	-75%	$ 17.10
Total	**$ 244.55**	**$ 208.90**	**$ (35.66)**	**26%**	**$ 247.03**	**$ 194.11**	**$ (52.93)**	**19%**	**$ 17.27**

Note: Results displayed in parentheses indicate a negative value.

[30] 119_Residential_COVID-19_Bill_Payment_Assistance_Program_Optional_for_Qualifying_Customers.pdf

4.3.2 ARREARAGE ANALYSIS

In addition to the external payment analysis, we also examined the change in arrearages. An arrearage is the unpaid ending monthly balance on a customer's bill. To estimate the non-energy benefit, we calculated the change in arrearages for Program participants and compared this to the change in arrearages for a comparison group.

The average monthly arrearage for the participant group decreased by $49, while it increased by $12 for the comparison group (Table 21).

The net difference in customer arrearages is $37. Arrearages among Program participants increased following receipt of Program services and by a substantially greater amount than among the comparison group; as a result, no non-energy benefit is attributable to the Program.

Table 21. Arrearage Summary for Participant and Comparison Groups

	Participant Group				Comparison Group				Net Difference in Arrearages
	Pre	Post	Change	%Change	Pre	Post	Change	%Change	
Monthly Arrearage	$ (4)	$ 45	$ 49	1097%	$ 73	$ 85	$ 12	16%	$ 37

Note: Negative values (indicated using parentheses) represent payments that exceeded the account balance, where an overage credit remained.

Because the two COVID-19-related bill assistance programs that extended into the evaluation period were time-limited and applied directly to outstanding customer account balances, the expiration of these supports may contribute to the increases in arrearages observed in 2022 for both participants and the comparison group.

4.3.3 ECONOMIC IMPACT ASSESSMENT

We conducted an economic impact assessment of the Program in operation for the 2022–2023 program years. The economic impact results were included as inputs to evaluate the cost-effectiveness of the Program.

We present results from the RIMS-II modeling in Table 22. The results are expressed in changes in employment (job years), labor income earned, value-added, and output in the region.[31] Each impact represents the sum of direct, indirect, and induced effects due to the Program and is expressed as the present value of the impact generated over the lives of the installed measures.

Table 22. Economic Impacts Summary for Pacific Power Washington's Program for PY2022–2023

Impact Type	Employment (Job-Years)	Labor Income	Economic Value Added	Economic Output
Total Effect	14.1	$859,749	$870,625	$1,965,963

The model's estimated impacts can be compared to spending to contextualize the results. Dividing the output in Table 22 by the total local spending ($3,088,803 in 2023 dollars) estimates that each dollar of Program spending on weatherization resulted in $0.64 of total output in the region.[32]

[31] Economic impacts measured in 2023 dollar value.

[32] We calculate this by dividing the output in Table 6 by the total local spending.

4.4 COST-EFFECTIVENESS

Apex Analytics estimated the cost-effectiveness of Pacific Power's 2022–2023 Washington Program. The Program passes the PTRC and TRC when NEBs are included.

The following assumptions were utilized in the analysis:

- Realization Rates: Pacific Power provided updated realization rates due to changes between the original predicted and evaluated energy savings in PY2022–PY2023.
- Modeling Inputs: Measure savings, costs, and NEBs; measure lives, incentive levels, Program delivery, and portfolio costs based on estimates provided by Pacific Power.
- Net-to-Gross (NTG): Ratios are assumed to be 1.0, consistent with condition (8)(a) to Order 01 in Docket UE-152072.

Table 23 presents the cost-effectiveness results at the program level for 2022-2023 by inclusion of NEBs.

Table 23. 2022–2023 Program Benefit/Cost Ratios by NEB Inclusion

NEB Status	PTRC	TRC	UCT	RIM	PCT[a]
Program with NEBs	1.22	1.21	0.15	0.13	n/a
Program without NEBs	0.17	0.15	0.15	0.13	n/a

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 24 presents the cost-effectiveness results without NEBs for 2022-2023.

Table 24. 2022–2023 Program Cost-Effectiveness Results (Without NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV[a] Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.98	$1,863,016	$312,987	($1,550,029)	0.17
Total Resource Cost Test (TRC) No Adder	$0.98	$1,863,016	$285,070	($1,577,946)	0.15
Utility Cost Test (UCT)	$0.98	$1,863,016	$279,170	($1,583,846)	0.15
Participant Cost Test (PCT)		$0	$1,856,233	$1,856,233	Pass[b]
Ratepayer Impact Measure Test (RIM)		$2,117,791	$279,170	($1,838,621)	0.13
Lifecycle Revenue Impacts ($/kWh)					$0.00021

[a] Net Present Value (NPV).

[b] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 25 presents the cost-effectiveness results, including NEBs for 2022-2023.

Table 25. 2022–2023 Program Cost-Effectiveness Results (Including NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.98	$1,863,016	$2,278,949	$415,933	1.22
Total Resource Cost Test (TRC) No Adder	$0.98	$1,863,016	$2,251,032	$388,016	1.21
Utility Cost Test (UCT)	$0.98	$1,863,016	$279,170	($1,583,846)	0.15
Participant Cost Test (PCT)		$0	$5,788,158	$5,788,158	Pass[a]
Ratepayer Impact Measure Test (RIM)		$2,117,791	$279,170	($1,838,621)	0.13
Lifecycle Revenue Impacts ($/kWh)					$0.00021

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 26 presents the cost-effectiveness results at the program level for 2022 by inclusion of NEBs.

Table 26. 2022 Program Benefit/Cost Ratios by NEB Inclusion

NEB Status	PTRC	TRC	UCT	RIM	PCT[a]
Program with NEBs	1.91	1.89	0.22	0.19	n/a
Program without NEBs	0.25	0.23	0.22	0.19	n/a

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 27 presents the cost-effectiveness results, without NEBs at the program level for 2022.

Table 27. 2022 Program Cost-Effectiveness Results (Without NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.57	$744,164	$184,936	($559,228)	0.25
Total Resource Cost Test (TRC) No Adder	$0.57	$744,164	$168,392	($575,772)	0.23
Utility Cost Test (UCT)	$0.57	$744,164	$165,442	($578,722)	0.22
Participant Cost Test (PCT)		$0	$782,388	$782,388	Pass[a]
Ratepayer Impact Measure Test (RIM)		$889,034	$165,442	($723,592)	0.19
Lifecycle Revenue Impacts ($/kWh)					$0.00011

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 28 presents the cost-effectiveness results, including NEBs at the program level for 2022.

Table 28. 2022 Program Cost-Effectiveness Results (Including NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.08	$744,164	$1,419,866	$675,702	1.91
Total Resource Cost Test (TRC) No Adder	$0.08	$744,164	$1,403,322	$659,158	1.89
Utility Cost Test (UCT)	$0.57	$744,164	$165,442	($578,722)	0.22
Participant Cost Test (PCT)		$0	$3,252,249	$3,252,249	Pass[a]
Ratepayer Impact Measure Test (RIM)		$889,034	$165,442	($723,592)	0.19
Lifecycle Revenue Impacts ($/kWh)					$0.00011

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 29 presents the cost-effectiveness results at the program level for 2023 by inclusion of NEBs.

Table 29. 2023 Program Benefit/Cost Ratios by NEB Inclusion

NEB Status	PTRC	TRC	UCT	RIM	PCT[a]
Program with NEBs	0.77	0.76	0.10	0.09	n/a
Program without NEBs	0.11	0.10	0.10	0.09	n/a

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 30 presents the cost-effectiveness results, without NEBs at the program level for 2023.

Table 30. 2023 Program Cost-Effectiveness Results (Without NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$1.29	$1,118,852	$128,051	($990,801)	0.11
Total Resource Cost Test (TRC) No Adder	$1.29	$1,118,852	$116,678	($1,002,174)	0.10
Utility Cost Test (UCT)	$1.29	$1,118,852	$113,728	($1,005,124)	0.10
Participant Cost Test (PCT)		$0	$1,073,845	$1,073,845	Pass[a]
Ratepayer Impact Measure Test (RIM)		$1,228,757	$113,728	($1,115,029)	0.09
Lifecycle Revenue Impacts ($/kWh)					$0.00029

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

Table 31 presents the cost-effectiveness results, including NEBs at the program level for 2023.

Table 31. 2023 Program Cost-Effectiveness Results (Including NEBs)

Cost-Effectiveness Test	Levelized $/kWh	NPV Costs	NPV Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$1.29	$1,118,852	$859,083	($259,769)	0.77
Total Resource Cost Test (TRC) No Adder	$1.29	$1,118,852	$847,710	($271,142)	0.76
Utility Cost Test (UCT)	$1.29	$1,118,852	$113,728	($1,005,124)	0.10
Participant Cost Test (PCT)		$0	$2,535,909	$2,535,909	Pass[a]
Ratepayer Impact Measure Test (RIM)		$1,228,757	$113,728	($1,115,029)	0.09
Lifecycle Revenue Impacts ($/kWh)					$0.00029

[a] Low-income programs have no customer costs and therefore a cost benefit ratio cannot be calculated for this test.

APPENDIX A. ACRONYM GLOSSARY

Table 32. Acronym Glossary

Acronyms	Definition
ADC	Average Daily Consumption
BMAC	Blue Mountain Action Council
CDD	Cooling Degree Days
CFL	Compact Fluorescent Light Bulb
D-in-D	Difference-in-Differences Regression
DHHS	United States Department of Health & Human Services
DOE	United States Department of Energy
FPL	Federal Poverty Level
H&S	Health and Safety
HDD	Heating Degree Days
kWh	Kilowatt-hour
LED	Light Emitting Diode Light Bulb
LIHEAP	Low-Income Home Energy Assistance Program
LIW	Low-Income Weatherization
NCAC	Northwest Community Action Center
NCEI	National Centers for Environmental Information
NEB	Non-Energy Benefit
NPV	Net Present Value
NTG	Net-to-Gross
OIC	Opportunities Industrialization Center of Washington
PCT	Participant Cost Test
PTRC	PacifiCorp Total Resource Cost Test
RIM	Ratepayer Impact Measure Test
RIMS-II	Regional Input-Output Modeling System
SMI	State Median Income
TRC	Total Resource Cost
UCT	Utility Cost Test
WADOC	Washington Department of Commerce, Community Services and Housing Division
YNHA	Yakima Nation Housing Authority

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