Appendix 2

2020 - 2021
Verification of Savings

Pacific Power

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AEG

2020–2021 PacifiCorp Washington Savings Verification

Prepared for: PacifiCorp

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EXECUTIVE SUMMARY

PacifiCorp selected Applied Energy Group, Inc. (AEG) to perform savings verification and process review of its Washington energy efficiency programs for the 2020-2021 biennial period. This study is not intended to duplicate or replace impact or process evaluations of Pacific Power's energy efficiency programs but rather to review and validate the measurement and verification (M&V) approaches, savings tracking, and reporting practices to validate the accuracy of the savings being reported for the biennial period.

As the overall portfolio verification and process review contractor, AEG's primary goals include:

- Reviewing the practices and methods currently employed for measurement and verification, tracking, reporting, cost effectiveness, and evaluation of EE program savings.
- Performing primary data collection activities that could not be performed during 2018-19 verification or 2020-21 evaluation activities due to the COVID-19 pandemic, including limited virtual and onsite verification for Home Energy Savings and Wattsmart Business projects.
- Verifying the calculation of total PacifiCorp portfolio MWh savings in WA State.

The executive summary provides an overview of the programs, describes AEG's approach to verification, and highlights the key findings and recommendations from the research effort. Details by task are provided in the attached report.

Overview of Programs

The verification focused on PacifiCorp's four Washington energy efficiency programs: Home Energy Savings (HES), Home Energy Reports (HER), Low Income Weatherization (LIW), and Wattsmart Business (WSB). A brief summary of the programs follows.

Home Energy Savings (HES)

The Home Energy Savings (HES) program offers a comprehensive set of customer-focused, residential energy efficiency incentives, including upstream, midstream, and end-user rebates. The program implementation vendor (Resource Innovations) manages all program activities and holds weekly calls with the PacifiCorp program manager to report progress and escalate issues. The HES program contributed between 9% and 13% of portfolio savings in the 2020-2021 biennium period, driven by downstream and upstream lighting and heat pump conversions and upgrades.

Home Energy Reports (HER)

The HER program is designed to generate quantifiable energy savings by sending customers reports that encourage energy-savings behavior and home improvements. Bidgely has delivered the program since 2018 when it adopted the randomized control trial (RCT) from the previous vendor and began delivering its own style of report. Bidgely's report continued providing customers with information about their homes' energy consumption, comparing their homes to other similar homes, and offering customized, energy-saving tips and tricks. In 2020 Bidgely re-randomized the program, abandoning the original RCT in favor of reselecting the treatment- and control-group customers.

Low Income Weatherization (LIW)

PacifiCorp's Low Income Weatherization (LIW) program provides no-cost energy efficiency services to income-qualified residential customers through a partnership with local non-profit community service agencies that provide wraparound services to vulnerable populations. All agencies offered Low Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP) services as part of their service offerings and received state, federal and utility funding for these programs. The program aims to reduce the

energy burden for program participants, maintain affordable housing inventory, improve air quality and support healthy living conditions, and mitigate health and safety issues.

Wattsmart Business

PacifiCorp's Wattsmart Business program offers services and incentives to commercial, industrial, and irrigation customers through midstream (distributors/suppliers) and downstream (customer) incentive mechanisms. Incentives are available for retrofit projects, new construction, and major renovation projects.

Wattsmart Business program measures and services are offered (and tracked) through five delivery channels.

- The **Custom Analysis Incentive** channel targets large energy users and projects that require custom analyses, though small- and mid-sized customers can also qualify. The design of these incentives offers multiple opportunities for energy efficiency upgrades; technical assistance helps customers identify energy efficiency opportunities and analyze the custom savings.
- **Typical Upgrades/Listed Incentives** primarily target small- and mid-sized customers for prescriptive energy efficiency improvements, although large customers are also eligible. Customers apply directly to Pacific Power or work with a trade ally to receive incentives.
- The **Small Business Enhanced Incentive** channel provides enhanced lighting incentives for small business customers through Pacific Power's trade ally network.
- Through the **Lighting Instant Incentives** channel, customers can receive point-of-purchase discounts on LEDs purchased through a participating lighting distributor. Customers who do not purchase from a participating distributor can apply for the incentive after purchase.
- **Energy Management** participants receive expertise and custom incentives for verified savings achieved through operations, maintenance, and management practices.

Research Approach

AEG implemented an efficient and holistic technical approach to achieve the research objectives through five key tasks. The tasks were designed to build on each other and include inherent redundancies and cross-checks to enhance the robustness of the verification. The five key tasks included the following:

- **Task 1 Project initiation** included a kickoff meeting, data request, and program manager interviews.
- **Task 2 Review of M&V Processes and Procedures** included a review of M&V guidance, checklists, documentation, and verification of inspection rates.
- **Task 3 Review of Evaluations and Cost-Effectiveness** included reviewing impact and process evaluation reports and a high-level review of the cost-effectiveness analysis focusing on consistency with accepted Washington methodology and sourcing of inputs.
- **Task 4 Validate Savings Tracking and Reporting** included verifying the extent to which PacifiCorp accurately tracked and reported program performance metrics in its program tracking database.
- **Task 5 Verify Portfolio Savings** included engineering desk reviews and virtual and onsite verification of individual projects to directly verify a sample of savings. It also combines the results of various research activities and tasks to verify the savings reported at the portfolio level.

Because the individual tasks were designed to include overlaps, AEG's approach leveraged multiple research activities, each of which contributed to completing one or more of the five key tasks. A description of each research activity and its contributions to each task is presented in Table ES-1 below.

Table ES-1 Research Activities by Task

Research Activity	Task 1	Task 2	Task 3	Task 4	Task 5
In-Depth Interviews Developed interview guide and conducted interviews with the residential (HES and HER), C&I (WSB), and low-income (LIW) program managers.	✓	✓	✓	✓	✓
Review EM&V Framework and Program Handbooks Identify key M&V and EM&V guidelines for each program.		✓	✓	✓	
Verify M&V Inspections Gathered inspection documentation, matched to records in the DSMC extracts, and confirmed whether inspection rate targets were met.		✓		✓	
Review EM&V Reports Investigated appropriateness of methods and inputs used to estimate impact, process, and cost-effectiveness results.			✓		✓
Review Annual Reports for Cost-Effectiveness Confirmed that the appropriate inputs were used to calculate 2020 annual cost-effectiveness results.			✓		
DSMC Extract Reviews Investigated the inclusion and quality of program-critical fields and reviewed the extracts for duplicated records or customers.		✓		✓	✓
High-Level Portfolio Cross-Check Compared savings and counts of projects by measure category included in the 2020 Annual Report to the 2020 DSMC Extract.				✓	✓
Desk Reviews Randomly sampled projects from HES, LIW, and WSB for desk reviews.		✓		✓	✓
HES Virtual Verification Called a random sample of HES heat pump customers and received photos of their systems for virtual verification.				✓	✓
WSB Onsite Verification Visited four WSB projects to gather key information and confirm the installation and scope of each measure.				✓	✓

Key Findings and Recommendations

Below we highlight the AEG's key findings and provide recommendations for program and process improvements. The recommendations fall into four general categories: backup documentation, tracking and reporting, third-party evaluation, and cost-effectiveness. Despite identifying some areas for future improvement, **AEG does not recommend any changes to savings based on the verification findings.** Our recommendations are related to the collection and storage of data to support third-party evaluation and verification and not the validity of savings.

Relating to Backup Documentation

- **In the future, collect post-inspection documentation from agencies participating in the Low Income Weatherization program regularly to ensure that it is readily available for audits and other verifications.** More consistent data collection will improve PacifiCorp's ability to internally track progress towards the inspection requirements outlined in program handbooks and the EM&V Framework. It will also improve how inspections are tracked in the DSMC extracts. Finally, more frequent data collection will also alleviate the need for the agencies to gather this documentation all at once. (See *Chapter 2 M&V Processes and Procedures*.)

- **Encourage third-party evaluation and verification contractors to work directly with program implementors to gather the necessary project files for HES and WSB projects not attached to the DSMC.** AEG found that 2020 and 2021 HES project files (applications and invoices) and 2020 WSB project files were stored in their native formats within program implementer databases. As such, PacifiCorp relied on requests to program implementors to fulfill all third-party requests for data resulting in a somewhat cumbersome request and fulfillment process. This process was further complicated by the multiple concurrent evaluations and parties involved. Establishing data transfer protocols with program implementors ahead of these requests (e.g., by hosting a shared drive that both the implementors and third-party contractors can access) could streamline the process and remove the burden on PacifiCorp staff to directly handle all data transfers. (See *Chapter 5 Portfolio Savings*.)
- **When storing inspection documentation, use the convention of the external project ID consistently across all programs and project categories.** In most cases, PacifiCorp appeared to use this convention, and AEG could easily map inspection documentation to the DSMC extract. However, several HES folders used the customer's last name instead of a project ID, making them difficult to map. (See *Chapter 2 M&V Processes and Procedures*.)

Relating to Tracking and Reporting (DSMC)

- **Consider adding a field to the DSMC extracts that identifies the EM&V Framework inspection threshold category under which each Wattsmart Business project belongs.** Including this field will ensure that the population of projects and inspections are tracked consistently across the various parties involved, including PacifiCorp, implementors and inspectors, and third-party evaluation and verification contractors. The additional field will also improve everyone's ability to track progress toward inspection targets. (See *Chapter 2 M&V Processes and Procedures* and *Chapter 4 Tracking and Reporting*.)
- **Review the final 2021 DSMC extract for accuracy in non-savings fields, as needed.** AEG could not conduct a full review of the final 2021 DSMC extract because of the verification effort timing. However, we identified a few issues that PacifiCorp may want to investigate further, including kWh savings showing up in the TRL reference and quantity fields. However, these discrepancies did not appear to impact the savings based on the projects we reviewed. (See *Chapter 4 Tracking and Reporting*.)
- **Continue to monitor the process by which WSB implementors can work directly in the DSMC database.** Many 2021 project files did not appear to be stored in DSMC as expected, which led to some delays in the verification effort. However, given that 2021 was the first year that implementors were able to access the DSMC, some difficulties are expected, and ultimately AEG was able to collect much of the documentation needed to complete the verification. PacifiCorp should consider conducting random, internal audits of project files to gauge how this process is working and make improvements as needed. (See *Chapter 4 Tracking and Reporting* and *Chapter 5 Portfolio Savings*.)

Related to Third-Party Evaluation and Cost-Effectiveness

- **Encourage high-quality reporting on sample design from program evaluators.** AEG determined that the HES 2019-2020 evaluation report met a minimum standard. However, the report would be more robust and valuable for designing future studies with better information about how the evaluator developed the sample frame and which customers were ultimately represented in their analysis. (See *Chapter 3 Program Evaluations and Cost Effectiveness*.)
- **Include cost-effectiveness analysis inputs and findings in the program evaluation reports.** The 2020-2021 Home Energy Reports evaluation report does not include cost-effectiveness analysis and findings. The Evaluation Work Plan for 2021-2022 Home Energy Savings and 2021-2022 Wattsmart Homes programs notes that cost-effectiveness will be calculated by a PacifiCorp-selected consultant and that the results will be included in ADM's report. Cost-effectiveness analysis inputs and findings should be consistent with the accepted Washington methodology and presented in the evaluation reports. (See *Chapter 3 Program Evaluations and Cost Effectiveness*.)

- **Update the 2017 Class 2 Demand-Side Management Decrement Study to ensure that the avoided costs included the components dictated by the Council's methodology.** (See *Chapter 3 Program Evaluations and Cost Effectiveness*.)
- **Ensure avoided costs are correctly entered into the analysis.** AEG was not able to collect or review the original avoided costs used in the cost-effectiveness analysis as intended. (See *Chapter 3 Program Evaluations and Cost Effectiveness*.)

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INTRODUCTION

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Research Objectives

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Overview of Research Approach

AEG implemented an efficient and holistic technical approach to achieve the research objectives through five key tasks. The tasks were designed to build on each other and include inherent redundancies and cross-checks to enhance the robustness of the verification.

The five key tasks included:

- **Task 1 Project initiation** included a kickoff meeting, data request, and program manager interviews.
- **Task 2 Review of M&V Processes and Procedures** included a review of M&V guidance, checklists, documentation, and verification of inspection rates.
- **Task 3 Review of Evaluations and Cost Effectiveness** included reviewing impact and process evaluation reports and a high-level review of the cost-effectiveness analysis focusing on consistency with accepted Washington methodology and sourcing of inputs.
- **Task 4 Validate Savings Tracking and Reporting** included verifying the extent to which PacifiCorp accurately tracked and reported program performance metrics in its program tracking database.
- **Task 5 Verify Portfolio Savings** included engineering desk reviews and virtual and onsite verification of individual projects to directly verify a sample of savings. It also combines the results of various research activities and tasks to verify the savings reported at the portfolio level.

Because the individual tasks were designed to include overlaps, AEG's approach leveraged multiple research activities, each of which contributed to completing one or more of the five key tasks. A description of each research activity and its contributions to each task is presented in Table 1 below.

Table 1 Research Activities by Task

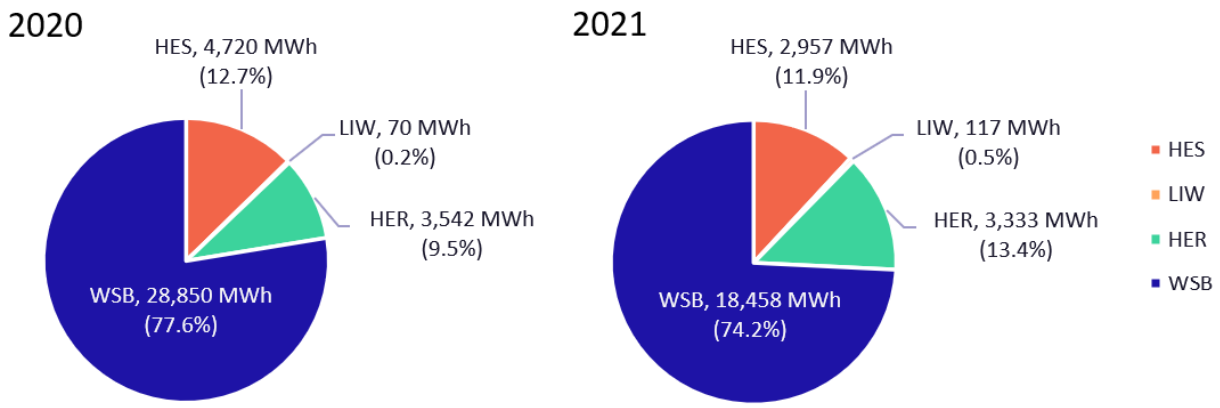
Research Activity	Task 1	Task 2	Task 3	Task 4	Task 5
In-Depth Interviews Developed interview guide and conducted interviews with the residential (HES and HER), C&I (WSB), and low-income (LIW) program managers.	✓	✓	✓	✓	✓
Review EM&V Framework and Program Handbooks Identify key M&V and EM&V guidelines for each program.		✓	✓	✓	
Verify M&V Inspections Gathered inspection documentation, matched to records in the DSMC extracts, and confirmed whether inspection rate targets were met.		✓		✓	
Review EM&V Reports Investigated appropriateness of methods and inputs used to estimate impact, process, and cost-effectiveness results.			✓		✓
Review Annual Reports for Cost-Effectiveness Confirmed that the appropriate inputs were used to calculate 2020 annual cost-effectiveness results.			✓		
DSMC Extract Reviews Investigated the inclusion and quality of program-critical fields and reviewed the extracts for duplicated records or customers.		✓		✓	✓
High-Level Portfolio Cross-Check Compared savings and counts of projects by measure category included in the 2020 Annual Report to the 2020 DSMC Extract.				✓	✓
Desk Reviews Randomly sampled projects from HES, LIW, and WSB for desk reviews.		✓		✓	✓
HES Virtual Verification Called a random sample of HES heat pump customers and received photos of their systems for virtual verification.				✓	✓
WSB Onsite Verification Visited four WSB projects to gather key information and confirm the installation and scope of each measure.				✓	✓

Program Descriptions

PacifiCorp realizes energy savings in Washington through four separate customer programs, plus the Northwest Energy Efficiency Alliance (NEEA) efforts.[1] The contribution of each of the four programs based on PacifiCorp's tracking database is shown in Figure 1. AEG used this distribution of savings and the nature of each program to guide verification efforts. While AEG reviewed savings tracking and verification processes, evaluation methods, and cost-effectiveness analyses for all programs, engineering review and virtual or onsite verification of individual projects focused on Wattsmart Business, Home Energy Savings (non-upstream lighting), and Low Income Weatherization, which jointly represent over 90% of savings.

[1] Verifying savings attributed to the efforts of the Northwest Energy Efficiency Alliance (NEEA) was outside the scope of this study.

Figure 1 Contribution to Overall Savings by Program



Each of the four programs offered by PacifiCorp Washington is described below.

Home Energy Savings (HES)

The Home Energy Savings (HES) program offers a comprehensive set of customer-focused, residential energy efficiency incentives, including upstream, midstream, and end-user rebates. The program implementation vendor (Resource Innovations) manages all program activities and holds weekly calls with the PacifiCorp program manager to report progress and escalate issues.

Savings claimed through the HES program are primarily from measures with deemed savings values developed by the Regional Technical Forum (RTF). Because of this, verification efforts are relatively straightforward, ensuring that the correct deemed savings value is applied to the correct measure. However, savings for certain measures are based on specific home characteristics or derived from energy modeling and require additional effort to verify that sufficient savings documentation is available.

Home Energy Reports (HER)

The HER program is designed to generate quantifiable behavioral savings. The HER program provides customized reports via email (or regular mail) to customers comparing their energy consumption to other similar homes and encouraging energy-saving behaviors and home improvements. The reports are intended to employ social norming and behavioral nudges to drive customers to conserve energy.

The HER is a turnkey program implemented by Bidgely. Savings for HER participants are estimated using a Randomized Control Trial (RCT). After defining an eligible population, the vendor randomly assigns potential participants to a treatment or control group. The control group usage is used to develop a counterfactual for the treatment customers and estimate the program impacts. Savings are also independently estimated by a third-party evaluator using the same treatment and control groups. Savings are reported by Bidgely once a month, showing comparisons between treatment and control groups and pre- and post-energy usage. The granular data on treatment and control groups and the number of recipients for each report are not tracked in DSMC. Still, they are available to PacifiCorp, if needed, upon request to the implementation vendors.

Low Income Weatherization (LIW)

PacifiCorp's Low Income Weatherization (LIW) program provides no-cost energy efficiency services to income-qualified residential customers through a partnership with local non-profit community service agencies that provide wraparound services to vulnerable populations. All agencies offered Low Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP) services as part of their service offerings. Agencies receive state, federal and utility funding for these programs. The program's goals include reducing the energy burden for program participants, maintaining affordable housing inventory, improving air quality and healthy living conditions, and reducing health and safety issues. Pacific Power estimates program

energy savings using a single measure ex-ante value per home that represents the bundled effect of all installed measures.

Wattsmart Business

PacifiCorp's Wattsmart Business program offers services and incentives to commercial, industrial, and irrigation customers through midstream (distributors/suppliers) and downstream (customer) incentive mechanisms. Incentives are available for retrofit projects, new construction, and major renovation projects.

Wattsmart Business program measures and services are offered (and tracked) through five delivery channels.

- **Custom Analysis Incentive.** This channel is targeted toward large energy users with projects that require custom analysis. The incentives are designed to offer multiple opportunities for energy efficiency upgrades. Small and midsize customers are also eligible for this incentive. Technical assistance is provided to help customers identify energy efficiency opportunities and provide analysis and verification of custom savings.
- **Typical Upgrades/Listed Incentives.** This channel offers prescriptive incentives primarily for small and midsized customers, although large customers are also eligible. Customers apply directly to Pacific Power or work with a trade ally to receive incentives.
- **Small Business Enhanced Incentive.** This channel provides enhanced lighting incentives for small business customers through Pacific Powers trade ally network.
- **Lighting Instant Incentives.** Customers can receive point-of-purchase discounts on LEDs purchased through a participating lighting distributor through this channel. Customers who do not purchase from a participating distributor can apply for the incentive after purchase.
- **Energy Management.** Participants receive expertise and custom incentives for verified savings achieved through operations, maintenance, and management practices.

Structure of this Report

The remainder of this report is organized to present the methodology, findings, and recommendations for each task, followed by overall study conclusions and recommendations:

- Task 1. Program Manager Interviews
- Task 2. Review M&V Processes and Procedures
- Task 3. Review Program Evaluations and Cost-Effectiveness
- Task 4. Validate Savings Tracking and Reporting
- Task 5. Verify Portfolio Level Savings

1 | PROGRAM MANAGER INTERVIEWS

AEG interviewed key PacifiCorp program staff to gain insight into the 2020-2021 program design and implementation, goals and tracking, customer satisfaction, and desired verification outcomes. The interviews also focused on how the COVID-19 pandemic impacted various aspects of the programs from the perspective of program staff.

Three staff interviews were completed:

- Don Jones Jr., Home Energy Savings (HES) and Home Energy Reports (HER) Program Manager
- Charity Spires, Low Income Weatherization (LIW) Program Manager
- Nancy Goddard, Wattsmart Business (WSB) Program Manager

Summary of Findings

At a high level, the programs struggled to achieve their savings goals in 2020 and 2021. COVID severely impacted the programs' abilities to deliver products and services to PacifiCorp Washington customers. PacifiCorp's service territories included some counties hit the hardest by the pandemic across the state. Due to the economic uncertainties and hardships caused by the pandemic, energy efficiency, energy bills, and energy-related projects became lower priorities for customers. In addition to COVID conditions, the savings targets increased relative to previous years resulting in a significant challenge for the programs.

Below, we summarize some of the additional findings by program.

Home Energy Savings

- The HES program, in particular, struggled to achieve its goals in 2020-2021. The COIVD pandemic was a key factor that focused residential customers on monetary concerns rather than efficiency. Surveys found that most participants cited saving money over environmental concerns as a primary driver of participation. Additional contributing factors included:
    - Many customers were not comfortable having contractors in their homes.
    - COVID-related supply chain issues particularly affected the residential programs, and these issues are continuing.
- PacifiCorp made the following changes to the HES in the 2020-2021 biennial period, including some in response to the COIVD pandemic.
    - HES increased incentives and program budgets, “getting more boots on the ground.”
    - HES conducted verification audits virtually with customers that were willing to participate.
- The HES program tracks savings in the internal Demand Side Management Central (DSMC) system.
    - The DSMC system includes all HES projects.
    - PacifiCorp has an extensive measure library that feeds most inputs into the tracking system directly.
- Residential customer satisfaction with PacifiCorp Programs is high
    - Sixty-five percent of Pacific Power residential customers in Washington are aware of energy efficiency or conservation programs, 2% higher than the West Large region average[2].

[2] J.D. Power’s 2021 Electric Utility Residential Customer Satisfaction Study

- On a scale from 0-10, Pacific Power's Washington residential customers provide a mean score of 7.2 on the utility's efforts to help customers manage monthly energy usage, compared to 6.9 for the West Large region average[3].
- Eighty-six percent of Pacific Power's Washington customers report the company is doing a "good job" (providing an answer between 6-10 on a 0-10 scale) of "Offering solutions to help customers use energy more efficiently." When customers recall receiving a Home Energy Report, scores lift to 88% for this question[4].

Home Energy Reports

- The implementation contractor for HER, Bidgely, provides one savings number each month, showing the comparison between the treatment and control groups.
- Beginning in 2020, Bidgely re-randomized Washington's HER program, abandoning the RCT designed by the previous implementor (which had been in effect since the first wave of treatment launched in 2011) and developing new treatment and control groups.

Low Income Weatherization

- Like the HES program, the LIW program also struggled to meet goals.
  - The pandemic closed many Community Action Agencies (CAA), and low-income customers could no longer access these resources, including the services and information PacifiCorp offered through the CAAs. Additionally, PacifiCorp Washington put a moratorium on disconnections because of economic hardships experienced by low-income customers during the pandemic, which could have disincentivized low-income customers from participating in energy efficiency now that they were in a less dire energy situation.
- PacifiCorp made the following changes to the LIW program in the 2020-2021 biennial period.
  - A COVID bill assistance program was implemented for customers in arrears.
- Working with agencies that provide various services and access to resources (e.g., food security, weatherization, etc.) has been successful for the LIW program.
- The DSMC system includes all LIW projects. PacifiCorp inputs data from the Community Action Agencies invoices.

Wattsmart Business

- The WSB program manager believes that increased targets were primarily responsible for the program's struggle to achieve goals in the 2020-2021 biennial period instead of delivery issues caused by the COVID-19 pandemic.
  - Many businesses in PacifiCorp Washington's service territory either shut down or (if deemed essential) had to spend significant time on their COVID-19 response, focusing on employee and customer safety over other initiatives.
- PacifiCorp made the following changes to the WSB program in the 2020-2021 biennial period.
  - WSB increased incentives, raised project-cost incentive caps, and introduced broader incentives for vendors.

[3] Ibid

[4] Escalent 2021 Residential Customer Satisfaction Research

  - The program encouraged business customers to conduct new projects when customers were open to them, helped business owners implement planned projects more efficiently, and revisited proposed projects when incentives increased to see if projects could move forward.

- The program also tracks savings in the internal DSMC system. Business implementation contractors began working in this system in 2021. Previously, these contractors worked in their systems and bulk uploaded the data to PacifiCorp's DSMC. They can also upload files to the project.

2 | M&V PROCESSES AND PROCEDURES

This task primarily consisted of reviewing the measurement and verification (M&V) procedures used by PacifiCorp to verify ex-ante savings estimates. M&V procedures included activities or processes to ensure the validity of savings estimates during program implementation by PacifiCorp program staff, program implementers, or trade allies and contractors.

AEG reviewed PacifiCorp's current M&V procedures, plans, and approaches through in-depth interviews with crucial PacifiCorp staff and by completing the following activities:

- Reviewing the procedures in Appendix 3 of PacifiCorp's Evaluation, Measurement and Verification Framework for Washington.
- Reviewing sampling methods and M&V plans and approaches currently in place.
- Verifying the procedures were followed by reviewing program data.
- Reviewing any M&V checklists that are available and benchmarking against industry best practices.
- Reviewing program handbooks that describe M&V procedures, such as those for reviewing custom projects or for conducting an inspection.

During this review, AEG assessed how well PacifiCorp's M&V activities aligned with industry best practices as presented in the Summary of the National Energy Efficiency Best Practices study[5] and our industry experience.

Summary of Findings

AEG's findings regarding PacifiCorp's current M&V activities are summarized below for each program.

Home Energy Savings

According to PacifiCorp's program guidelines and interviews with PacifiCorp staff, projects undergo the following verification procedures:

- PacifiCorp requires that a sample of downstream projects be inspected post-installation if they include at least one of the following measures: insulation, windows, ducting, heat pumps, and water heaters. For randomly selected projects, the program implementer should visit the homes where the measures were installed (or verify through a phone call).
- All post-purchase incented (downstream) measures undergo a quality assurance review before issuing the customer/dealer incentive and recording savings (e.g., proof-of-purchase receipt review) and eligible equipment review. Additionally, the customer account and address are checked to ensure the program administrator does not pay for the same measure twice or double-count measure savings.
- For the upstream component of the HES program, no site or virtual inspections are conducted. The program administrator ensures quality control and verifies measures for product eligibility and correct pricing. Pricing is also confirmed by program administrator field visits to retail locations. Customer eligibility for Wattsmart Starter Kits is verified using the customer's account number and last name and cross-verifying with the current PacifiCorp customer database.

AEG's M&V review focused on ensuring that PacifiCorp met its post-installation inspection targets. As part of Task 4 Validate Savings Tracking and Reporting and Task 5 Verify Portfolio Savings, we assessed the extent to which PacifiCorp's internal quality control procedures captured duplicate incentive payments for customers and ensured proof of purchase.

[5] National Energy Efficiency Best Practices Study, Volume S – Cross-Cutting Best Practices and Project Summary, Quantum Consulting for Pacific Gas and Electric Company, 2004. http://www.eebestpractices.com/pdf/BP_Summary.pdf

AEG requested all post-inspection documentation from PacifiCorp to verify post-installation inspections, then matched these records to the tracking database extracts. As shown in Table 2-1, PacifiCorp met or exceeded its post-inspection targets for single-family installations but fell short of most of its multifamily and manufactured home installations for 2020 and 2021. This shortfall could be related to the COVID-19 pandemic, which ramped up at the start of the biennium and made conducting onsite inspections difficult. PacifiCorp also limited customer touchpoints during this time. Some of the shortfalls for heat pumps could be related to missing home types in the tracking database; 35 heat pump records did not have an associated home type, which could skew the percentage of post-inspected projects.

AEG does not recommend making any adjustments to savings based on missing post-inspection thresholds because of the unique circumstances surrounding the 2020-2021 biennium with regards to COVID. However, we note that the 2018-2019 Washington Savings Verification also found that qualifying projects installed in multifamily were not inspected at their required rates. AEG provides specific recommendations later in this chapter of the report.

Table 2-1 HES Inspection Verification

Building Type	Measure	Target	% Inspected	Notes
2020				
Multi Family	Insulation	100%	100%	
	Heat Pumps	100%	43%	35 heat pump projects do not have building type
Manufactured Home	Windows	5%	N/A	1 measure installed
	Ducting	5%	0%	16 measures installed
	Heat Pumps	5%	8%	
Single Family	Insulation	5%	8%	Single family inspection rates are applied to the aggregate of downstream and mechanical measures.
	Windows			
	Ducting			
	Heat Pumps			
	Water Heater			
Single Family	Whole Home	5%	38%	
2021				
Multi Family	Insulation	100%	N/A	No measures installed in this category
	Heat Pumps	100%	77%	There are 3 inspection reports in this category that do not match data in the tracking system
Manufactured Home	Windows	5%	N/A	2 measures installed
	Ducting	5%	3%	
	Heat Pumps	5%	2%	
Single Family	Insulation	5%	10%	Single family inspection rates are applied to the aggregate of downstream and mechanical measures.
	Windows			
	Ducting			
	Heat Pumps			
	Water Heater			

Single Family	Whole Home	5%	8%

Low Income Weatherization

The Low Income Weatherization Program guidelines require measure eligibility screening and post-installation inspections. Specifically, after homes have been treated through the program and receive payments,

- all measures should be qualified through a US Department of Energy-approved audit tool or priority list,
- all projects should be inspected by an agency inspector,
- a state inspector should randomly inspect a small subset of projects, and
- an independent third party should inspect between 5-10% of participating homes.

Similar to the HES M&V review, AEG focused its review on assessing the extent to which PacifiCorp achieved post-inspection targets for Low Income Weatherization projects. We requested post-inspection documentation from the four participating agencies and the third-party inspector and matched it to records in the tracking database. Documentation supporting the state inspections was not available.

As shown in Table 2-2, PacifiCorp far exceeded the inspection rate targets for third-party inspections, particularly for 2021. According to the program manager, they decided to conduct additional inspections in 2021 because they could not meet internal inspection targets (four per agency) in 2020.

At the time of this draft report, one agency had not been able to collect the post-inspection documentation, which is likely the driver behind the agency inspections not meeting target inspection rates.

Table 2-2 LIW Inspection Verification

Year	Inspector Type	Target	% Inspected	Notes
2020	Third Party	5-10%	20%	
	Agency	100%	86%	AEG has not yet received data from NCAC/YVFWC
	State	Spot-Check	59%	
2021	Third Party	5-10%	72%	
	Agency	100%	45%	AEG has not yet received data from NCAC/YVFWC
	State	Spot-Check	24%	

Wattsmart Business

Inspection requirements for Wattsmart Business projects are summarized in Appendix A. Inspection requirements, described in the EM&V Framework, vary depending on the amount of the incentive or savings and the type of project.

To verify that PacifiCorp met the WSB inspection targets, AEG looked at how inspections were flagged in the DSMC extracts and collected back-up documentation (e.g., inspection reports or inspection summaries) from PacifiCorp and third-party implementors. Based on the DSMC extracts and back-up documentation, AEG does not plan on recommending any adjustments to savings or project counts. Overall inspection counts suggest that the appropriate projects were ultimately inspected, but verifying inspection rates per the EM&V Framework was difficult for two primary reasons:

- First, the DSMC extracts did not include a field that categorized the WSB projects according to the groups provided in the EM&V Framework. Having this field in the DSMC extracts is critical since many WSB projects include measures that could fit into multiple categories. Without this field, AEG did its best to categorize projects appropriately but ultimately found discrepancies (such as more post-inspection reports than projects in the category population) that led us to question the accuracy of our process as it compared to PacifiCorp's and the implementors'.
- Second, not all documentation was stored in-house. The level of summary detail provided by the implementers was not standardized, and at times it was challenging to understand which elements pertained to which project groups, though the "Managed By" field in the DSMC extracts identified the responsible implementor and delivery channel. That said, PacifiCorp and the implementations vendors helped fill the gaps and lend support where they could.

Recommendations

Based on its review of M&V processes and procedures, AEG provides the following recommendations.

- **In the future, collect post-inspection documentation from agencies participating in the Low Income Weatherization program regularly to ensure that it is readily available for audits and other verifications.** More consistent data collection will improve PacifiCorp's ability to internally track progress towards the inspection requirements outlined in program handbooks and the EM&V Framework. It will also improve how inspections are tracked in the DSMC extracts. Finally, more frequent data collection will also alleviate the need for the agencies to gather this documentation all at once.
- **Consider adding a field to the DSMC extracts that identifies the EM&V Framework inspection threshold category under which each Wattsmart Business project belongs.** Including this field will ensure that the population of projects and inspections are tracked consistently across the various parties involved, including PacifiCorp, implementors and inspectors, and third-party evaluation and verification contractors. The additional field will also improve everyone's ability to track progress toward inspection targets.
- **When storing inspection documentation, use the convention of the external project ID consistently across all programs and project categories.** In most cases, PacifiCorp appeared to use this convention, and AEG could easily map inspection documentation to the DSMC extract. However, several HES folders used the customer's last name instead of a project ID, making them difficult to map.

3 | PROGRAM EVALUATIONS AND COST EFFECTIVENESS

After reviewing PacifiCorp's Evaluation Measurement and Verification Framework for Washington (EM&V Framework) as part of Task 2 (Review M&V Processes and Procedures) to understand how PacifiCorp integrates and plans evaluation activities across its portfolio, AEG then worked with PacifiCorp to gain a comprehensive view of previous and current third-party program evaluation efforts. We also reviewed the cost-effectiveness analysis in PacifiCorp's 2020-2021 annual reports.

Given the staggered timing of PacifiCorp's program evaluations, only the Home Energy Reports program had a complete evaluation report covering the full 2020-2021 biennium period. However, given PacifiCorp's consistent and established evaluation approaches, we decided to supplement the available EM&V reports with either a work plan for part of the 2020-2021 biennium period or the latest EM&V report not reviewed as part of the previous (2018-2019) verification effort as follows:

- 2019-2020 Home Energy Savings Program Evaluation Report[6]
- Evaluation Work Plan for 2021-2022 Home Energy Savings, 2021-2022 Wattsmart Homes, and 2020-2021 Home Energy Reports programs[7]
- 2016-2017 Low Income Weatherization Program Evaluation Report[8]
- 2020-2021 Home Energy Reports Program Evaluation Report[9]
- 2018-2019 Wattsmart Business Program Evaluation Report[10]

Summary of Findings

Below we present a summary of our findings in two subsections, (1) Impact and Process Evaluation, and (2) Cost-effectiveness.

Impact and Process Evaluation

PacifiCorp's EM&V Framework establishes the overall approach to conducting EM&V of its energy efficiency programs, incorporating industry best practices regarding principles of operation, methodologies, evaluation methods, definitions of terms, and protocols. The framework is based on several pertinent sources, including the Uniform Methods Project (UMP),[11] The National Action Plan for Energy Efficiency, [12] the SEE Action Energy Efficiency Program Impact Evaluation Guide,[13] and the International Performance Measurement and Verification Protocols (IPMVP).[14]

[6] ADM Associates, Inc. Evaluation, Verification and Measurement Report. Residential Home Energy Savings Program: Washington. Program Years 2019-2020 (September 2021). Prepared for PacifiCorp.

[7] ADM Associates, Inc. Evaluation Work Plan for 2021-22 HES and WHS Programs and 2020-2021 HERs Program (April 2022). Prepared for PacifiCorp.

[8] ADM Associates, Inc. Washington Low Income Weatherization Program Evaluation, Measurement & Verification Report 2016-2017 (November 2020). Prepared for Pacific Power.

[9] ADM Associates, Inc. Evaluation, Verification and Measurement Report. Home Energy Reports Program: Washington (April 13, 2022). Prepared for Pacific Power.

[10] Cadmus, VuPoint Research. 2018-2019 Washington Wattsmart Business Program Evaluation (July 8, 2021). Prepared for Pacific Power.

[11] Uniform Methods Project of Determining Energy Efficiency Program Savings, Protocols, NREL, Cadmus Group, US DOE. https://www.nrel.gov/docs/fy18osti/70472.pdf

[12] National Energy Efficiency Best Practices Study, Volume S – Cross Cutting Best Practices and Project Summary, Quantum Consulting for Pacific Gas and Electric Company, 2004. http://www.eebestpractices.com/pdf/BP_Summary.pdf

[13] SEE Action Energy Efficiency Program Impact Evaluation Guide, 2012. https://www4.eere.energy.gov/seeaction/system/files/documents/emv_ee_program_impact_guide_0.pdf

[14] Efficiency Valuation Organization, International Performance Measurement and Verification Protocols. https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

AEG developed checklists to ensure its reviews of the impact, process, and cost-effectiveness analyses were consistent across programs and focused on critical components aligned with industry best practices, including:

- Presentation of appropriate background information, which defines the scope of EM&V activities across the portfolio.
- Guidance for the planning of evaluations, including timing, budgets, goals, and guidelines for the level of rigor required.
- Establishment of reasonable guidelines around levels of precision and error for savings estimation, which includes the consideration of competing constraints on budgets and timing.
- Presentation of well-documented guidelines regarding the collection and storage of measure data.
- Guidance regarding timing, frequency, and common goals of process evaluation.
- Guidance regarding the inclusion of actionable recommendations.
- Recommendations to incorporate EM&V findings into program implementation in real-time.
- Guidance regarding analyzing the cost-effectiveness of programs.

Figure 3-1 shows the criteria included in the process and impact evaluation checklists. We also present the ratings used to evaluate the EM&V methods and results based on alignment with industry best practices.

Figure 3-1 Ratings and Criteria for EM&V Review

Ratings:
Unknown **(U)** – Not enough detail to rate
Inappropriate **(I)** – Does not meet minimum
Minimum **(M)** – Meets minimum requirement
Appropriate **(A)** – Aligns with best practice
Gold Standard **(GS)** – Exceeds best practice

Process Criteria
Data Validation
Data sources described
Cleaning and validation described
Tracking Database Review
Program Descriptions
Program Challenges and Successes
Database Management
Sample Design
Stratification
Sample Sizes
Representativeness
Primary Data Collection
Participant/Non-participant Surveys
Interviews
Analysis & Reporting
Results presentation
Confidence & precision

Impact Criteria
Data Validation
Data sources described
Cleaning and validation described
Tracking Database Review
Sample Design
Stratification
Sample Sizes
Representativeness
Expansion Method
Primary Data Collection
Participant/Non-participant Surveys
Interviews
Onsite/virtual
Metering
Reporting
Transparency
Documentation
Recommendations
Approaches and Methods by Measure
Appropriateness of M&V Approach
Appropriateness of EM&V Approach
COVID-19 Effects
Timing of Activities
Results Presentation

In the subsections that follow, we present a summary of our results for each program.

Home Energy Savings

AEG reviewed the 2019-2020 Home Energy Savings program evaluation report, prepared by ADM Associates in September 2021. AEG found that the process and impact EM&V approaches to evaluating the Home Energy Savings program seemed appropriate and generally conformed with industry best practices. However, the report lacked clear documentation throughout the impact and process portions of the evaluation, leading to us giving many key metrics an "Unknown" rating and an overall "Minimum" score.

In particular, the evaluation report did not provide adequate detail about the sample design. It also did not adequately define the sample frame, how the evaluator developed the frame via data cleaning, or how the frame compared to the population of participants. There was also no discussion about the representativeness of the survey respondents relative to the target population.

See the complete Home Energy Savings EM&V verification checklist.

Low Income Weatherization

AEG reviewed the 2016-2017 Low Income Weatherization program evaluation report, prepared by ADM in November 2020. AEG found that, overall, the EM&V approaches used for both the process and impact evaluations were appropriate and conformed with industry best practices. In particular, the report was well organized and clearly written, with excellent documentation of the various methods used in the analysis, which led to an overall rating of "Gold Standard."

See the complete Low Income Weatherization EM&V verification checklist.

Home Energy Reports

AEG reviewed the 2020-2021 Home Energy Reports program draft evaluation report, prepared by ADM Associates in early 2022. AEG found that, overall, the EM&V approaches used for the process and impact evaluations met industry gold standards based on the methods used to estimate savings and conduct customer surveys and the amount of interim and final information they provided (e.g., validity testing and model specifications, customer counts, etc.). In particular, the report did an excellent job of documenting all steps in the analysis. Overall, we assigned a rating of "Gold Standard" to this evaluation.

See the complete Home Energy Reports EM&V verification checklist.

Wattsmart Business

AEG reviewed the 2018-2019 Wattsmart Business program evaluation report, prepared by the Cadmus Group in July 2021. AEG found that, overall, the EM&V approaches used for the process and impact evaluations were appropriate and conformed with industry best practices. In particular, the report did an excellent job of documenting the sample design and the engineering analysis. The report also made clear that the process results were based on small sample sizes. Overall, we assigned a rating of "Gold Standard" to this evaluation.

See the complete Wattsmart Business EM&V verification checklist.

Evaluation Cost-Effectiveness Review

AEG conducted a high-level review of the cost-effectiveness analysis presented in evaluation reports, focusing on consistency with accepted Washington methodology and sourcing of inputs. To perform this review, AEG relied on the following sources:

- PacifiCorp's 2020-2021 Biennial Conservation Plan for its Washington Service Area
- PacifiCorp's 2019 Integrated Resource Plan (IRP) Volume 1 (October 18, 2019)
- PacifiCorp's 2017 Integrated Resource Plan Volume 1

- Washington Administrative Code Section 480-109-100 (8)[15]
- The Northwest Power and Conservation Council's (Council) Seventh Northwest Conservation and Electric Power Plan (7th Plan), specifically Appendix G, pages G-19 – G-24.[16]

Based on a review of these sources, AEG developed the checklist shown in Table 3-1. The checklist is designed as a structured guide to check consistency with Commission guidance, Council methodology, and best practices for documentation and data presentation. Cost-effectiveness test definitions are provided in Table 3-3.

Table 3-1 Evaluation Report Cost-Effectiveness Checklist

Question	Checklist
Is the Total Resource Cost Test, as modified by the Council, the primary cost-effectiveness test?	x
Are cost-effectiveness results also reported from the Utility Cost Test perspective?	x
Do benefits include a regional 10% conservation credit (PTRC test only)?	x
Did PacifiCorp appropriately summarize measure-level detail to develop program cost-effectiveness inputs?	x
Are line losses consistent with values used to report portfolio-level savings?*	x
Are discount and inflation rates taken from PacifiCorp's IRP?*	x
Do benefit-cost ratios fall into expected ranges based on program type?	x
Does Home Energy Reports analysis appropriately account for lifetime savings?	x

* Reviewed only for evaluation reports that covered 2020 and/or 2021.

AEG found that PacifiCorp's Wattsmart Business and Low Income Weatherization evaluation reports aligned with Commission guidance, Council methodology, and industry best practices for cost-effectiveness analysis, as shown in the checklist below.

Table 3-2 Evaluation Report Cost-Effectiveness Findings

Question	Wattsmart Business	Low Income Weatherization
Is the Total Resource Cost Test, as modified by the Council, the primary cost-effectiveness test?	Yes	Yes
Are cost-effectiveness results also reported from the Utility Cost Test perspective?	Yes	Yes
Do benefits include a regional 10% conservation credit (PTRC test only)?	Yes	Yes
Did PacifiCorp appropriately summarize measure-level detail to develop program cost-effectiveness inputs?	Yes	Yes
Do line losses match values used to report portfolio-level savings?*	N/A	N/A
Do discount and inflation rates match PacifiCorp's IRP?*	N/A	N/A
Do benefit-cost ratios fall into expected ranges based on program type?	Yes	Yes
Does Home Energy Reports analysis appropriately account for lifetime savings?	N/A	N/A

* Only reviewed for evaluation reports that cover 2020 and/or 2021.

[15] https://apps.leg.wa.gov/WAC/default.aspx?cite=480-109-100

[16] Northwest Power and Conservation Council. Seventh Northwest Conservation and Electric Plan (February 25, 2016). Appendix G. www.nwcouncil.org/sites/default/files/7thplanfinal_appdixg_consresources_1.pdf

The 2020-2021 Home Energy Reports Program evaluation report does not present cost-effectiveness analysis. AEG recommends that the cost-effectiveness analysis and findings included in the report are consistent with the accepted Washington methodology and sourcing of inputs, per the checklist in Figure 3-1.

The Evaluation Work Plans for the 2021-2022 Home Energy Savings, 2021-2022 Wattsmart Homes, and 2020-2021 Home Energy Reports programs note that cost-effectiveness for the Home Energy Savings and Wattsmart Homes Programs will be calculated by a PacifiCorp-selected consultant and that the results will be included in ADM's report. Again, AEG recommends that the cost-effectiveness analysis and findings are consistent with the accepted Washington methodology and sourcing of inputs, per the checklist in Figure 3-1.

Annual Report Cost-Effectiveness Review

The review's objective was to assess whether the methodology, inputs, and assumptions used to determine cost-effectiveness were appropriate and consistent with Washington Utilities and Transportation Commission (WUTC or Commission) guidance and industry standards and best practices. To verify the 2020 Annual Report cost-effectiveness analysis, AEG reviewed specific inputs (e.g., avoided costs, line losses, and discount rates), outputs, and documentation to validate and assess the appropriateness of cost-effectiveness analysis. A detailed review of cost-effectiveness model algorithms was outside the scope of this review.

To perform this review, AEG relied on the following sources:

- 2020 Annual Report Cost-Effectiveness Memos and Input Spreadsheets
- PacifiCorp's 2020-2021 Biennial Conservation Plan for its Washington Service Area
- PacifiCorp's 2019 Integrated Resource Plan (IRP) Volume 1 (October 18, 2019)
- Washington Administrative Code Section 480-109-100 (8)
- The Northwest Power and Conservation Council's (Council) Seventh Northwest Conservation and Electric Power Plan (7th Plan), specifically Appendix G, pages G-19 – G-24

PacifiCorp Washington reports on the cost-effectiveness of its energy efficiency programs and portfolio from five different perspectives, consistent with industry standards and Commission guidance. The National Action Plan for Energy Efficiency (NAPEE) guide for Understanding Cost-Effectiveness of Energy Efficiency Programs[17] provides an overview of the industry-standard test perspectives (Table 3-3). A "benefit-to-cost ratio" can be calculated for each perspective by dividing the net present value benefits by the net present value costs, with categories of applicable benefits and costs varying by perspective. If this ratio is greater than or equal to 1.0 (i.e., benefits meet or exceed costs) from a given perspective, the program or portfolio is considered cost-effective from that perspective.

Table 3-3 Overview of Standard Cost-Effectiveness Tests[18]

Test	Acronym	Key Question Answered	Summary Approach
Participant cost test	PCT	Will the participants benefit over the measure life?	Comparison of costs and benefits of the customer installing the measure
Program administrator cost test	PACT	Will utility bills increase?	Comparison of program administrator costs to supply-side resource costs
Ratepayer impact measure	RIM	Will utility rates increase?	Comparison of administrator costs and utility bill reductions to supply side resource costs

[17] NAPEE's Understanding Cost-Effectiveness of Energy Efficiency Programs, November 2008. www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

[18] NAPEE Guide page 2-2.

Test	Acronym	Key Question Answered	Summary Approach
Total resource cost test	TRC	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings
Societal cost test	SCT	Is the utility, state, or nation better off as a whole?	Comparison of society's cost of energy efficiency to resource savings and non-cash costs and benefits

PacifiCorp includes five perspectives in its cost-effectiveness analysis and reporting: the PCT, PACT, RIM, TRC, and the "PacifiCorp Total Resource Costs" (PTRC). Per Commission guidance, the PTRC test is the primary test used to assess the cost-effectiveness of the energy efficiency programs and portfolio. The PTRC is the TRC with an additional 10% adder on the benefits, consistent with Commission direction and the Council's methodology.

AEG developed the checklist shown in Table 3-4, designed as a structured guide to check consistency with Commission guidance, Council methodology, and best practices for documentation and data presentation.

Table 3-4 2020 Annual Report Cost-Effectiveness Checklist

Question	Checklist
Is the Total Resource Cost Test, as modified by the Council, the primary cost-effectiveness test?	x
Are cost-effectiveness results also reported from the Utility Cost Test perspective?	x
Do benefits include:	
Avoided energy costs	x
Generation deferral costs	x
Transmission deferral costs	x
Distribution deferral costs	x
Non-electric impacts, where quantifiable and attributable	x
Regional 10% conservation credit (PTRC test only)	x
Social cost of carbon	x
Did PacifiCorp appropriately summarize measure-level detail to develop program cost-effectiveness inputs?	x
Are load shape assignments reasonable?	x
Are line losses consistent with values used to report portfolio-level savings?	x
Are discount and inflation rates taken from PacifiCorp's 2019 IRP?	x
Do benefit-cost ratios fall into expected ranges based on program type?	x
Is the Low-Income Weatherization program removed from portfolio-level cost-effectiveness analysis?	x

In general, AEG found that PacifiCorp's 2020 Annual Report cost-effectiveness analysis aligned with Commission guidance, Council methodology, and industry best practices; however, some opportunities to enhance clarity were identified and are summarized in the Recommendations section below.

Avoided Costs

AEG reviewed PacifiCorp's 2020-2021 Biennial Conservation Plan for its Washington Service Area to determine whether the avoided costs included the components dictated by the Council's methodology. PacifiCorp did not develop an updated Class 2 Demand-Side Management Decrement Study to determine whether the avoided costs included the components dictated by the Council's methodology. However, based on our review of the Plan and the 2017 Class 2 Demand-Side Management Decrement Study, we believe that the avoided costs incorporate a number of factors, including:

- Avoided Energy Costs
- Generation Deferral Costs
- Transmission Deferral Costs
- Distribution Deferral Costs
- Social Cost of Carbon

We believe that, as a result of how PacifiCorp's avoided costs are derived from the 2017 IRP, a carbon cost is embedded in the decrement values to account for environmental externalities. This concept is described in the comparison of PacifiCorp and Council methodologies; however, it is not explicitly stated in either the 2017 Decrement Study or the 2020 Annual Report. PacifiCorp did include a discussion of carbon costs in its 2020-2021 Biennial Conservation Plan, and AEG recommends PacifiCorp continue to document alignment with Commission guidance on carbon costs in the future.

The avoided costs were applied incorrectly in the 2020 Annual Report. The avoided cost data was shifted by one year, such that 2019 avoided costs were incorrectly labeled 2020, 2020 costs labeled 2021, etc. AEG recommends reviewing the avoided costs in the future to ensure the correct year is utilized in the cost-effectiveness analysis.

Discount and Inflation Rate

The 2020 Annual Report inflation and discount rates matched the values in PacifiCorp's 2019 IRP.

Non-Electric Impacts

The 2020 Annual Report included three (3) quantified non-energy impacts:

- *10% Power Act Credit.* The 10% Northwest Power Act Credit is accounted for in the PTRC.
- *Quantifiable Environmental Externalities.* As noted above, the social cost of carbon was included in a proxy portfolio as part of the 2019 IRP process. The portfolio incorporates the social cost of carbon as specified in Senate Bill 5116, Clean Energy Transformation Act (CETA). PacifiCorp and stakeholders discussed the proxy portfolio and determined that the scenario was in general compliance with WAC 480-109-100 (2) (b).
- *Quantifiable Non-Energy Impacts (NEIs).* NEIs were quantified for water and 'other' and included for the 2020 Annual Report. The definition of 'other' NEIs is unclear. As such, AEG recommends defining the NEIs explicitly in future reporting.

Recommendations

In summary, AEG has the following recommendations.

- **Encourage high-quality reporting on sample design from program evaluators.** AEG determined that the HES 2019-2020 evaluation report met a minimum standard. However, the report would be more robust and valuable for designing future studies with better information about how the evaluator developed the sample frame and which customers were ultimately represented in their analysis.
- **Include cost-effectiveness analysis inputs and findings in the program evaluation reports.** The 2020-2021 Home Energy Reports evaluation report does not include cost-effectiveness analysis and findings. The Evaluation Work Plan for 2021-2022 Home Energy Savings and 2021-2022 Wattsmart Homes programs notes that cost-effectiveness will be calculated by a PacifiCorp-selected consultant and that the results will be included in ADM's report. Cost-effectiveness analysis inputs and findings should be consistent with the accepted Washington methodology and presented in the evaluation reports.
- **Update the 2017 Class 2 Demand-Side Management Decrement Study to ensure that the avoided costs included the components dictated by the Council's methodology.**

- **Ensure avoided costs are correctly entered into the analysis.** AEG was not able to collect or review the original avoided costs used in the cost-effectiveness analysis as intended.

4 | TRACKING AND REPORTING

AEG verified the extent to which PacifiCorp accurately tracked and reported program performance metrics in its program tracking database, the Demand Side Management Central (DSMC), and examined PacifiCorp's program tracking procedures for accuracy and procedural reliability. Specifically, we determined how the DSMC (1) was configured to capture program-critical information and (2) accurately captured the information for which it was configured.

We conducted the following activities to help us make these determinations:

- Reviewed the 2020 and 2021 DSMC extracts for program-critical information, missing or inadequate data in key fields, and duplicated records.
- Performed a high-level comparison of savings and participant counts as tracked in PacifiCorp's 2020 tracking system and reported in portfolio reports to determine their consistency and identify inaccuracies.[19]
- Assessed the extent to which PacifiCorp or the EM&V contractors adequately documented values used to estimate program energy savings and other metrics in the program records through engineering desk reviews.

The following sections summarize findings related to these goals and provide recommendations for improvement.

Summary of Tracking and Reporting Validation Findings

The subsections below present our findings related to program data collection and tracking and the program tracking processes.

Tracking and Reporting Process

First, AEG interviewed program managers to learn about their current tracking and reporting procedures, focusing on any processes that changed since the 2018-2019 biennium period verification. The 2018-2019 biennium verification[20] found that the program managers generally followed robust data reconciliation and validation procedures across all transfer cadences, including weekly data transfers, monthly incentive reconciliations when generating incentive invoices, and quarterly extracts for program implementors to reconcile against internal tracking systems. Because PacifiCorp's Technical Reference Library (TRL) ties into the DSMC, most measure inputs (e.g., savings) import automatically when projects are entered into the system.

One improvement mentioned in the interviews is that business contractors now work exclusively in the DSMC tracking system. Previously, these contractors provided PacifiCorp with data from their own internal tracking systems that PacifiCorp had to configure for the DSMC. However, these contractors do not include the agencies through which the LIW program reaches eligible customers; PacifiCorp still manually enters information for LIW projects using the invoices provided by the agencies, which leaves room for some error.

The 2018-2019 biennium period verification also noted that PacifiCorp did not store detailed project data or back-up documentation for most programs implemented by a third party. AEG confirmed that this was still the case as it went through the 2020-2021 verification process. As mentioned in the program manager interviews, the Wattsmart Business implementors were able to work directly in the DSMC beginning in 2021, but AEG found during its requests for inspection reports and the program files for sampled projects that this was not often the case.

[19] Since the 2021 annual report was not completed by the time of the savings verification, AEG only reviewed the 2020 annual report for consistency.

[20] Applied Energy Group. 2018-2019 Washington Savings Verification. Prepared for PacifiCorp. May 22, 2020.

DSMC Review

Next, AEG reviewed the DSMC extracts to verify whether they included all program-critical information. We then assessed the quality of the fields. Finally, we developed a checklist based on the Summary of the National Energy Efficiency Best Practices study[21] and our industry experience providing program tracking services to guide this exercise. Note that because of the verification timing, AEG was not able to conduct a full review of the final 2021 DSMC extract.

Key findings include the following:

- **Nearly all fields identified as program-critical were included in the 2020 and 2021 DSMC extracts.** These included appropriate program and project identifiers, including measure categories, types, and quantities; measure energy and demand savings and estimated useful lives; and information on costs and incentives required for cost-effectiveness calculations. As discussed in Task 2, one program-critical item not currently tracked is the inspection threshold category for Wattsmart Business projects. AEG considers this a program-critical field since PacifiCorp must meet certain inspection rate targets per the EM&V Framework. (See Chapter 2 for further discussion.)
- **Most fields were useable and included very few missing or erroneous records.** In particular, all measure description fields (e.g., "Measure Category," "Measure Type," "Measure Sub-Type") were exceptionally clean. Accounting or payment records were clearly identified, as were records associated with post-inspection adjustments. Home Type was missing for most Home Energy Savings records in the 2021 DSMC extract, though the program implementer was able to provide them upon request. This information is critical for determining if PacifiCorp met its inspection targets for this program. (See Chapter 2 for further discussion.) PacifiCorp confirmed that the next version of the 2021 DSMC extract would reconcile this error. Home Type was only missing for 35 HES (non-upstream) records in 2020.
- **As with any tracking system, there is some room for minor improvements.** The "Managed By" field listed "Agency-LIW" for all Low Income Weatherization projects. Including the name of the agency (since there are only four) and tracking the agency post-inspections in the DSMC could help ensure that required inspection rate thresholds are met. Sub-programs and delivery streams are tracked in the current system through several fields. Currently, the upstream lighting component of HES is identified through the customer name (i.e., customer name = "Upstream"). The Small Business Lighting and Midmarket/Instance Incentives components of the Wattsmart business program can be identified through the "Managed By" field or through the "Program Name" field (2020 only). Having a single field to house sub-program or delivery stream information could improve clarity and usability.

DSMC Accuracy

Through engineering desk reviews, AEG investigated whether PacifiCorp's current tracking and reporting processes and procedures led to an accurate tracking system. For a sample of projects from HES, LIW, and WSB programs, we collected back-up project files such as invoices and savings calculation workbooks to confirm whether measure types, quantities, savings, and costs were entered correctly into the system. As described in detail in Chapter 5, AEG found that the DSMC extracts aligned with the backup project documentation in nearly all cases, suggesting that PacifiCorp's quality control processes work to prevent errors in entering information into the database.

For the sampled projects, AEG found a few cases where the TRL reference and quantity fields included the kWh savings or customer incentives values. These discrepancies did not impact the kWh savings values, which AEG verified through the desk reviews, and may not have much bearing on PacifiCorp's annual or biennium reporting.

[21] National Energy Efficiency Best Practices Study, Volume S – Cross Cutting Best Practices and Project Summary, Quantum Consulting for Pacific Gas and Electric Company, 2004. http://www.eebestpractices.com/pdf/BP_Summary.pdf

Annual Reporting Accuracy

AEG performed a high-level cross-check of project counts and savings by measure category between the 2020 annual report and the 2020 DSMC extract to determine whether PacifiCorp ultimately used the savings and projects reported out by the DSMC to calculate cost-effectiveness. During this review, we did not find any discrepancies between the results reported by the DSMC and the savings, measure counts, and estimated useful lives included in the 2020 annual reports for each program to calculate cost-effectiveness.

Recommendations

AEG offers the following recommendations for consideration.

- **As mentioned, consider adding a field to the tracking database that identifies the EM&V Framework inspection threshold category under which each Wattsmart Business project belongs.** AEG considers this a program-critical field since PacifiCorp must meet inspection thresholds specific to these categories. (See *Chapter 2* for further discussion.)
- **Review the final 2021 DSMC extract for accuracy in non-savings fields, as needed.** AEG could not conduct a full review of the final 2021 DSMC extract because of the verification effort timing. However, we identified a few issues that PacifiCorp may want to investigate further, including kWh savings showing up in the TRL reference and quantity fields. However, these discrepancies did not appear to impact the savings based on the projects we reviewed.
- **Continue to monitor the process by which WSB implementors can work directly in the DSMC database.** Many 2021 project files did not appear to be stored in DSMC as expected, which led to some delays in the verification effort. However, given that 2021 was the first year that implementors were able to access the DSMC, some difficulties are expected, and ultimately AEG was able to collect much of the documentation needed to complete the verification. PacifiCorp should consider conducting random, internal audits of project files to gauge how this process is working and make improvements as needed.

5 | PORTFOLIO SAVINGS

To verify that PacifiCorp appropriately claimed savings during the 2020-2021 biennial period, AEG performed independent engineering desk reviews for a sample of projects from the HES, LIW, and WSB programs. We also conducted virtual verification with a sample of HES heat pump participants and onsite visits with a sample of WSB participants. Consistent with the 2018-2019 savings verification methods, we excluded the Home Energy Reports program from these verification activities. We also excluded upstream lighting from the HES samples as the participating customer population is unknown.

The independent engineering desk reviews allowed AEG to check for systematic errors and other inconsistencies, while the site visits provided us with the data needed to estimate savings with greater accuracy. The site visits were also important, given that they may not have been an option for the evaluation contractors given the COVID-19 pandemic.

The following sections describe how AEG designed the desk review, in-person, and virtual site visit samples for each program, summarizes each activity's findings, and provides recommendations to improve program tracking, documentation, or evaluation practices.

Also, recall that this study is not intended to duplicate or replace impact or process evaluations of PacifiCorp Washington's energy efficiency programs and verification approaches, and sample sizes reflect that.

Sample Design

Table 5-1 shows the desk review sample design by program, stratum, and the portfolio overall. AEG designed the desk review sample using the final 2020 DSMC extract and the draft 2021 DSMC extract.[22] After reviewing the distribution of measure types and savings by program, we first determined the number of projects needed to achieve a precision of at least ±15% at the 80% confidence level around desk review findings for each program (and better, where the budget allowed).

Within each program, we stratified by major measure category, which we defined in conjunction with PacifiCorp program managers to align with their goals for the verifications. In particular, we wanted to focus on heat pumps installed through the HES program because of their substantial contribution to the HES portfolio of projects and savings while also investigating the backup documentation for non-heat pump measures. Similarly, while lighting measures comprised a large portion of the WSB savings, we also wanted to capture custom projects and other types of measures in the desk review sample. We also anticipated that any findings from the desk reviews would be similar within these measure groups. Finally, we distributed the sample points to strata within the program using Neyman's Allocation, which uses information about the variability of savings and the project population sizes to optimize this distribution.

AEG used simple random sampling to select projects for desk reviews from the HES and LIW strata. We sampled HES heat pump projects for desk reviews in two parts:

- First, we randomly selected a large number of projects to include in the list for virtual verifications with the goal of completing the virtual verification and desk reviews for 15 to 20 customers.
- Next, we randomly sampled another 15 projects for desk reviews from the remaining heat pump projects to reach the total HES heat pump goal of 31 desk reviews.

To select WSB projects, we used a probability proportional to size (PPS) sampling approach, which gives projects with higher overall savings a higher chance of selection. This method works well for non-residential programs with project populations that are less homogenous and allowed AEG to directly verify a larger portion of the WSB population of savings. Of the 32 sampled WSB projects, we completed onsite visits with four participants.

[22] The reconciled DSMC extract for 2021 was not available when AEG was designing the sample.

Table 5-1 Desk Review Sample Design

Program	Measure Group	Population Count of Projects	Population MWh	Sampled Projects	Expected Precision	Confidence Level
Home Energy Savings	Non-Heat Pump	2,564	1,057	26	±14%	85%
	Heat Pump	1,000	3,139	31	±13%	85%
	Total	**3,564**	**4,196**	**57**	**±10%**	**85%**
Low Income Weatherization	All	65	122	11	±19%	80%
	Total	**65**	**122**	**11**	**±15%**	**80%**
Wattsmart Business	Custom	57	13,163	9	±24%	85%
	Lighting	310	24,601	15	±19%	85%
	Other	103	7,434	8	±25%	85%
	Total	**470**	**45,198**	**32**	**±15%**	**85%**
	Total	***4,099***	***49,516***	***100***	***≤ ±15%***	***85%***

Summary of Findings

The following sections describe the engineering desk reviews, HES virtual verifications, and WSB onsite visits in greater detail and summarize the findings.

Engineering Desk Reviews

AEG collected all available back-up documentation for the projects sampled for desk reviews, primarily invoices, savings calculation workbooks, measure specification sheets, and inspection reports. The desk reviews focused on verifying that the savings, costs, and other metrics reported in the DSMC extracts aligned with the information provided in the project documentation. To guide the desk reviews, AEG developed a checklist that divided the reviews into four parts:

- Project Documentation Verification
- Measure Verification
- Savings Verification
- Costs and Incentives Verification

The documentation that AEG used for the desk reviews fell into several categories, including primary data collection for the HES virtual surveys, full project files, and inspection reports. With the exception of WSB lighting, AEG collected full project files and verified all four key categories for the projects in its desk review sample, as shown in Table 5-2. Requests for five WSB project files and the energy kits shipment inventory went unfulfilled.

Table 5-2 Desk Review Documentation

Program (Subcomponent)	Documentation Received	Proportion of Sample Verified	Project Documentation	Measure Type	Savings	Costs and Incentives
HES (Included in Virtual Verification)	Survey responses; photos of heat pump nameplates; project files (invoices)	100%	✓	✓	✓	✓
HES (Excluded from Virtual Verification)	Program files (invoices)	100%	✓	✓	✓	✓
HES (Energy Kits)	Shipment invoice	0%	-	-	✓	N/A
LIW	Agency and third-party inspection reports	100%	✓	✓	✓	✓
WSB (Lighting)	Program files (invoices, savings verification reports)	75%	✓	✓	✓	✓
WSB (Custom)		100%				
WSB (Other)		100%				

Key findings included the following.

- **HES and LIW measures were entered correctly into the DSMC in 100% of cases and aligned with the values deemed in the technical reference library.** AEG replicated the savings for all HES and LIW measures included in the sample for desk reviews and found that savings aligned between the DSMC extract and the deemed savings provided in the technical reference library.
- **In general, savings for deemed measures implemented through WSB appeared to align with the technical reference library.** As mentioned, AEG confirmed some issues with duplicated records and savings values in the updated 2021 DSMC extract, and PacifiCorp's most recent extract appears to have reconciled these; the deemed savings for qualifying WSB measures aligned with the TRL.
- **Overall, PacifiCorp and its implementation vendors appeared to use industry-standard practices and engineering best judgement to document and estimate savings for custom WSB projects.** After a high-level review of the project savings verification reports for custom projects, AEG identified only one WSB custom record for PacifiCorp and its implementor for review.
- **When documentation was provided, it generally aligned with the information included in the DSMC extracts.** AEG found that information such as facility type, project numbers, site address, measure types, savings, and costs aligned with the inputs in the DSMC extract in nearly all cases across HES, LIW, and WSB programs when the information was provided in the backup documentation and readily available.
- **These findings may not apply to projects for which documentation was not readily available.** The data collection effort was ongoing through the end of the verification reporting, and in the end, AEG did not receive all project files for sampled WSB lighting projects or the shipment inventory for sampled energy kits. Based on the documentation we have received so far, we do not believe it necessary to recommend a change in savings because of missing project documentation; however, our findings are limited to the projects we were able to verify.

HES Virtual Verification

In addition to desk reviews, AEG also conducted virtual verifications for a sample of HES heat pump projects. This involved calling customers about their heat pumps and requesting nameplate photos.[23] The survey guide questions primarily focused on customers' pre-existing equipment and included instructions for taking the photos that were emailed to customers after they completed the survey.

The HES virtual verifications were not intended to be statistically representative of all HES heat pump recipients or achieve a level of precision. Since PacifiCorp has already contracted with a third-party EM&V consultant to perform an in-depth evaluation, AEG's intent was not to replicate this effort, but rather to spot-check measures of high interest to PacifiCorp.

AEG used the survey responses to gather limited information about pre-existing equipment and confirm that the heat pump nameplate data (e.g., HSPF or SEER values) aligned with the savings assigned to the records in the DSMC extract and indicated on the contractor invoices. AEG found that the nameplate data generally matched the savings claimed for each heat pump in the sample. In three cases (of 18 air source heat pumps in the sample), the model's HSPF was slightly slower than the 9.0 rating required by the program (8.2 to 8.5). In one case, AEG found that a respondent and backup program files indicated that a heat pump conversion took place in a home where a ducted heat pump currently existed. AEG alerted PacifiCorp of this one case.

WSB Onsite Visits

AEG conducted onsite visits with four customers who implemented projects through the WSB program. During the onsite visits, AEG investigated equipment installation and operations and verified parameters key to energy savings calculations for each measure.

Once onsite, AEG directly verified that nearly all of the equipment claimed in the DSMC extracts was installed and operating as expected and in alignment with the methods and parameters provided in the project files. The one exception was for a street lighting project where personnel transitions led to lost knowledge about where the street lighting had been installed. Thus, AEG staff could only directly verify a small portion of the streetlighting. However, AEG does not recommend making any adjustments to savings based on this visit since it appeared to be a one-off case.

Recommendations

Please consider the following recommendations.

- **Continue to monitor the process by which WSB implementors can work directly in the DSMC database.** Many 2021 project files did not appear to be stored in DSMC as expected, which led to some delays in the verification effort. PacifiCorp should consider conducting random, internal audits of project files to gauge how this process is working and make improvements as needed. (See *Chapter 4* for further discussion.)
- **Encourage third-party evaluation and verification contractors to work directly with program implementors to gather the necessary project files for HES and WSB projects not attached to the DSMC.** AEG found that 2020 and 2021 HES project files (applications and invoices) and 2020 WSB project files were stored in their native formats within program implementer databases. As such, PacifiCorp relied on requests to program implementors to fulfill all third-party requests for data resulting in a somewhat cumbersome request and fulfillment process. This process was further complicated by the multiple concurrent evaluations and parties involved. Establishing data transfer protocols with program implementors ahead of these requests (e.g., by hosting a shared drive that both the implementors and third-party contractors can access) could streamline the process and remove the burden on PacifiCorp staff to directly handle all data transfers.

[23] AEG Initially developed the survey guides for the 2018-2019 biennium verification, but this effort was ultimately put on hold at the time because of the COVID-19 pandemic.

A | PROJECT INSPECTION CRITERIA

Home Energy Savings Program

Table A-1 HES Inspection Status by Measure – Downstream Delivery Mechanism

Inspections	No Inspections
Central air conditioning duct sealing	Central air conditioners
Duct sealing and insulation	Clothes washers
Heat pumps	Evaporative cooler
Heat pump water heaters	Hybrid/heat pump clothes dryers
Insulation	Line voltage thermostats
Windows	New manufactured homes
	Smart thermostats

Measures that receive inspections are performed by program administrator staff for a sample of single-family, manufactured, multifamily, and new homes projects. Specific inspection rates required for each home type remain confidential to protect program integrity.

Wattsmart Business

Table A-2 Wattsmart Business Inspection Status – By Project Type and Size

Lighting Projects (Typical Upgrades)
Incentive above high threshold*
• Retrofits - 100 percent pre/post-installation site or virtual inspections of all projects with incentives over a specified dollar amount. Project cost documentation reviewed for all projects.
• New construction - 100 percent post-installation site inspections of all projects with incentives over a specified dollar amount.
Incentive between low and high thresholds*
• Retrofits - 100 percent pre-installation site or virtual inspections of all projects with incentives between the low and high threshold amounts. Note inspections may be waived on a case by case basis for projects completed by Premium Vendors and below a threshold that is between the low and high threshold. A percent of post-installation site or virtual inspections by program administrator of projects with incentives between the low and high threshold amounts. Project cost documentation reviewed for all projects. For lighting controls only retrofit projects, 100 percent post-installation site or virtual inspections.
• New construction – 100 percent post-installation site or virtual inspections of projects with incentives between the low and high threshold amounts.
Incentive below low threshold*
• A percent of post-installation site or virtual inspections by program administrator of projects with incentives under a specified dollar amount.
Lighting – Small Business
• Onsite or virtual post-incentive inspections are performed by third-party program administrator on a minimum of X* percent of approved projects for each approved Small Business Vendor based on project count per calendar year.
• Onsite or phone surveys will be conducted with participating customers to ensure documentation accuracy, installation and product quality, and customer satisfaction.
Lighting – Midmarket/Instant Incentives
• Third party program administrator conducts regular spot checks on a sampling of approved projects after incentive processing. Inspections will include phone, virtual and onsite inspections.
• All projects with customer incentives over $X* will receive an onsite or virtual inspection.
• A minimum of X* percent sampling of all remaining projects will be selected for phone inspections. An additional X* percent sampling will be selected for onsite or virtual inspections.
• For typical upgrades, required inspections are performed by a third-party consultant. For the small business and instant incentive offers, required inspections are performed by the program administrator.
Non-Lighting Projects
• Typical upgrades/listed measures where savings are deemed
• 100 percent of applications with an incentive that exceeds a specified dollar amount will be inspected (via site or virtual inspection) (typically by program administrator).
• A minimum of a specified percent of remaining non-lighting applications will be inspected, either in person or via telephone interview, (typically by program administrator).
• Typical upgrades/listed measures where savings are determined using a simplified analysis tool)
• 100 percent of applications with project savings that exceeds a specified threshold will be inspected (via site or virtual inspection) (typically by program administrator).
• A minimum of a specified percent of remaining non-lighting applications will be inspected, either in person or via telephone interview, (typically by program administrator).
Custom Projects
• 100 percent pre/post installation inspections, invoice reconciled to inspection results. Site or virtual pre/post inspections are required for projects with savings over a specified threshold. For projects with savings below threshold, inspection information may be collected by phone or email.
• No pre-inspection for new construction.
• Inspections are conducted by the program administrator

* Specific thresholds and inspection rates are omitted from this table to protect program integrity.

B | EM&V REVIEW CHECKLISTS

Home Energy Savings

Table B-1 HES Process Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	U	No explanation of how the general customer survey sample was derived.
Cleaning and validation described	U	No discussion of survey sample cleaning or validation
Tracking Database Review	GS	Reviewed a census of program tracking data, associated savings values, input assumptions and calculations contained in the Technical Resource Library (TRL) files provided by Pacific Power
Program Descriptions		
Program Challenges and Successes	A	
Database Management	A	
Sample Design		
Stratification	U	No discussion of stratification
Sample Sizes	M	Sample frame not provided. Only number sampled and surveys returned
Representativeness	U/I	Response rates provided; no comparison to census or population; no discussion of weighting; not clear if 90/10 applied to measure review and survey or measure review only
Primary Data Collection		
Participant/Non-participant Surveys	A	General customer survey, energy kit participant survey
Interviews	A	Interviews with implementers, staff
Analysis & Reporting		
Results presentation	A	
Confidence & precision	U	No discussion of confidence and precision of the survey results.
Overall	**M**	**Need more insight into the survey sample design, representativeness and precision.**

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Table B-2 HES Impact Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	GS	
Cleaning and validation described	GS	Cleaning and validation discussed for each measure
Tracking Database Review	GS	Reviewed a census of program tracking data, associated savings values, input assumptions and calculations contained in the Technical Resource Library (TRL) files provided by Pacific Power
Sample Design		
Stratification	A	Stratified by measure
Sample Sizes	A	Several measures involve a census. When sampled, sample sizes are listed but not the sample criteria or the sample frame
Representativeness	M	90/10 for all measures; limited detail provided
Expansion Method	A	
Primary Data Collection		
Participant/Non-participant Surveys	A	General customer survey, energy kit participant survey
Interviews	NA	Not conducted for this evaluation
Onsite/virtual	NA	Not conducted for this evaluation
Metering	NA	Not conducted for this evaluation
Reporting		
Transparency	A	
Documentation	A	Other than the sample frame issues above; well documented
Recommendations	A	
Approaches and Methods by Measure		
Appropriateness of M&V Approach	A	Deemed savings using RTF
Appropriateness of EM&V Approach	GS	UES review all measures, additional billing analysis for HVAC measures. Surveys to determine ISRs for energy kits and upstream lighting
COVID-19 Effects	U	Mentioned COVID in the process section but provided no details on how COVID impacted savings. No discussion on whether COVID effects were accounted for in impact estimation approach.
Timing of Activities	A	
Results	A	
Overall	**A**	**Would like to see more discussion regarding the sample design and the impact of COVID**

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Low Income Weatherization

Table B-3 LIW Process Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	GS	DSMC data and reports, billing data, and other program data and verification, as necessary
Cleaning and validation described	GS	Program tracking data and billing data cleaned; all steps described
Tracking Database Review	GS	Each program year's dataset was reviewed for completeness, consistency, and compliance with the provided TRL files
Program Descriptions		
Program Challenges and Successes	A	
Database Management	A	
Sample Design		
Stratification	N/A	Census, no stratification required
Sample Sizes	GS	Census
Representativeness	GS	Achieved required survey completes for 90/10
Primary Data Collection		
Participant/Non-participant Surveys	A	Participant Survey
Interviews	A	Interviews with program staff
Analysis & Reporting		
Results presentation	A	
Confidence & precision	GS	90/10
Overall	**GS**	

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Table B-4 LIW Impact Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	GS	DSMC and TRL data pulls and reports, billing data, weather data, and other program data and verification, as necessary
Cleaning and validation described	GS	Program tracking data and billing data cleaned; all steps described
Tracking Database Review	GS	Each program year's dataset was reviewed for completeness, consistency, and compliance with the provided TRL files
Sample Design		
Stratification	N/A	All participants that had the necessary data were included
Sample Sizes	N/A	
Representativeness	GS	
Expansion Method	N/A	
Primary Data Collection		
Participant/Non-participant Surveys	A	Participant survey
Interviews	N/A	
Onsite/virtual	N/A	
Metering	N/A	
Reporting		
Transparency	A	
Documentation	A	
Recommendations	A	
Approaches and Methods by Measure		
Appropriateness of M&V Approach	GS	Single measure ex ante value per home representing the bundled effect of all installed measures; based on previous evaluation reports
Appropriateness of EM&V Approach	GS	Billing analysis for energy savings; difference in difference vs. comparison group for payment analysis, RIMS II for economic analysis
COVID-19 Effects	N/A	2016-2017 report
Timing of Activities	A	
Results	A	
Overall	**GS**	

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Home Energy Reports

Table B-5 HER Process Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	U	Assuming that they used the program tracking data cleaned as part of the impact evaluation, but should be explicity stated.
Cleaning and validation described	U	Assuming that they used the program tracking data cleaned as part of the impact evaluation, but should be explicity stated.
Tracking Database Review	U	Assuming that they used the program tracking data cleaned as part of the impact evaluation, but should be explicity stated.
Program Descriptions		
Program Challenges and Successes	A	Interviewed PacifiCorp and implementation program staff and summarizes successes with the program.
Database Management	U	Assuming that they used the program tracking data cleaned as part of the impact evaluation, but should be explicity stated.
Sample Design		
Stratification	GS	Type of survey received (treatment only) and treatment/control designation.
Sample Sizes	GS	
Representativeness	GS	Random sample from treatment and control populations.
Primary Data Collection		
Participant/Non-participant Surveys	GS	Participant Survey
Interviews	A	Interviews with PacifiCorp and implementation program staff
Analysis & Reporting		
Results presentation	GS	
Confidence & precision	A	No precision provided around results of the participant survey. Stated in the text whether there were significant differences between treatment- and control-group responses.
Overall	**GS**	

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Table B-6 HER Impact Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	GS	Gathered monthly billing data for a year pre-treatments and through 2020 and 2021.
Cleaning and validation described	GS	Provided detailed cleaning steps and demonstrated pre-period balance between treatment and control groups.

Tracking Database Review	N/A	
Sample Design	N/A	
Stratification	N/A	Billing analysis included the population of treatment and control customers.
Sample Sizes	N/A	
Representativeness	N/A	
Expansion Method	N/A	
Primary Data Collection		
Participant/Non-participant Surveys	GS	Conducted a survey with treatment and control customers to determine upstream lighting impacts.
Interviews	N/A	
Onsite/virtual	N/A	
Metering	GS	Gathered monthly billing data for a year pre-treatments and through 2020 and 2021.
Reporting		
Transparency	GS	Detailed methodologies, include cleaning steps, and provided detailed analysis results by year and wave.
Documentation	GS	
Recommendations	A	
Approaches and Methods by Measure		
Appropriateness of M&V Approach	A	Monthly estimates of savings calculated using a difference-in-differences regression analysis using monthly billing data that included all program treatment and control customers by wave. Evaluator noted concerning differences in customer counts.
Appropriateness of EM&V Approach	GS	Estimates of savings calculated by modeling calendarized monthly billing data using a difference-in-differences panel regression model following the UMP. Tested both linear regression with fixed effects and post-only regression models to investigate impact-sensitivity to model specification. Accounted correctly for uplift.
COVID-19 Effects	GS	Month-by-year fixed effects controlled for the naturally-occurring changes in consumption over time, including the impacts of COVID-19, so that differences reflected true program-drives changes to consumption. Tested the impact of a standalone COVID indicator.
Timing of Activities	GS	Collected sufficient post-period data.
Results	GS	Results appear reasonable. Although the re-randomized waves saved more in their first year of treatment than their second, ADM clearly shows that per-household consumption was substantially higher in the first year, likely driven by COVID. ADM also notes that lower-than-typical savings is likely driven by included previously-treated customers in the control groups.
Overall	**GS**	

Wattsmart Business

The following tables summarize AEG's review of the Wattsmart Business process and impact evaluations.

Table B-7 WSB Process Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	GS	Annual report, program tracking data, nonresidential customer database, program website
Cleaning and validation described	A	Removed measures with duplicate or missing contact info from survey sampling frame.
Tracking Database Review	GS	Validated the accuracy of data in the program tracking database and whether the results matched the annual reports
Program Descriptions		
Program Challenges and Successes	A	
Database Management	A	
Sample Design		
Stratification	GS	By program offering and measures installed
Sample Sizes	A	Fell short of target number of completed surveys
Representativeness	A	
Primary Data Collection		
Participant/Non-participant Surveys	GS	Participants, partial participants and nonparticipants
Interviews	GS	Program staff, administrators and trade allies
Analysis & Reporting		
Results presentation	GS	
Confidence & precision	U	Not listed
Overall	**GS**	

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

Table B-8 WSB Impact Evaluation Checklist

Criteria	Rating	Comments/Questions
Data Validation		
Data sources described	A	
Cleaning and validation described	A	
Tracking Database Review	GS	Validated the accuracy of data in the program tracking database and whether the results matched the annual reports
Sample Design		
Stratification	GS	Stratified 27 measure types into seven strata to account for the largest amount of savings and quantity of projects per stratum
Sample Sizes	GS	
Representativeness	A	Designed to achieve 80/20 per stratum and 90/10 at nonresidential portfolio level.
Expansion Method	GS	
Primary Data Collection		
Participant/Non-participant Surveys	GS	Participant, partial participant and nonparticipant surveys
Interviews	GS	Contacted customers where possible for additional information and to verify reported documentation
Onsite/virtual	A	Supplemental virtual assessments
Metering	N/A	
Reporting		
Transparency	GS	
Documentation	GS	
Recommendations	GS	Ties recommendations to conclusions
Approaches and Methods by Measure		
Appropriateness of M&V Approach (IPMVP)	GS	Used deemed savings, measure specific calculator workbooks or models,
Appropriateness of EM&V Approach	GS	Virtual assessments and engineering analysis. Reviewed all available calculations and inputs, verified reported documentation with customers and collected site specific data where possible
COVID-19 Effects	GS	Asked customers if hours of operation were affected by COVID
Timing of Activities	A	
Results	GS	
Overall	**GS**	

Ratings: Unknown (U), Inappropriate (I), Minimum (M), Appropriate (A), Gold Standard (GS)

C | TRACKING DATABASE REVIEW CHECKLIST

Table C-1 Tracking Database Review Checklist

Metric Category	Data Element	DSMC Field
Identifiers	Program Number; Program Name	Program Name
	Project ID	External Project ID
	Application Number	Application Number
	Sub-Program	(Included in program name)
	Selection for M&V	Number of Trl
	Implementor or Delivery Mechanism	Managed By; Customer Name = “Upstream”
Measure Descriptors	Measure Category	Measure Category
	Measure Type	Measure Type
	Measure Sub-Type	Measure Sub-Type
	Measure Name	Measure Name
	Measure Custom Name	Measure Custom Name
	Quantity	Quantity
	Quantity Units	Unit
Savings	kWh savings	kWh/Yr Savings
	kW savings	kW (Savings)
	Measure Life	Measure Cost
Costs	Measure Cost	Reported Measure Cost; Report Cust CoPay; Admin Cost
	Incentive Amount	Customer Incentive; Partner Incentive
	Cost Recovery Date	Cost Recover Date

D | DESK REVIEW CHECKLIST

Table D-1 Desk Review Checklist

Review Category	Review Element
Project Documentation Verification	Complete Project Doc? (1/0)
	Info Rating (1-5)
	Project # Match? (1/0)
	Site Match?
	Facility Type
	C&I: Evidence of Inspection? (1/0)
	C&I: Inspection Report Description?
	C&I: Verification Report Complete?
Measure Verification	Measure Description
	Type Match? (1/0)
	Quantity Match? (1/0)
Savings Verification	kWh Match? (1/0)
	UES Match?
	Measure Life Match? (1/0)
	Savings Calc Type (From TRL)
	(Deemed Savings Measure) Right Savings Chosen?
	(Deemed Savings Measure) Deemed Value Up to Date?
	(Deemed Savings Measure) UES*Qty Track Savings?
	(Calculated Savings Measure) Appropriate Calculator Provided?
	(Calculated Savings Measure) Inputs Reasonable?
	(Calculated Savings Measure) Data Methods
	(Custom Savings Measure) Inputs Reasonable?
	(Custom Savings Measure) Measured Data for Baseline?
	(Custom Savings Measure) Measured Data for EE Case?
Costs and Incentives Verification	Cost Match? (1/0)
	Incentive Match? (1/0)
	Incentive <= Measure Cost?
	Invoice Attached? (1/0)
	Invoice Date
	True Incentive Percentage
	Project Cap Percentage

E | HOME ENERGY SAVINGS VIRTUAL VERIFICATION SURVEY GUIDES

Air Source Heat Pump

PacifiCorp Verification – Air Source Heat Pump Survey – FINAL – 3-1-2022

INPUTS

[YOUR NAME]

[CUSTOMER NAME]

[SENDER EMAIL ADDRESS]

A. INTRODUCTION

Hello, this is **[YOUR NAME]** from the Applied Energy Group, or AEG. We are calling on behalf of Pacific Power to get some information about your participation in the Home Energy Savings energy efficiency program. It should only take about 5 minutes of your time. [IF NECESSARY: Your responses to these questions will not affect the incentive you already received.]

A1. Is this a good time for you?

a. Yes
b. No [SCHEDULE CALLBACK OR MARK AS REFUSAL]

B. SCREENING

B1. According to our records, you installed a central heat pump Heating and Air Conditioning System and received a rebate from Pacific Power through their Home Energy Savings program. Is that correct?

a. Yes
b. No [TERMINATE]
c. Don't know [TERMINATE]

B2. Are you the best person in your household to talk about the central heat pump Heating and Air Conditioning System you installed?

a. Yes
b. No [ASK TO SPEAK WITH BEST PERSON; REPEAT INTRO]

C. PRE-EXISTING EQUIPMENT

C1. What type of heating system did your new central heat pump Heating and Air Conditioning System replace?

a. Central gas furnace with ducts/vents to individual rooms
b. Central boiler with hot water/steam radiators or baseboards in individual rooms
c. Electric forced air furnace with ducts/vents to individual rooms
d. Electric resistance or baseboard heat
e. Under-floor or radiant electric heating
f. Air-source heat pump
g. Ground-source or geothermal heat pump
h. Ductless split system (also known as a ductless heat pump)
i. Other [SPECIFY] _____ [PROBE IF NEEDED: For example, wood or pellet stoves? Portable space heaters?]
j. Not sure

C2. What type of fuel did the heating system you replaced use?

a. Natural gas
b. Electricity
c. Other [SPECIFY] _____

C3. How old was your heating system when you replaced it with the central heat pump Heating and Air Conditioning System?

a. [RECORD AGE] _____

C4. Do you currently have a back-up or secondary heating system in addition to your new central heat pump heating and air conditioning system?

a. Yes
b. No [SKIP TO SECTION D PHOTO OF CURRENT SYSTEM]

C5. [IF C4 = YES] What type of heating system did your backup or secondary heating system?

a. Central gas furnace with ducts/vents to individual rooms
b. Central boiler with hot water/steam radiators or baseboards in individual rooms
c. Electric forced air furnace with ducts/vents to individual rooms
d. Electric resistance or baseboard heat
e. Under-floor or radiant electric heating
f. Air-source heat pump
g. Ground-source or geothermal heat pump

h. Ductless split system (also known as a ductless heat pump)
i. Other [SPECIFY] _____ [PROBE IF NEEDED: For example, wood or pellet stoves? Portable space heaters?]
j. Not sure

C6. [IF C4 = YES] What type of fuel is used for your back up/secondary heating system?
a. Natural gas
b. Electricity
c. Other [SPECIFY] _____

D. Photo of Current System

If possible, we would like to get a picture of your Heat Pump system, specifically the nameplate located on the outside the unit. If you are willing to take the photo, we will send you an email with instructions on locating the nameplate. Once you take the photo, you can simply reply to that email and attach the photo. After reviewing the quality of the photo, we will send you a $25 e-gift certificate from Tango.

[IF ASKED: The nameplate should be located outside right on your heat pump unit. It is typically a metal plate or white sticker and includes the name of the manufacturer, serial and model numbers and information on size and efficiency. The instructions we send you will include a picture of a similar nameplate, so you know what to look for.]

[IF NECESSARY: The nameplate information will only be used to help improve Pacific Power's energy efficiency programs and will not be shared with any other entities.]

D1. Are you willing and able to take this photo and email it to us?
a. Yes [REPLY: That's great! Thank you.]
b. No [SKIP TO CLOSING]

D2. Can you please give me your email address so I can send you the instructions?
a. [RECORD EMAIL] _____

E. Instructions

In the next few minutes, you should receive an email with instructions for taking the photo. The email will come from **[SENDER EMAIL ADDRESS]**. Reply to that email with the photo attached, and we will respond with a link to a $25 e-gift certificate from Tango.

E1. Do you have any questions?

F. CLOSING

That's all the questions that we have for you today. Thank you for your time.

EMAIL TEXT Air Source Heat Pump

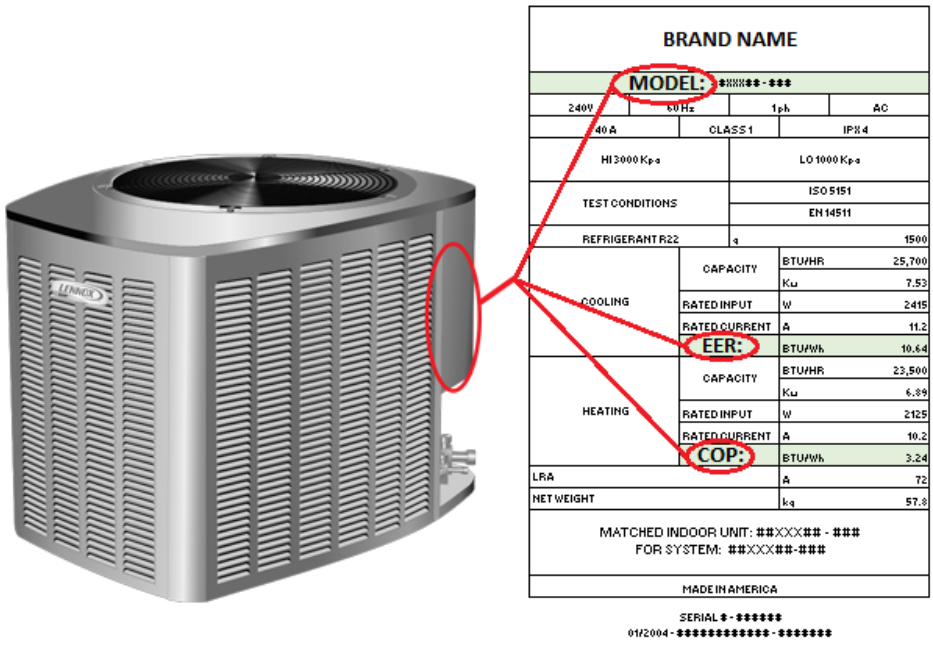
Hi **[CUSTOMER NAME]**,

Thank you for taking the time to talk to me about your participation in Pacific Power's Home Energy Savings energy efficiency program. As explained during the phone call, we need a high-quality photo of the nameplate located on your heat pump.

Here are some tips on where to find the nameplate:

Heat pump systems typically include several main parts. The first part is the **Heat Pump Condenser unit**, which is **located OUTSIDE of your home**. This system then connects to an indoor evaporator/air handler unit, which distributes the heated or cooled air throughout your home via ductwork.

We want the nameplate of the OUTDOOR unit, the Heat Pump Condenser itself**.** It should have a nameplate on it that looks similar to the picture below. The areas highlighted in green are most important to our study; please ensure the image you upload shows those values clearly.



^Central Heat Pump Condenser

Once you take the photo, please reply to this email and attach the photo. Once we review the quality of the photo, we will send you a $25 e-gift certificate from Tango.

If you have any questions, please do not hesitate to contact me. If you would like to talk to someone at Pacific Power about this study, please contact **Nancy Goddard at nancy.goddard@pacificorp.com**.

Thank you

AEG

Ductless Heat Pump

PacifiCorp Verification – Ductless Heat Pump Survey – FINAL – 3-1-2022

INPUTS

[YOUR NAME]

[CUSTOMER NAME]

[SENDER EMAIL ADDRESS]

A. INTRODUCTION

A1. Hello, this is **[YOUR NAME]** from the Applied Energy Group, or AEG. We are calling on behalf of Pacific Power to get some information about your participation in the Home Energy Savings energy efficiency program. It should only take about 5 minutes of your time. [IF NECESSARY: Your responses to these questions will not affect the incentive you already received.]

A2. Is this a good time for you?

a. Yes [CONTINUE]
b. No [SCHEDULE CALLBACK OR MARK AS REFUSAL]

B. SCREENING

B1. According to our records, you installed a ductless heat pump system and received a rebate from Pacific Power through their Home Energy Savings program. Is that correct?

a. Yes
b. No [TERMINATE]
c. Don't know [TERMINATE]

B2. Are you the best person in your household to talk about the ductless heat pump system you installed?

a. Yes
b. No [ASK TO SPEAK WITH BEST PERSON; REPEAT INTRODUCTION]

C. PRE-EXISTING EQUIPMENT

C1. Did you install this ductless heat pump system to replace an existing heating system for your entire home, or is it a supplemental system?

a. Replaced existing system
b. Supplemental system

[ONLY ASK C2 AND C3 IF C1 = REPLACED EXISTING SYSTEM]

C2. [IF C1 = REPLACED EXISTING SYSTEM] What type of heating system did your new ductless heat pump system replace?

a. Central gas furnace with ducts/vents to individual rooms
b. Central boiler with hot water/steam radiators or baseboards in individual rooms
c. Electric forced air furnace with ducts/vents to individual rooms
d. Electric resistance or baseboard heat
e. Under-floor or radiant electric heating
f. Air-source heat pump
g. Ground-source or geothermal heat pump
h. Ductless split system (also known as a ductless heat pump)
i. Other [SPECIFY] _____ [PROBE IF NEEDED: For example, wood or pellet stoves? Portable space heaters?]
j. Not sure

C3. [IF C1 = REPLACED EXISTING SYSTEM] What type of fuel did the heating system you replaced use?

a. Natural gas
b. Electricity
c. Other [SPECIFY] _____

[ONLY ASK C4 AND C5 IF C1 = SUPPLEMENTAL SYSTEM]

C4. [IF C1 = SUPPLEMENTAL SYSTEM] What type of heating system is the main heating system in your home?

a. Central gas furnace with ducts/vents to individual rooms
b. Central boiler with hot water/steam radiators or baseboards in individual rooms
c. Electric forced air furnace with ducts/vents to individual rooms
d. Electric resistance or baseboard heat
e. Under-floor or radiant electric heating
f. Air-source heat pump
g. Ground-source or geothermal heat pump
h. Ductless split system (also known as a ductless heat pump)
i. Other [SPECIFY] _____ [PROBE IF NEEDED: For example, wood or pellet stoves? Portable space heaters?]
j. Not sure

C5. [IF C1 = SUPPLEMENTAL SYSTEM] What type of fuel is used for your main heating system?

a. Natural gas
b. Electricity
c. Other [SPECIFY] _____

C6. How many outside units does your new ductless heat pump system have?

a. [RECORD NUMBER OF OUTSIDE UNITS] ____outside units

b. Don't Know

D. PHOTO OF CURRENT SYSTEM

If possible, we would like to get a picture of the nameplate located on the outside unit(s) of your ductless heat pump system. If you are willing to take the photo(s), we will send you an email with instructions on locating the nameplate on each unit. Once you take the photo(s), you can simply reply to that email and attach the photo(s). After reviewing the quality of the photo, we will send you a $25 e-gift certificate from Tango.

[IF ASKED: The nameplate should be located outside right on your heat pump units. It is typically a metal plate or white sticker and includes the name of the manufacturer, serial and model numbers and information on size and efficiency. The instructions we send you will include a picture of a similar nameplate, so you know what to look for.]

[IF NECESSARY: The nameplate information will only be used to help improve Pacific Power's energy efficiency programs and will not be shared with any other entities.]

D1. Are you willing and able to take a photo/photo of your outside unit(s) and send them to us?

a. Yes [REPLY: That's great! Thank you.]

b. No [SKIP TO CLOSING]

D2. Can you please give me your email address so I can send you the instructions?

a. [RECORD EMAIL] _____

E. INSTRUCTIONS

In the next few minutes, you should receive an email with instructions for taking the photo. The email will come from **[SENDER EMAIL ADDRESS]**. Reply to that email with the photo attached, and we will respond with a link to a $25 e-gift certificate from Tango.

E1. Do you have any questions?

F. CLOSING

That's all the questions that we have for you today. Thank you for your time.

EMAIL TEXT Ductless Heat Pump

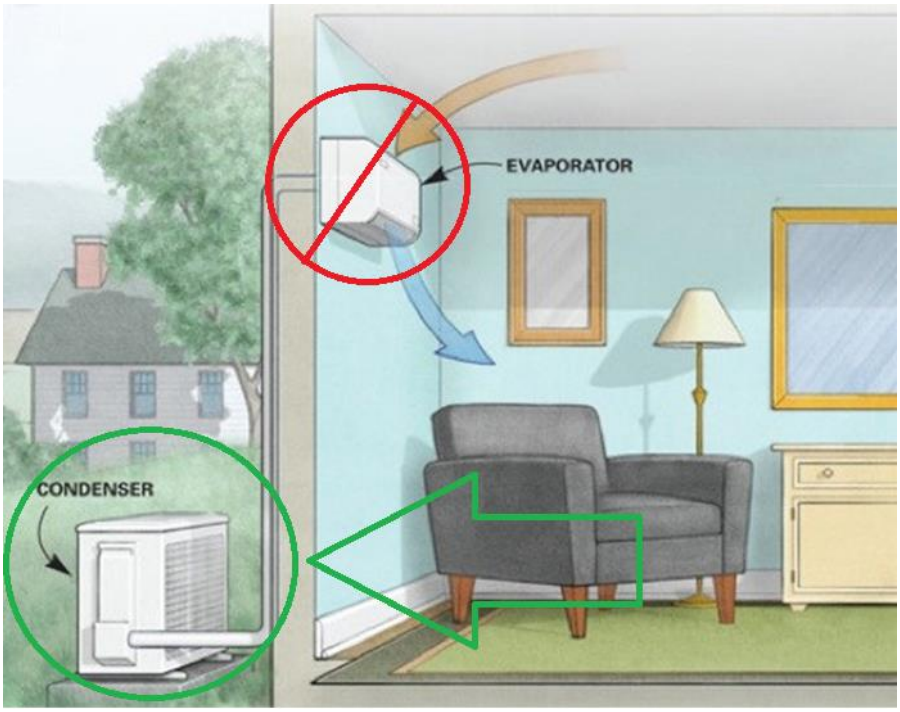
Hi **[CUSTOMER NAME]**,

Thank you for taking the time to talk to me about your participation in Pacific Power's Home Energy Savings energy efficiency program. As explained during the phone call, we need a high-quality image of the nameplate located on your heat pump. If you have more than one outside unit, please provide a picture of each unit.

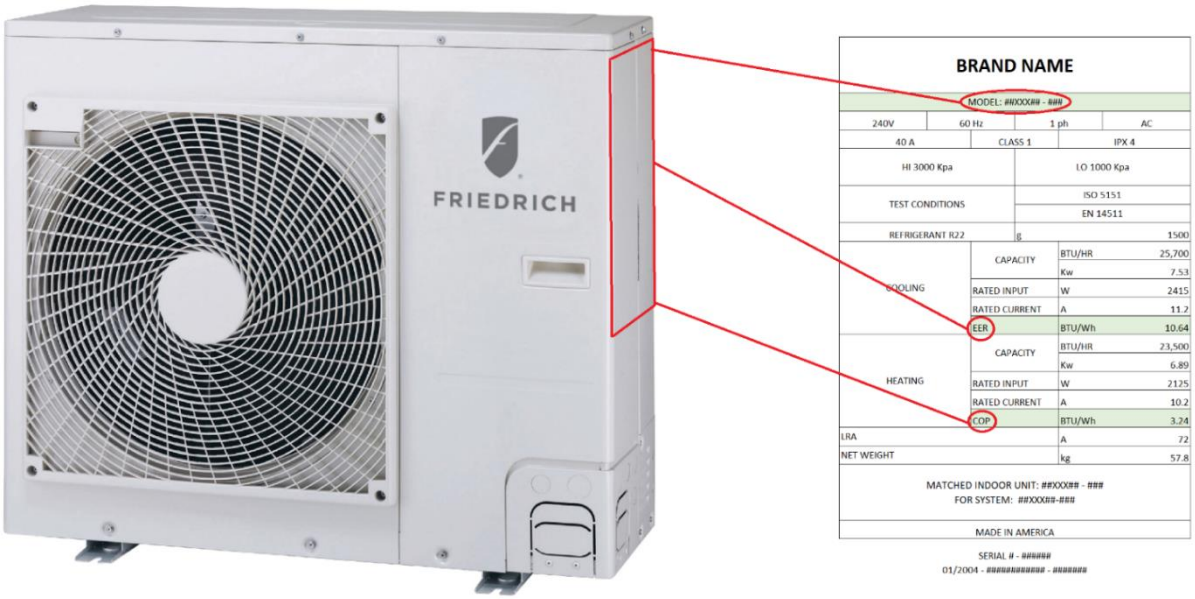
Here are some tips on where to find the nameplate(s):

Ductless heat pump systems typically include 2-4 main parts. The first part is the **Heat Pump Condenser unit**, which is **located OUTSIDE of your home**. This system then connects to one or more interior registers, which are the units inside your home that distribute the heated or cooled air.

We want the nameplate of the OUTDOOR unit, the Heat Pump Condenser itself. The HVAC unit *inside* your house is **NOT** what we are looking for in this survey, and neither is the thermostat you use to adjust the temperature. See the figure below for an example of a typical ductless heat pump setup showing the interior (evaporator) register unit and the outdoor (condenser) unit. (Note that one condenser may be connected to multiple registers in the home.)



Again, **we need the nameplate of the OUTDOOR unit**. It should have a nameplate on it that looks similar to the picture below. The areas highlighted in green are most important to our study; please ensure the image you upload shows those values clearly. **Please provide photos of EACH of your outdoor units if you have multiple.**



^Ductless Heat Pump Condenser

Once you take the photo(s), please reply to this email and attach the photo(s). Once we review the quality of the photo(s), we will send you a $25 e-gift certificate from Tango.

If you have any questions, please do not hesitate to contact me. If you would like to talk to someone at Pacific Power about this study, please contact **Nancy Goddard at nancy.goddard@pacificorp.com**.

Thank you

AEG