2018-2019 WASHINGTON SAVINGS VERIFICATION

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Report prepared for:
PACIFICORP

Energy Solutions Delivered.

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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 2018-2019 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.

Study Overview

The key objective of this study was to review the evaluation, measurement, and verification (EM&V) approaches implemented as part of PacifiCorp's Washington energy efficiency programs for the 2018-2019 biennial period. More specifically, AEG's key goals were to:

- Verify savings claimed by PacifiCorp during the 2018-2019 biennial period using methodologies consistent PacifiCorp's evaluation, measurement, and verification (EM&V) framework, Washington Utilities and Transportation Commission (Commission) guidance, and stakeholder expectations.
- Review program level measurement and verification practices and procedures, savings tracking and reporting, impact and process evaluation methods, cost effectiveness inputs and methods, and overall accuracy of the program and portfolio savings claims.

To accomplish the objectives, AEG broke the project into the key research activities described below:

Figure E-1 Summary of Research Activities

Validate Savings Verification Processes

- AEG reviewed the M&V approaches used to verify ex-ante savings estimates

Validate Savings Tracking and Reporting Practices

- AEG examined PacifiCorp's program tracking procedures for Washington

Impact and Process Evaluation Review

- AEG reviewed the most recent evaluation of each PacifiCorp program for the appropriateness and robustness of the various approaches

Annual Report Cost-Effectiveness Review

- AEG reviewed the cost-effectiveness analysis supporting PacifiCorp's 2018 Annual Report

Verify Portfolio Savings.

- AEG leveraged previous activities , augmented by an independent engineering desk review and for a sample of projects in major programs.

Program Descriptions

The study focused on PacifiCorp's four Washington energy efficiency programs: Home Energy Savings (HES), Home Energy Reports (HER), Low Income Weatherization (LIW), and Wattsmart Business. Savings associated with Northwest Energy Efficiency Alliance (NEEA) efforts were not included in this verification study. A brief summary of the programs plus high-level findings from the program manager interviews are summarized below:

Home Energy Savings. The HES program offers a comprehensive set of customer-focused residential energy efficiency incentives, including upstream, midstream, and end user rebates. A program implementation vendor runs and manages all program activities.

- During the 2018-2019 biennium, the HES program went through a major vendor transition, from CLEAResult to Nexant through the summer of 2019. This transition was planned over several months and was staggered based on each delivery channel's need and lifecycle.
- PacifiCorp began using "floating" unit energy savings (UES) values for reporting in the 2018-2019 biennium, meaning that deemed values were updated during the biennial period where appropriate.

Home Energy Reports. The HER program is designed to generate quantifiable behavioral savings that cannot be feasibly attained through standard energy efficiency efforts. The HER program provides customized reports to customers, comparing their billed energy use to homes in their area with similar energy consumption.

- The HER program went through a major contract transition from Oracle to Bidgely in 2018. Bidgely provides similar materials as those provided under Oracle including paper and email reports, tips and recommendations and a web portal with home energy audit tool. One notable addition is disaggregated usage information which was not previously provided by Oracle.
- While PacifiCorp's equipment-based programs report ex-ante savings for biennial reporting, HER savings for the 2018-2019 biennial period will be reported ex-post based on the findings of the program evaluation.

Low Income Weatherization. PacifiCorp's LIW program provides no-cost energy efficiency services to income-qualified residential customers through a partnership with local non-profit agencies.

- The Low Income Weatherization program provides is delivered through a partnership with local non-profit agencies. The program is bolted onto the state of Washington's Weatherization Assistance Program (WAP) and PacifiCorp's contribution varies based on the availability of Matchmaker Program funds.
- Project information is currently entered manually into PacifiCorp's tracking system by the program manager.

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

- Baselines for lighting measures were updated from a single stipulated baseline to adopt the Regional Technical Forum (RTF) dual baseline, which better aligns lighting project savings and costs.
- A portion of the program management responsibilities for the managed accounts delivery channel was outsourced to Cascade Energy in 2019, however, PacifiCorp program staff still maintain primary responsibility for interfacing with managed accounts.

- PacifiCorp began using "floating" unit energy savings (UES) values for reporting in the 2018-2019 biennium, meaning that deemed values were updated during the biennial period where appropriate.

Key Findings and Recommendations by Research Activity

Through this study, AEG verified that PacifiCorp appropriately claimed savings for the 2018-2019 and has robust evaluation, measurement, verification, and reporting processes in place that align with industry best practices. Key findings and recommendations for reach research activity are summarized below.

Validate Savings Verification Processes

AEG found PacifiCorp to have robust measurement and verification processes that align with industry best practices. By comparing planned and actual project inspection rates, AEG was able to confirm that PacifiCorp met or exceeded its inspection rates for all Wattsmart Business delivery channels and most Home Energy Savings measure categories. However, during the 2018-2019 biennium, PacifiCorp fell short of its target inspection rate for multifamily projects. Based on conversation with the program manager, it appears that this disconnect was related to the implementation vendor transition discussed above. Because the un-inspected multifamily measures represent a de minimis share of total HES savings for the biennium and because no issues were identified with the multifamily measures that were inspected, AEG does not recommend any adjustment to savings due to misalignment of planned and actual inspection rates.

AEG presents the following recommendations for PacifiCorp's Consideration:

- Add new fields to DSMC to identify measures that are subject to inspection and to group projects into the inspection categories identified in the EM&V Framework,
- Track measures/projects inspected directly in DSMC rather than relying on separate tracking by program implementers,
- Use the new data stored in DSMC to directly track inspection rates against EM&V Framework thresholds during the biennium.

Validate Savings Tracking and Reporting

PacifiCorp's tracking and reporting system, DSM Central (DSMC), is a centralized database that incorporates all program data in an integrated fashion. DSMC tracks all measure-level attributes needed to verify project-, program- and portfolio-level savings and incentives. It also stores additional information necessary for cost-effectiveness analysis, including measure lives and net-to-gross (NTG) ratios and complies with best practices for energy efficiency program data tracking. DSMC includes a technical reference library (TRL) that is a structured repository for all measures, assumptions, and data sources. This accessible web database is integrated with DSMC to verify the appropriateness of reported savings and incentives issued to customers. Based on a demonstration of DSMC and program staff interviews AEG concluded that PacifiCorp's data tracking processes meet or exceed the best management practices in the field. AEG presents the following recommendations for PacifiCorp's Consideration:

- Develop a data dictionary of the data fields used in DSMC. A data dictionary was not provided to AEG and we recommend creating one if it is not currently available. For example, DSMC tracks multiple dates for each project including "Cost Recovery Date", "Project Creation Date", "Project Last update Date", and "Measure Effective Date". Some of these dates are assigned and created in DSMC and some come over as part of program data transfer. A comprehensive data dictionary, with explanation of all data fields will be a helpful resource, particularly for third-party program evaluators.

- LIW program data is manually entered into DSMC by the PacifiCorp program manager based on program agency invoices; this is a potential area for process improvement to reduce opportunities for manual error.

Impact and Process Evaluation Review

To verify that PacifiCorp's Evaluation, Measurement, and Verification (EM&V) practices are aligned with industry standards, AEG reviewed the most recent completed program evaluation reports for the HES, LIW, and Wattsmart Business Programs and the workplan for the current HER program evaluation. Through this review, AEG found that PacifiCorp's recent third-party program evaluations are generally aligned with industry best practices for impact evaluation, process evaluation, and cost-effectiveness analysis.

AEG presents the following recommendations for PacifiCorp's Consideration:

- Including appendices with additional details including survey instruments and technical aspects, detailed methodologies or rationale for impact evaluation activities would enhance transparency and comprehensiveness of evaluation reporting.
- AEG recommends that PacifiCorp ensure exact alignment between the source documents and cost-effectiveness inputs in future evaluation report cost-effectiveness analysis.

Annual Report Cost-Effectiveness Review

AEG reviewed PacifiCorp's 2018 Annual Report cost-effectiveness inputs, methodology, and results to verify alignment with Washington Utilities and Transportation Commission guidance, Northwest Power and Conservation Council methodology, and industry best practices. In general, AEG found PacifiCorp's cost-effectiveness analysis to be well-aligned with best practices, noting only a few opportunities to improve documentation.

AEG presents the following recommendations for PacifiCorp's Consideration:

- Environmental externalities are a benefit considered by the Council. AEG believes that these are included in PacifiCorp's decrement study, but this is not explicitly stated. PacifiCorp has sufficiently addressed this issue 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 inflation rate stated in the 2018 Annual Report cost-effectiveness memo is 2.2%, as compared to a value of 2.22% in PacifiCorp's 2017 Integrated Resource Plan (IRP). While this small variance will not materially impact cost-effectiveness results, AEG recommends exactly aligning these values in the future as a best practice.
- To clarify alignment with Council methodology, AEG recommends making the inclusion of non-energy impacts and operation and maintenance costs (O&M) more explicit for all programs in future reporting.

Portfolio Savings Verification

Through engineering desk review for a sample of projects and portfolio-level cross-check analysis, AEG was able to verify that PacifiCorp appropriately claimed savings for the 2018-2019 biennial period. AEG had also planned to conduct site visits to verify the installation of a sample of Home Energy Savings program measures, however, this was ultimately not possible due to the outbreak of the COVID-19 pandemic Although the HES program transition created some challenges for project document acquisition, AEG generally found sampled projects to be well-documented and was able to confirm that the correct savings were claimed for all sampled projects.

AEG presents the following recommendations for PacifiCorp's Consideration:

- AEG found projects to be well-documented in general, however there are some opportunities to make project documentation more robust.
- While AEG was not able to conduct on-site verification as planned due to the COVID-19 virus, site visits are a valuable tool for verifying measure installation. AEG recommends PacifiCorp continue to consider including on-site verification in savings verification studies for future biennial periods.
- While PacifiCorp was ultimately able to provide supporting documentation for all sampled projects, the document acquisition process for this study was delayed as a result of data transfer processes during the HES implementation vendor transition. AEG understands that this type of major vendor transition does not occur often, so PacifiCorp may not need to review vendor transfer protocols again for several biennia. However, AEG recommends that the next time a major vendor transition does occur, PacifiCorp apply the lessons learned from this study's document acquisition process to ensure proper documentation is readily available.

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INTRODUCTION

PacifiCorp selected Applied Energy Group, Inc. (AEG) to perform savings verification and process review of its Washington energy efficiency programs for the 2018-2019 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.

Study Overview

The goals of the study, a summary of each research activity, and a brief description of each energy efficiency program covered by this review are presented below.

Research Goals

The key objective of this study was to review the evaluation, measurement, and verification (EM&V) approaches implemented as part of PacifiCorp's Washington energy efficiency programs for the 2018-2019 biennial period. More specifically, AEG's key goals were to:

- Verify savings claimed by PacifiCorp during the 2018-2019 biennial period using methodologies consistent with PacifiCorp's evaluation, measurement, and verification (EM&V) framework, Washington Utilities and Transportation Commission (Commission) guidance, and stakeholder expectations.
- Review:
    - Program-level measurement and verification practices and procedures
    - Program-level savings tracking and reporting
    - Program-level impact and process evaluation methods and approaches
    - Cost-effectiveness inputs, methodology, and reporting
    - The accuracy of project, program, and portfolio savings claims

Research Activities

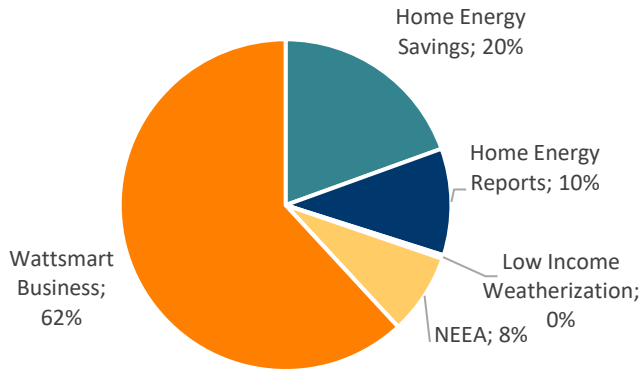
To accomplish the objectives, AEG broke the project into the key research activities described below:

- Validate Savings Verification Processes. The review and validation of M&V approaches used to verify ex-ante savings estimates included visibility into data being collected, verified, measured, and tracked on a project and program basis through existing M&V procedures.
- Validate Savings Tracking and Reporting Practices. AEG examined PacifiCorp's program tracking procedures for Washington.
- Impact and Process Evaluation Review. AEG reviewed the most recent evaluation of each PacifiCorp program, examining the appropriateness and robustness of the various approaches based on AEG's EM&V experience and industry best practice.

- Annual Report Cost-Effectiveness Review. AEG focused this review on cost-effectiveness analysis supporting PacifiCorp's 2018 Annual Report.[1]
- Verify Portfolio Savings. AEG leveraged Tasks 2-5, augmented by an independent engineering desk review and for a sample of projects in major programs.

Program Descriptions

Figure 1-1 Projected 2018-2019 Savings by Source



PacifiCorp realizes energy savings in Washington through four separate customer programs, plus the efforts of the Northwest Energy Efficiency Alliance (NEEA). The relative contribution of each source of savings is shown in Error! Not a valid bookmark self-reference., based on PacifiCorp's 2018-2019 Biennial Conservation Plan. 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 of individual projects focused on Wattsmart Business and Home Energy Savings, which jointly represent over 80% of savings. Verifying savings attributed to the efforts of the Northwest Energy Efficiency Alliance (NEEA) was outside the scope of this study.

At the outset of the study AEG conducted in-depth interviews with each of PacifiCorp's program management staff. These interviews were used to inform many areas of the study but were primarily designed to obtain key information about each program, program changes, or important issues of challenges that would be important during AEG's review as described in the subsections that follow.

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. A program implementation vendor runs and manages all program activities and holds weekly calls with the PacifiCorp program manager to report progress and escalate issues.

During the 2018-2019 biennium, the HES program went through a major vendor transition, from CLEAResult to Nexant through the summer of 2019. This transition was planned over several months and was staggered based on each delivery channel's needs and lifecycle. For example, downstream rebates that were in process during the transition would be completed by CLEAResult rather than transferred to Nexant. Similarly, upstream lighting, inventories were exhausted before changing to the new vendor. Savings tracking associated with this transition is discussed in Chapter 4.

PacifiCorp started using "floating" unit energy savings (UES) values for reporting in the 2018-2019 biennium, meaning that deemed values were updated during the biennial period where appropriate. Prior

[1] The timing of this project did not allow for a review of cost-effectiveness analysis from PacifiCorp's 2019 Annual Report or 2018-2019 Biennial Conservation Report.

to 2018, UES values were "frozen" for the biennial period for consistency between target-setting and reporting. Under the new "floating" UES system, UES values are updated for the second year of the biennium based on updates to Regional Technical Forum (RTF) analysis or other sources. Given the time required to modify programs and update UES values to be effective January 1 of the second year of the biennium, these changes are reflective of RTF measure updates approved through the summer of the first year of the biennium.

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.

Key aspects of AEG's verification will include:

- Careful review of data tracking and deemed savings for a sample of participants while being mindful of the transition from one vendor to another
- Confirmation that the appropriate deemed savings estimates are included in the TRL
- Review of EM&V approaches

Home Energy Reports (HER)

The HER program is designed to generate quantifiable behavioral savings that cannot be feasibly attained through standard energy efficiency efforts. The HER program provides customized reports to customers, comparing their billed energy use to homes in their area with similar energy consumption. This comparison is intended to leverage social norming effects and behavioral nudges to drive customers to reduce their energy consumption.

The HER program went through a major contract transition from Oracle to Bidgely in 2018. Bidgely provides similar materials as those provided under Oracle including paper and email reports, tips and recommendations, and a web portal with home energy audit tool. One notable addition is disaggregated usage information which was not previously provided by Oracle.

Savings for HER participants are estimated using a Randomized Control Trial (RCT). Once defining an eligible population, the vendor randomly assigns potential participants to either 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. During the transition from Oracle to Bidgely, the original treatment and control group assignments were maintained. Due to the nature of the behavioral energy efficiency program, only general report information, including report date and claimed savings are sent to PacifiCorp and stored in DSM Central (DSMC). The granular data on treatment and control groups and the number of recipients for each report are not tracked in DSMC, but are available to PacifiCorp, if needed, upon request to the implementation vendors.

Key aspects of AEG's verification will include:

- Review of 3rd party evaluator's savings estimation approach.
- Review of the transition of savings via the program tracking database.

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 agencies. The LIW program is bolted onto the state of Washington's Weatherization Assistance Program (WAP) and based on the availability of Matchmaker Program funds, can pay for 50% or 100% of allowable weatherization upgrades. This program is run through four participating agencies. Program data are input manually into DSMC by PacifiCorp staff. Installed measures are tracked individually, but savings are deemed per weatherized home based on the results of program evaluations. PacifiCorp's program manager noted challenges that are common with low-income weatherization programs across the country, including disqualifying structural issues (i.e. roof leak and moisture problem, etc.) and low participation rate. Future program tracking automation was noted as a desired process improvement for this program.

Because the LIW program provides less than 1% of PacifiCorp's portfolio-level savings, AEG's focused on verifying processes and evaluation efforts, but did not verify project savings as part of this study.

Wattsmart Business

PacifiCorp's Wattsmart Business program offers services and incentives to commercial, industrial, and agricultural customers through midstream (distributors/suppliers) and downstream (customer) incentive mechanisms. Incentives are available for retrofit projects as well as new construction and major renovation projects. Nexant and Cascade Energy are contracted program administrators managing incentive administration, day-to-day operations of the trade ally network, and outreach to unmanaged accounts. Nexant manages commercial measures including lighting, HVAC, building envelope, and food services. Cascade Energy manages agricultural and industrial measures, including irrigation, compressed air, farm and dairy, wastewater, and refrigeration applications.

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

- Managed Accounts or Custom Projects. This channel provides outreach and delivers, primarily, technical energy analysis services and custom incentives to large managed accounts. Managed accounts are large customers/communities, i.e., cities and counties, that have a PacifiCorp customer account representative. A PacifiCorp Project Manager works directly with customer representatives and managed account holders and, along with Cascade Energy, engages in more complex projects not covered under one of the other offerings.
- Small/Mid-Market Projects. This channel offers technical assistance and incentives for small and midsized custom opportunities with non-managed accounts. This channel, also called Small/Mid-Market Project Facilitation, provides outreach, project management, and engineering services. This delivery channel is managed and administered jointly by Cascade Energy and Nexant.
- Trade Ally Coordinator Projects. This delivery channel relies primarily on trade allies (i.e., contractors, vendors, and distributors) in PacifiCorp's Washington service territory to communicate energy efficiency and incentive opportunities and generate project leads This delivery channel is managed and administered jointly by Cascade Energy and Nexant.
- Midstream Lighting or Instant Incentives. Through this channel, customers can receive point-of-sale discounts on energy efficiency lighting. Customers who don't purchase from a participating vendor can apply for the incentive after purchase. This program is administered by Nexant and is tracked as "Mid-Stream Lighting" in DSMC.

- Small Business Program. Small business customers on rate Schedule 24 are eligible to receive free lighting assessments and enhanced incentives for lighting retrofits and other measures installed by approved contractors. This program is administered by Nexant.

During the interview we identified a couple of important program changes. First, baselines for lighting measures were updated from a single deemed baseline to adopt the RTF dual baseline which better aligns lighting project savings and costs. Second, a portion of the program management responsibilities for the managed accounts delivery channel was outsourced to Cascade Energy in 2019, however, PacifiCorp program staff still maintain primary responsibility for interfacing with managed accounts.

Key aspects of AEG's verification will include:

- Careful review of data tracking and deemed, calculated, and custom savings
- Confirmation that the appropriate deemed savings estimates are included in the TRL
- Review of EM&V approaches

Study Limitations

The emergence and spread of the COVID-19 virus had a significant impact on this study. AEG had planned to conduct site visits to verify the installation for a sample of Home Energy Savings program measures in late March and early April. In early March, it became clear that the COVID-19 virus presented significant health risks to PacifiCorp customers and AEG staff, leading AEG and PacifiCorp to jointly agree to cancel in-person site visits. AEG explored several alternatives to in-person visits, including virtual site visits using video sharing and telephone and email interviews. Ultimately, it was determined that given the rapid spread of the virus in Washington, direction from local government officials, and PacifiCorp's desire to minimize requests of customers during this difficult time, none of these options were viable. As such, AEG's savings verification work for specific projects was performed solely through an engineering desk review. Note, PacifiCorp's implementation contractors already perform on-site verification for a sample of projects.

Structure of this Report

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

- Section 2. Validate Savings Verification Processes
- Section 3. Validate Savings Tracking and Reporting Practices
- Section 4. Impact and Process Evaluation Review
- Section 5. Annual Report Cost-Effectiveness Review
- Section 6. Portfolio Savings Verification

2

VALIDATE SAVINGS VERIFICATION PROCESSES

This task primarily consisted of reviewing the measurement and verification (M&V) approaches used by PacifiCorp to verify ex-ante savings estimates. M&V approaches include activities conducted (such as pre- and post-installation inspections) or processes followed (such as sampling a specific percentage of all projects for inspections) to ensure the validity of savings estimates during program implementation by PacifiCorp program staff, program implementers, or trade allies and contractors.

Methodology

To complete this step in the verification, AEG reviewed PacifiCorp's current procedures, plans, and approaches. This included:

- Reviewing the procedures in Appendix 1 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.

AEG also collected information on current M&V activities from PacifiCorp program staff through in-depth-interviews and documentation requests, including visibility into data being collected, measured, verified, and tracked on a project and program basis.

Best Practices

AEG used the following list of best practices presented in the Summary of the National Energy Efficiency Best Practices study[2] and our own industry experience to assess how well PacifiCorp's M&V activities align with the best practices:

- Base quality control on program's relationship with vendors, number of vendors involved, types of measures, project volume, and variability of project size
- Use measure product specification in program requirements and guidelines
- Verify accuracy of rebates, coupons, invoices to ensure the reporting system is recording actual product installations by the target market
- Require pre-inspections for large or uncertain impact projects
- Conduct in-program measurement/impact evaluation for the very largest projects or those with uncertain impacts
- Assure quality of product through independent testing procedures

[2] 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

- Assess customer satisfaction with the product through evaluation
- Build in statistical features to the sampling protocol to allow a reduction in the number of required inspections based on observed performance & demonstrated quality of work

Findings

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

Home Energy Savings

For the Home Energy Savings program's downstream delivery mechanism, the various measures are grouped into those that receive inspections and those that do not in the table below.

Table 2-1 HES Inspection Status by Measure – Downstream Delivery Mechanism

Inspections	No Inspections
Central air conditioning best practices installation and sizing	Central air conditioners
Duct sealing	Clothes washers
Duct sealing and insulation	Evaporative cooler
Heat pump commissioning, controls, and sizing	Heat pumps
Heat pump water heaters	Hybrid/hear pump clothes dryers
Insulation	Line voltage thermostats
Windows	Low flow showerheads
	Low flow aerators
	New manufactured homes
	Smart thermostats

Measures that receive inspections are performed by implementation vendor staff as follows:

- >=5 percent of single-family homes,
- >=5 percent of manufactured homes,
- 100 percent of multifamily projects, and
- 20 percent of new homes projects.
- Single-family home inspection rates are applied to the total aggregate of downstream mechanical and weatherization measures.

Measures Receiving Inspections

To verify that PacifiCorp's actual HES measure inspection rates aligned with the established M&V practices during the 2018-2019 biennium, AEG compared the total number of measures incentivized in each of the categories above to the list of measures inspected by the program implementers. Because DSMC does not group measures by these categories or track which measures were inspected, AEG assigned each DSMC record to a category based on its measure name and merged this with a list of inspected projects provided by the program implementer.

Through this process, AEG was able to verify that PacifiCorp met or exceeded its inspection threshold for single-family, manufactured, and new homes measures, however, it fell short for multifamily homes. Although PacifiCorp's protocol is to inspect all qualifying measures in multifamily homes, AEG was only able to verify that 67% of measures were inspected during the biennial period. Based on a

conversation with the program manager, it appears that this disconnect was related to the implementation vendor transition. Because the un-inspected 33% of multifamily measures represent only 0.3% of total HES savings for the biennium and because no issues were identified with the 67% of multifamily measures that were inspected, AEG does not recommend any adjustment to savings due to misalignment of planned and actual inspection rates. However, AEG does present recommendations to improve future alignment below.

Measures Not Receiving Inspections

For measures that do not receive inspections, all post-purchase incented measures undergo a quality assurance review prior to the issuance of the customer/dealer incentive and recording of savings (e.g. proof-of-purchase receipt review) and eligible equipment review. Additionally, customer account and customer 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 inspections are conducted. Quality control is ensured by the implementation vendor who verifies measures for product eligibility and correct pricing. Pricing is also verified by implementation vendor 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.

Low Income Weatherization

For the Low Income Weatherization Program, all measures are qualified through a US Department of Energy-approved audit tool or priority list and 100% receive an inspection by an agency inspector. In addition, a state inspector also follows with random inspections. Finally, PacifiCorp also hires an independent inspector to inspect between 5-10 percent of homes treated (post-treatment and payment).

Wattsmart Business

Inspection requirements for Wattsmart Business projects are summarized in Table 2-2.

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

Lighting Projects (Typical Upgrades)
Inspection requirements vary depending on the amount of the incentive and the type of project. Incentive above high threshold* • Retrofits - 100 percent pre- and post-installation site 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 inspections of all projects with incentives between the low and high threshold amounts. A percent of post-installation site 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 inspections. • New construction – 100 percent post-installation site inspections of projects with incentives between the low and high threshold amounts. Incentive below low threshold* • A percent of post-installation site inspections by program administrator of projects with incentives under a specified dollar amount.
Lighting – Small Business
• On-site 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. • On-site 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 both phone and on-site inspections. • All projects with customer incentives over $X* will receive an on-site 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 on-site 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 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 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
• No pre-inspection for new construction. • Inspections are conducted by third-party energy engineering firms for the in-house project manager/consultant delivery channel. • Inspections are conducted by outsourced delivery team for projects delivered by third party outsourced program delivery teams.

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

To verify that PacifiCorp's actual Wattsmart Business project inspection rates aligned with the established M&V practices during the 2018-2019 biennium, AEG compared the total number of measures incentivized in each of the categories above to the list of projects inspected by the program implementers. Through this process, AEG was able to confirm that PacifiCorp met or exceeded all of its Wattsmart Business project inspection rate targets.

Recommendations

Although PacifiCorp has robust M&V protocols that align with industry best practices, PacifiCorp was not able to satisfy all of its established protocols during the 2018-2019 biennium. To improve alignment moving forward, AEG has the following recommendations:

- Add new fields to DSMC, to identify measures that are subject to inspection and group projects into the inspection categories identified in the EM&V Framework,
- Track measures/projects inspected directly in DSMC rather than relying on separate tracking by program implementers,
- Use the new data stored in DSMC to directly track inspection rates against EM&V Framework thresholds during the biennium.

3

VALIDATE SAVINGS TRACKING AND REPORTING

The tracking of program activity, including participants, their actions, incentives (if provided), and expected savings, is a critical component of program operations. Without accurate and adequate information, program metrics and results cannot be stated with confidence. In this task, we examined PacifiCorp's program tracking procedures for Washington as they center around Demand Side Management Central (DSMC), Pacific Power's project management, and reporting database. DSMC provides project management tools, a validation for each project, and a data warehouse with robust reporting capabilities.

Methodology

AEG took a two-pronged approach to understand and assess the DSMC database: a desk review of DSMC data extracts, and a PacifiCorp-led demonstration of the DSMC:

1. AEG conducted a thorough review of DSMC 2018 and 2019 program data extracts which included all data fields stored and tracked for PacifiCorp's Washington residential and non-residential energy efficiency programs. AEG verified that all program-critical information is tracked in DSMC and that values that go into the estimation of energy savings are adequately documented in the program records and associated technical resource library (TRL). AEG used the program staff interviews to answer questions regarding the information residing within the DSMC. A more detailed description of this review, including the checklist used to assess the completeness of the tracking database is described in the Best Practices section that follows.
2. AEG requested a DSMC demonstration to better understand system capabilities, use, and standard validation and reporting processes. PacifiCorp staff provided AEG with an in-depth demonstration of the system.

Best Practices

During AEG's review, we used the following list of best practices presented in the Summary of the National Energy Efficiency Best Practices study[3] and our own industry experience providing program tracking services to develop a checklist and list of questions to guide the DSMC review, demonstration, and staff interviews. The list of best practices is broken into two distinct segments, the first focusing on how program data are collected and tracked in DSMC, and the second focusing on PacifiCorp's process to ensure that tracking and reporting are accurate.

Program data collection and tracking:

- Design program tracking system to support the requirements of evaluators as well as program staff
- Clearly articulate the data requirements for measuring program success
- Define and identify key information needed to track and report early in the program development process

[3] 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 staff used the checklist presented in Table 3-1below to confirm that all key elements were being defined and tracked within the DSMC database.

Table 3-1 Program Tracking Data Elements Checklist

Type	Parameter
Identifiers	Program Number
	Project ID
	Application Number
	Description of Project ID
	Program
	Subprogram
	Selection for M&V
	Implementer or Delivery Mechanism
Measure	Measure Category
	Measure Type
	Measure Sub-Type
	Measure Name
	Measure Custom Name
	Quantity
	Qty Units
Savings	kWh savings
	kW savings
	Measure Life
Costs	Measure cost
	Incentive payment amount
	Invoice Date
	Cost Recovery Date
	Partner Incentive
	Customer Incentive
Savings	Measure type
	Unit savings
	Measure cost
	Measure life

Program tracking process:

- Use the Internet to facilitate data entry and reporting; build in real-time data validation systems that perform routine data quality functions
- Automate, as much as is practical, routine functions (e.g., monthly program reports)
- Develop electronic application processes
- Develop accurate algorithms and assumptions on which to base savings estimates
- Conduct regular checks of tracking reports to assess program performance
- Balance the level of tracking planned against program resource availability
- Document tracking system and provide manuals for all users

To help guide the demonstration and the staff interviews, AEG identified the following priority areas:

- Examine how (and when) DSMC is used for program management, data collection, and reporting.

- Verify DSMC's reporting capabilities and how its data and reports are used to track progress toward program goals.
- Review current data reconciliation and data quality assurance/quality control (QA/QC) processes. What are the established data transfer timelines for each program and how is data modification/correction for old projects handled?
- Explain the taxonomy of various categories in DSMC. For example, how "Cost recovery date", "Project Creation Date", Project Last update Date", and "Measure Effective Date" are set for each program.
- Review how backup documentation and granular program data are created and stored.
- Review of how M&V site visits are tracked and potentially selected and/or triggered within the system.

Findings

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

Program Data Collection and Tracking

AEG verified that each element listed in Table 3-1 was appropriately represented in the TRL and DSMC extracts for the HES, HER, LIW, and Wattsmart Business programs. Key conclusions of our review are below:

- DSMC is a centralized database that incorporates all program data in an integrated fashion. DSMC tracks all measure-level attributes needed to verify project-, program- and portfolio-level savings and incentives. It also stores additional information necessary for cost-effectiveness analysis, including measure lives and net-to-gross (NTG) ratios and complies with best practices identified above regarding data tracking.
- PacifiCorp has implemented a TRL that is a structured repository for all measures, assumptions, and data sources. This accessible web database is integrated with DSMC to verify the appropriateness of reported savings and incentives issued to customers. The TRL includes, but is not limited to, the following measure data:
    - Description of ex-ante savings estimates
    - Measure life
    - Evaluated and planned realization and NTG rates and notes
    - Reference source of assumption for information used in cost-effectiveness analysis (e.g. measure costs)

Program Tracking Processes

Based on the DSMC demonstration and program staff interviews AEG concluded that the PacifiCorp's data-tracking processes meet or exceed the best management practices in the field. Key conclusions of our review are below:

- PacifiCorp has robust data reconciliation and validation processes which include:
    - Real-time savings validation: Program data are sent to DSMC weekly and savings data are validated for each data transfer, which is either accepted or rejected based on a set of specific criteria. Real-time data validation uses a list of required fields for each program savings calculation, which is linked to the TRL.

  - Monthly incentive invoice reconciliation: Incentive invoices are calculated using DSMC values which are reconciled against vendor invoices on a monthly basis.
  - Quarterly data reconciliation: On a quarterly basis, a DSMC data extra is provided to program implementers for verification and reconciliation against their internal tracking systems.
- Pipeline tracking and reporting are facilitated for different projects on a program-specific basis.
- Granular program data and backup documentation for programs managed by third-party implementors, such as HES, HER, and Wattsmart business (for un-managed accounts), are tracked and stored by program implementers and only critical program data is sent to PacifiCorp's DSMC dashboard.
- Granular program data and all backup documentation for Wattsmart Business managed account or custom projects are stored and tracked in the DSMC.
- DSMC clearly identifies project or applications that have been flagged for additional M&V during implementation, such as site visits or inspections.

Recommendations

PacifiCorp is currently meeting and exceeding industry best practices regarding program savings tracking and reporting. Nonetheless, AEG developed the following recommendations that could further improve the clarity of the data or refinement of processes:

- Develop a data dictionary of the data fields used in DSMC. A data dictionary was not provided to AEG and we recommend creating one if it is not currently available. For example, DSMC tracks multiple dates for each project including "Cost Recover Date", "Project Creation Date", "Project Last update Date", and "Measure Effective Date". Some of these dates are assigned and created in DSMC and some come over as part of program data transfer. A comprehensive data dictionary, with an explanation of all data fields, will be a helpful resource, particularly for third-party program evaluators.
- LIW program data is manually entered into DSMC by the PacifiCorp program manager based on program agency invoices; this is a potential area for process improvement to reduce opportunities for manual error.
- Consider requesting, capturing, and tracking project-level data on M&V and QA site visits for applicable programs.

4

IMPACT AND PROCESS EVALUATIONS REVIEW

This section describes AEG's review of PacifiCorp's program impact and process evaluations.

Methodology

AEG began by reviewing PacifiCorp's Evaluation Measurement and Verification Framework for Washington (EM&V Framework) 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. Given the staggered timing of PacifiCorp's program evaluations, only the HES program, had a complete evaluation report covering part of the 2018-2019 biennium period. However, given PacifiCorp's well-established and consistent evaluation approaches, AEG was able to review the work plan for the current HER evaluation and previous evaluation reports for the Wattsmart Business and Low Income Weatherization program to provide a comprehensive view into PacifiCorp's EM&V practices. AEG ultimately focused the review on the evaluation reports and work plan for the four programs listed below.

- 2017-2018 Washington Home Energy Savings Program Evaluation Report[4]
- 2013-2015 Low Income Weatherization Program Evaluation Report[5]
- 2018-2019 Home Energy Reports Program Evaluation Work Plan[6]
- 2016-2017 Wattsmart Business Program Evaluation Report[7]

To complete the review, AEG developed separate checklists for impact and process evaluation activities and cost-effectiveness analysis using various industry sources. We then used these checklists to compare the activities documented in the EM&V reports or plans against the appropriate best practice for that specific program type. During this review, we paid special attention to the timing of EM&V activities, process and impact evaluation activities and methods, sampling/expansion approaches employed, field verification approaches (if any), and evaluator recommendations and reporting.

Best Practices

PacifiCorp's EM&V Framework establishes the overall approach to conducting EM&V of its energy efficiency programs, incorporating industry best practices with regards to principles of operation, methodologies, evaluation methods, definitions of terms, and protocols. The framework is based on a number of pertinent sources, including the Uniform Methods Project (UMP),[8] The National Action Plan for

[4] ADM Associates. Final Evaluation report for PacifiCorp Residential Home Energy Savings Program in Washington, Program Years 2017-2018 (December 4, 2019).

[5] Opinion Dynamics. Final Washington Low Income Weatherization Program Evaluation for Program Years 2013-2015 (January 10, 2018). Prepared for PacifiCorp.

[6] Because the 1018-2019 HER program evaluation was being completed at the same time as this study, AEG was only able to review the work plan, not the final report.

[7] Cadmus Group LLC, ADM Associates, VuPoint Research. 2016-2017 Washington *wattsmart* Business Program Evaluation (November 6, 2018). Prepared for Pacific Power.

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

Energy Efficiency, [9] the SEE Action Energy Efficiency Program Impact Evaluation Guide, [10] and the International Performance Measurement and Verification Protocols (IPMVP). [11] Key aspects of the EM&V Framework as they pertain specifically to best practices around EM&V activities include:

- 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 include 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.

The following subsection presents a brief summary of EM&V best practices to provide context for the checklists used to review the impact, process, and cost-effectiveness approaches presented in the EM&V reports.

EM&V Activities

Cross-cutting, impact, process, and reporting activities are described below. AEG primarily used the SEE Action Energy Efficiency Program Impact Evaluation Guide to develop the checklists, supplemented with the other sources listed above and AEG's own industry experience.

Cross-Cutting Activities

Cross-cutting activities refer to various activities that cut across both process and impact evaluations. The activities below are the ones we typically expect to see documented in an evaluation report.

- Data Validation. All evaluation activities rely on the timely collection and appropriate validation of program and participant data. AEG checked to ensure that the types of data and validation were appropriate for each program. Key aspects of data validation include: cross-checking participant and measure counts; reconciliation of missing, zero, or negative data; identification of outliers and erroneous values; removal of any data that might adversely affect or intentionally not be included in the evaluation. During our review we focused on the appropriateness and documentation of the data validation approach, and information on excluded observations, if provided.
- Tracking database review. A thorough review of the tracking database ensures that all information needed to calculate savings for a measure or project is being appropriately and adequately tracked.

[9] 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

[10] 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

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

For more information on tracking database best practices, see Section 3 above. AEG's review focused on the elements of the tracking database that were checked by the EM&V contractor.

- Sample Design. Efficient sample design ensures that evaluation goals can be met within the expectations for confidence and precision. AEG's review focused on the following specific sample design elements: segmentation or stratification, sample sizes, desired precision, and achieved precision. Based on the EM&V Framework, impact evaluation samples should be designed to achieve a 10% level of precision with 90% confidence. However, there are cases where 20% precision and 80% confidence are appropriate.
- Primary Data Collection. Cross-cutting primary data collection activities include interviews (staff, contractor, trade ally, or implementer) and participant and non-participant surveys. For these activities, AEG reviewed the information presented in the evaluation reports, and the survey instruments themselves when available. AEG's review focused specifically on whether the target information was successfully collected, and whether it led to any meaningful recommendations.

Process Evaluation Activities

The goal of process evaluations is to determine how effective program operations are, from both the perspective of program administrators and program participants. Typical process evaluations include program design, program administration, program implementation, participant experience including satisfaction, and barriers to participation. AEG reviewed each process evaluation to ensure that the evaluation approaches were in line with program goals and that each activity conducted was in-line with industry best practice.

Impact Evaluation Activities

The goal of impact evaluations is to quantify the effects of a program, including reductions in energy usage, demand, and often non-energy impacts including reduced emissions. AEG's review of impact evaluations focused on the overall process used for the evaluation, and whether the savings estimation approaches were in-line with industry best practice for each measure or measure category. Impact evaluation activities fall into three key categories:

- Measurement and verification (M&V). Measurement and verification activities determine gross savings at individual sites or for specific projects. They can include measurements in combination with engineering calculations, statistical analysis, or simulation modeling. Determining which M&V activities might be appropriate for specific projects or programs generally rely on the IPMVP, an international energy efficiency M&V guidance document. IPMVP options fall into four basic categories or options. AEG's review of impact evaluation M&V activities focused on ensuring that the appropriate IPMVP option was selected and applied.
    - Option A involves using a combination of stipulations and/or measurements of key factors combined with engineering models.
    - Option B, like Option A, includes the assessment of savings using key factors combined with engineering models. However, in Option B key factors should be measured rather than stipulated. Commonly measured parameters include hours of use, wattage, flow rates, etc.
    - Option C involves the use of whole-building meters or submeters to assess the savings of an entire building or facility. Data is often analyzed using regression approaches.
    - Option D involves calibrated simulation modes of systems, components, or whole-facility energy consumption. Common simulation programs include DOE-2 and EnergyPlus.

- Deemed savings. Deemed savings values are estimates of energy or demand savings for a single unit of an installed energy efficiency measure. These deemed values are developed based on prior analytical methods or metered data and are considered widely acceptable within the region and industry. For example, PacifiCorp routinely uses deemed savings values from RTF measure workbooks. When reviewing deemed savings estimates, AEG focused on ensuring that the correct savings estimate was applied to the correct measure, and that any algorithms are being calculated correctly based on collected data.
- Consumption data analysis. Consumption data analysis measures whole facility efficiency savings on average for a group of homes, buildings, or participants using experimental designs such as randomized control trials (RCTs) or quasi-experimental designs. These methods leverage large samples (or censuses) of residential or commercial billing data and are commonly used to estimate the impacts of residential behavior programs and whole-house retrofit or weatherization programs. AEG's review focused on the appropriateness of the experimental design and the actual savings estimation approach.

Reporting

Best practices in reporting include a clear description of the program, the evaluation goals, the data acquired and its validation, the sample design (if applicable), the savings methods employed, and the results of any process-related activities. Reports should be concise, but still include enough data so that results are transparent and easily understood. Backup documentation, such as survey instruments or derivations can be included in appendices. Mistakes should be minimal, and formatting should be consistent. Finally, recommendations should be forward-looking and actionable.

EM&V Checklist

Table 4-1 below presents the checklist used to conduct the EM&V reviews based on the best practices described above.

Table 4-1 EM&V Review Checklist

Component	Impact Evaluation	Process Evaluation
Data Validation	x	x
Data sources described	x	x
Cleaning and validation described	x	x
Tracking database review	x	x
Program Descriptions		x
Program Challenges and Successes		x
Database Management		x
Sample Design	x	x
Stratification	x	x
Confidence & Precision	x	x
Primary Data Collection		
Participant/Non-Participants Surveys	x	x
Interviews	x	x
Savings Estimates by Measure/Category		
M&V Approach (IMPVP)	x	

Component	Impact Evaluation	Process Evaluation
Deemed Approach	x	
Consumption Data Analysis (Billing analysis)	x	
Reporting / Transparency	x	x

Cost Effectiveness

AEG also 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:

- Washington Administrative Code Section 480-109-100 (8)[12]
- 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[13]
- PacifiCorp's 2014-2015 Biennial Conservation Plan (BCP), Appendix 3 on consistency with Council methodology[14]
- PacifiCorp's 2017 Integrated Resource Plan Volume 1[15]

Based on a review of these sources, AEG developed the checklist shown in Table 4-2, 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 Section 5.

Table 4-2 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 2017 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 2018 and/or 2019.

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

[13] 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

[14] PacifiCorp. 2014-2015 Biennial Conservation Report, Washington. www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/environment/dsm/washington/WA_2014-2015_Biennial_Report_Appendix.pdf

[15] PacifiCorp. 2017 Integrated Resource Plan, Volume I (April 4, 2017). www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2017-irp/2017_IRP_VolumeI_IRP_Final.pdf

Findings

For each program, AEG completed the Evaluation Checklist presented in Table 4-1 above, providing each category with a rating of Unknown, Gold Standard, Appropriate, or Inappropriate. The Evaluation Checklists and a brief discussion of the results are presented in the program-specific subsections that follow.

Home Energy Savings

AEG reviewed the 2017-2018 Residential Home Energy Savings program evaluation report, prepared by ADM Associates, and published December 4, 2019. AEG found that, overall, the EM&V approaches used for both the process and impact evaluations were appropriate and conform to industry best practices. In particular, the report was well-organized and clearly written with excellent documentation of the various methods used in the analysis. In addition, AEG noted efficient use of resources between the process and impact evaluations through the implementation of a general population survey to both establish in-service rates (ISRs) for the impact evaluation and achieve process-related research goals. Conversely, a couple of minor typographical errors were noted and an additional area for improvement would be to include the survey instruments as an appendix to the report.

Table 4-3 below summarizes the results of AEG's review of each component of the HES evaluation workplan.

Table 4-3 Home Energy Savings Evaluation Checklist

Component	Impact Evaluation Rating	Process Evaluation Rating
Data Validation	*Overall – Appropriate*	NA
Data sources described	Appropriate	NA
Cleaning and validation described	Appropriate	NA
Tracking Database Review	Appropriate	NA
Program Descriptions	NA	*Overall – Appropriate*
Program Challenges and Successes	NA	Appropriate
Database Management	NA	Appropriate
Sample Design	*Overall – Appropriate*	*Overall – Appropriate*
Stratification	Appropriate	Appropriate
Confidence & Precision	Appropriate	Appropriate
Primary Data Collection	*Overall - Appropriate*	*Overall - Appropriate*
Participant Surveys	Appropriate	Appropriate
Implementer Interviews	Appropriate	Appropriate
For Each Measure Type/Category	*Overall – Appropriate*	NA
Deemed Savings Approach	Appropriate	NA
Reasonableness of Results	Appropriate	NA
Reporting	*Overall – Appropriate*	*Overall – Appropriate*
Transparency	Appropriate	Appropriate
Documentation	Appropriate	Appropriate
Recommendations	Appropriate	Appropriate

Home Energy Reports

AEG reviewed the 2018-2019 Home Energy Reporting Program Workplan prepared by Cadmus and dated February 28, 2020. AEG found that, overall, the EM&V approaches presented in the work plan conformed to industry best practice. In particular, the energy savings estimation methods proposed were comprehensive, including validation of the randomized control trial (RCT), subgroup-level analysis, and channeling analysis representing an example of gold standard evaluation approaches. The results of AEG's review are presented in the table below; note that some areas are greyed out because they are only applicable to final reports, not work plans.

Table 4-4 below summarizes the results of AEG's review of each component of the HER evaluation workplan.

Table 4-4 Home Energy Reports Workplan Checklist

Component	Impact Evaluation Rating	Process Evaluation Rating
Data Validation	*Overall - Appropriate*	*Overall - Appropriate*
Data sources described	Appropriate	Appropriate
Cleaning and validation described	Appropriate	Appropriate
Tracking Database Review	Appropriate	NA
Program Descriptions	NA	NA
Program Challenges and Successes	NA	NA
Database Management	NA	NA
Sample Design	*Overall – Appropriate*	*Overall – Appropriate*
Stratification	Appropriate	Appropriate
Confidence & Precision	Appropriate	Appropriate
Primary Data Collection	*Overall - Appropriate*	*Overall - Appropriate*
Participant Surveys	Appropriate	Appropriate
Implementer Interviews	Appropriate	Appropriate
For Each Measure Type/Category	*Overall – Gold Standard*	NA
Consumption Data Analysis	Gold Standard	NA
Reasonableness of Results	NA	NA
Reporting	NA	NA
Transparency	NA	NA
Documentation	NA	NA
Recommendations	NA	NA

Low Income Weatherization

AEG reviewed the 2013-2015 Low Income Weatherization program evaluation report, prepared by Opinion Dynamics, and published January 10, 2018. AEG found that, overall, the EM&V approaches used for both the process and impact evaluations were appropriate and conform to industry best practices. In particular, the report was well organized and clearly written with excellent documentation of the various methods used in the analysis.

Table 4-5 below summarizes the results of AEG's review of each component of the Low Income Weatherization evaluation.

Table 4-5 Low Income Weatherization Evaluation Checklist

Component	Impact Evaluation Rating	Process Evaluation Rating
Data Validation	*Overall – Gold Standard*	NA
Data sources described	Gold Standard	NA
Cleaning and validation described	Appropriate	NA
Tracking Database Review	Appropriate	NA
Program Descriptions	NA	*Overall - Appropriate*
Program Challenges and Successes	NA	Appropriate
Database Management	NA	Appropriate
Sample Design	Census Approach	*Overall - Appropriate*
Stratification	NA	Appropriate
Confidence & Precision	NA	Unknown
Primary Data Collection	NA	*Overall - Appropriate*
Participant Surveys	NA	Appropriate
Agency Interviews	NA	Appropriate
For Each Measure Type/Category	*Overall - Appropriate*	NA
Consumption Data Analysis	Appropriate	NA
Reasonableness of Results	Appropriate	NA
Reporting	*Overall - Gold Standard*	*Overall - Gold Standard*
Transparency	Gold Standard	Gold Standard
Documentation	Gold Standard	Gold Standard

Wattsmart Business

AEG reviewed the 2016-2017 Wattsmart Business program evaluation report, prepared by Cadmus Group LLC, ADM Associates, and VuPoint Research and published November 6, 2018. AEG found that, overall, the EM&V approaches used for the process and impact evaluations were appropriate and conform to industry best practices. In particular, the report did an excellent job of documenting the review of the tracking database and providing an overview of the program, including program challenges and successes. Conversely, AEG noted that two aspects of the evaluation were not clearly explained in the body of the report or in the appendices: the validation approach used to prepare data for the impact and process activities and the sample expansion approach used to estimate population-level impacts. AEG also believes that due to the extremely small sample sizes achieved in the partial participant surveys, some caveats should have been provided to the reader indicating that the results were not likely representative of the larger population. Finally, AEG recommends that more detailed descriptions of the impact evaluation activities for each measure might be useful as an appendix.

Table 4-6 below summarizes the results of AEG's review of each component of the Wattsmart Business evaluation.

Table 4-6 Wattsmart Business Evaluation Checklist

Component	Impact Evaluation Rating	Process Evaluation Rating
Data Validation	Unknown	Unknown
Tracking Database Review	Gold Standard	Gold Standard

Component	Impact Evaluation Rating	Process Evaluation Rating
Program Descriptions	NA	*Overall - Gold Standard*
Program Challenges and Successes	NA	Gold Standard
Database Management	NA	Gold Standard
Sample Design	*Overall - Appropriate*	*Overall - Appropriate*
Stratification	Appropriate	Appropriate
Confidence & Precision	Appropriate	Unknown
Primary Data Collection	NA	*Overall - Appropriate*
Participant surveys	NA	Appropriate
Non-Participants Surveys	NA	Appropriate
Partial Participant Surveys	NA	Inappropriate
For Each Measure Type/Category	*Overall - Appropriate*	*Overall - Appropriate*
Deemed Savings Approach	Appropriate	Appropriate
M&V Approach	Appropriate	Appropriate
Reasonableness of Results	Appropriate	Appropriate
Reporting	*Overall - Minimum*	*Overall - Appropriate*
Documentation	Minimum	Appropriate
Transparency	Minimum	Appropriate
Recommendations	Appropriate	Appropriate

Cost-Effectiveness Analysis

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

Table 4-7 Evaluation Report Cost-Effectiveness Findings

Question	Wattsmart Business	Home Energy Savings	Low Income Weatherization
Is the Total Resource Cost Test, as modified by the Council, the primary cost-effectiveness test?	Yes	Yes	Yes
Are cost-effectiveness results also reported from the Utility Cost Test perspective?	Yes	Yes	Yes
Do benefits include a regional 10% conservation credit (PTRC test only)?	Yes	Yes	Yes
Did PacifiCorp appropriately summarize measure-level detail to develop program cost-effectiveness inputs?	Yes	Yes	Yes

Do line losses match values used to report portfolio-level savings?*	n/a	No	n/a
Do discount and inflation rates match PacifiCorp's 2017 IRP?*	n/a	No	n/a
Do benefit-cost ratios fall into expected ranges based on program type?	Yes	Yes	Yes

* Will only be reviewed for evaluation reports that cover 2018 and/or 2019.

Note, because the Home Energy Savings program evaluation was the only report to cover part of the 2018-2019 biennium, this is the only report for which AEG checked line losses, discount rates, and inflation rates against PacifiCorp's annual reports and Integrated Resource Plan (RIP). The only small issue identified in AEG's cost-effectiveness review was that it appears that some cost-effectiveness inputs may have been rounded in the Home Energy Savings program evaluation report (Table 4-8).

Table 4-8 Cost-Effectiveness Inputs Comparison

Cost-Effectiveness Input	Evaluation Report	Comparison
Line Losses	9.7%	9.67% (2018 Annual Report C/E Analysis)
Discount Rate	6.6%	6.57% (2017 IRP)
Inflation Rate	2.2%	2.22% (2017 IRP)

Recommendations

Based on our review of the evaluation reports, AEG developed the following recommendations for PacifiCorp's consideration.

- Including appendices with additional details including survey instruments and technical aspects, detailed methodologies, or rationale for impact evaluation activities would enhance transparency and comprehensiveness of evaluation reporting.
- AEG recommends that PacifiCorp ensure exact alignment between the source documents and cost-effectiveness inputs in future evaluation report cost-effectiveness analysis.

5

ANNUAL REPORT COST-EFFECTIVENESS REVIEW

Due to the timing of this study and because it is filed at the same time as PacifiCorp's 2018-2019 Biennial Conservation Report, AEG was not able to review cost-effectiveness analyses for the entire biennial period. Rather, AEG focused its review on the cost-effectiveness analysis in PacifiCorp's 2018 Annual Report. Because PacifiCorp's cost-effectiveness methodology did not change in 2019 and because both years' inputs are based on PacifiCorp's 2017 IRP, the 2018 Annual Report represents a reasonable proxy for the analysis and reporting that will be included in the full Biennial Conservation Report.

Methodology

The objective of the review 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 2018 Annual Report cost-effectiveness analysis, AEG reviewed specific inputs (e.g., program savings and costs, 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:

- Inputs to 2018 Annual Report cost-effectiveness analysis (WA 2018 Tables & Charts v4.xlsx)
- 2018 Annual Report Cost-Effectiveness Memos
- PacifiCorp's 2017 Class 2 Demand-Side Management Decrement Study (Decrement Study)
- Washington Administrative Code Section 480-109-100 (8)
- WUTC Order 01 in Docket UE-171092 accepting Pacific Power's 2018-2019 Biennial Conservation Target, specifically Condition 8 in Attachment A
- 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's 2014-2015 Biennial Conservation Plan, Appendix 3 on consistency with Council methodology
- PacifiCorp's 2017 Integrated Resource Plan (IRP) Volume 1 (April 4, 2017).

Best Practices

Cost-Effectiveness Test Definitions

PacifiCorp 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 (NAPEE Guide)[16] provides an overview of the industry-standard test perspectives (Table 5-1). For

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

each perspective, a "benefit-to-cost ratio" can be calculated 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 5-1 Overview of Standard Cost-Effectiveness Tests

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
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 costs of energy efficiency to resource savings and non-cash costs and benefits

Source: NAPEE Guide page 2-2

PacifiCorp includes five perspectives in its cost-effectiveness analysis and reporting: the first four form Table 5-1 plus the "PacifiCorp Total Resource Costs" (PTRC), which is the same as the Total Resource Cost Test, but with an additional 10% adder on the benefits, consistent with Commission direction and the Council's methodology. Per Commission guidance,[17] the PTRC test is the primary test used to assess the cost-effectiveness of the energy efficiency programs and portfolio.

Cost-Effectiveness Analysis Review Checklist

Based on a review of the sources listed above, AEG developed the checklist shown in Table 5-2, designed as a structured guide to check consistency with Commission guidance, Council methodology, and best practices for documentation and data presentation.

Table 5-2 2018 Annual Report Cost-Effectiveness Checklist

Question	2018 Annual Report 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

[17] WUTC Order 01 in Docket UE-171092 accepting Pacific Power's 2018-2019 Biennial Conservation Target, Attachment A, Condition 8(a), Jan 2018.

Question	2018 Annual Report Checklist
Non-electric impacts, where quantifiable and attributable	x
Regional 10% conservation credit (PTRC test only)	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 2017 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

Findings

In general, AEG found that PacifiCorp's 2018 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 2017 Class 2 Demand-Side Management Decrement Study to determine whether the avoided costs included the components dictated by the Council's methodology. The Class 2 DSM avoided costs incorporate a number of factors, including:

- Avoided Energy Costs
- Generation Deferral Costs
- Transmission Deferral Costs
- Distribution Deferral Costs

Additionally, the Council's analysis includes environmental externalities. 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 2018 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.

Discount and Inflation Rate

AEG reviewed PacifiCorp's 2017 Integrated Resource Plan (IRP)[18] to determine if the inflation rate and discount rates matched the values utilized in the 2018 Annual Report. The 2017 IRP utilized an annual escalation rate of 2.22% and a discount rate of 6.57% while the 2018 Annual Report utilized an annual escalation rate of 2.2% and a discount rate of 6.57%. AEG recommends that PacifiCorp ensure exact alignment between these values in future analysis.

[18]www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2017-irp/2017_IRP_VolumeI_IRP_Final.pdf

Non-Electric Impacts

Per PacifiCorp's Biennial Conservation Plan, there are three quantified non-energy impacts included in calculating the PacifiCorp Total Resource Cost.

- Quantifiable Non-Energy Impacts (NEIs). NEIs were included for residential programs, but not Wattsmart Business. In the 2018 Annual Report, it was not clear whether this is because there are no NEOs associated with the Wattsmart Business program or because PacifiCorp chose not to include NEIs in the analysis. We understand from discussions with PacifiCorp that they are currently working to include NEIs in future annual reports. In instances where no NEIs are being claimed, we recommend stating the reason explicitly in future reporting.
- Quantifiable Environmental Externalities. As noted above, we believe that a carbon cost is embedded in the 2017 Decrement Study to account for environmental externalities, however, this is not explicitly stated in either the Decrement Study or the 2018 Annual Report.
- 10% Power Act Credit. The 10% Power Act Credit is accounted for in the PacifiCorp Total Resource Cost Test.

Ongoing and Periodic O&M Costs

Per PacifiCorp's Biennial Conservation Plan, the PacifiCorp Total Resource Cost test should include ongoing and periodic operation and maintenance (O&M) costs where data are available. It is unclear if there are any O&M costs associated with the programs or where they appear in the analysis (i.e., they may be included as NEIs). AEG recommends explicitly stating whether O&M costs are included in the analysis and, if appropriate, separating them from other NEIs to align with how the Council defines categories of benefits.

Recommendations

In summary, AEG has the following recommendations regarding cost-effectiveness:

- Environmental externalities are a benefit considered by the Council. AEG believes that these are included in PacifiCorp's decrement study, but this is not explicitly stated. PacifiCorp has sufficiently addressed this issue 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 inflation rate stated in the 2018 Annual Report cost-effectiveness memo is 2.2%, as compared to a value of 2.22% in PacifiCorp's 2017 Integrated Resource Plan (IRP). While this small variance will not materially impact cost-effectiveness results, AEG recommends exactly aligning these values in the future as a best practice.
- To clarify alignment with Council methodology, AEG recommends making the inclusion of non-energy impacts and operation and maintenance costs (O&M) more explicit for all programs in future reporting.

6

PORTFOLIO SAVINGS VERIFICATION

This section describes AEG's methodology and findings from the verification of PacifiCorp's portfolio savings.

Methodology

In order to verify that PacifiCorp appropriately claimed savings during the 2018-2019 biennial period, for measures in major programs, AEG performed engineering desk review for a sample of applications from the Home Energy Savings and Wattsmart Business programs. As discussed in Section 1 of this report, because of the small total contribution to portfolio-level savings from the Low Income Weatherization program and the methods used to estimate savings from the Home Energy Reports program, these programs were excluded from the engineering review.

In addition to engineering desk review, AEG had planned to conduct site visits to verify the installation of a sample of Home Energy Savings program measures in late March. However, in early March, it became clear that the COVID-19 pandemic presented significant health risks to PacifiCorp customers and AEG staff, leading AEG and PacifiCorp to jointly agree to cancel in-person site visits. AEG explored several alternatives to in-person visits, including virtual site visits using video sharing and telephone and email interviews. Ultimately, it was determined that given the rapid spread of the virus in Washington, direction from local government officials, and PacifiCorp's desire to minimize requests of customers during this difficult time, none of these options were viable. As such, AEG's savings verification work for specific projects was performed solely through engineering desk review. Note, PacifiCorp's implementation contractors already perform on-site verification for a sample of projects.

Sample Design

It is important to recall that the purpose of the savings verification is not to repeat or replace traditional third-party EM&V, but to provide an additional level of validation for the savings being reported. As such, the sample design was not held to a specific level of confidence and precision (e.g., 90/10) but was guided by a desire to obtain 80% confidence and 20% precision for both the residential and non-residential samples.

For each program, AEG developed a stratified random sample based on the number of applications[19] by measure category. AEG then determined the required sample size for an 80/20 design and allocated the sample points proportionally by measure. The residential and non-residential sample each included 50 applications.[20] Table 6-1 and Table 6-2 present the samples for the Home Energy Savings and Wattsmart Business programs, respectively.

[19] AEG used the application as the sample point, therefore for any application that included multiple measures, all measures that were part of the application were included in the sample.

[20] AEG did not calculate final achieved precision in this context, however, the residential sample required 40 points for an overall 80/20 confidence/precision, while the commercial sample required 70 points.

Table 6-1 Home Energy Savings Sample Design

Measure Category	Avg kWh Savings	Application Count	Sample Size
Appliances	148	220	**5**
Building Shell	730	316	**10**
Energy Kits	384	3,735	**0**
HVAC	1,968	2,149	**25**
Water Heating	1,304	63	**5**
Whole Home	3,173	112	**5**
Total		**6,595**	**55**

Table 6-2 Wattsmart Business Sample Design

Measure Category	Avg kWh Savings	Application Count	Sample Size
Additional Measures	147,513	4	**0**
Building Shell	8,418	11	**2**
Compressed Air	167,030	15	**5**
Energy Management	363,082	16	**5**
HVAC	19,816	45	**5**
Irrigation	30,924	49	**5**
Lighting	44,545	616	**16**
Motors	50,042	16	**2**
Refrigeration	212,984	57	**5**
Total		**332**	**50**

Supporting Documentation Acquisition

For each project included in the engineering review sample, AEG requested supporting documentation from PacifiCorp that could be used to verify the evaluated savings, including invoices, applications, calculation files, and project savings verification reports. PacifiCorp was able to provide the required documentation for all sampled projects. While PacifiCorp was ultimately able to provide all requested supporting documentation, this process did identify some issues arising from the HES implementation vendor transition, which are discussed later in this Section.

Project Review

For each project in the sample, AEG reviewed the available documentation to verify that PacifiCorp had claimed the correct savings and to assess the robustness of supporting material. To guide this review, AEG developed a systematic approach to reviewing key documentation elements; the checklist used is provided in Appendix A to this report. Using this checklist, PacifiCorp developed an "info rating" for each project, ranging from one to five, with one representing the minimum information required to verify savings and five representing robust, best-in-class documentation that could be used to verify location, cost, incentives, and other project elements.

High-Level Cross-Check Analysis

After performing program-specific savings verification, AEG reviewed the workbooks used by PacifiCorp to calculate portfolio-level savings for the biennial period. To verify that claimed portfolio-level savings were appropriate, AEG reviewed the following:

- The aggregation of measure-level savings to the program level,
- The application of line losses to convert from program-level savings at the meter to savings at the generator,
- The conversion of annual to biennial savings for the Home Energy Reports program, accounting for the two-year measure life, and
- The summation of program-level savings to arrive at a portfolio-level savings value to compare to PacifiCorp's biennial target.

Findings

Through the engineering desk review and cross-check analysis, AEG did not identify any issues that would suggest adjusting claimed savings for the 2018-2019 biennium. However, AEG did identify some opportunities to improve documentation for future biennial periods, which are discussed below.

Home Energy Savings

For each of the 50 sampled HES projects, AEG was able to verify that the savings in the DSMC database matched the deemed savings found in the TRL database or project-specific calculations. Almost all (48) of these projects used deemed values and did not require calculations to determine savings. For those projects with site-specific calculations, the supporting documentation was used to calculate and verify the savings.

As discussed above, each project's supporting documentation was rated on a scale from one to five. In general, AEG found projects to be well documented with an average rating of 4.37 out of 5. While the primary objective of the engineering review was to verify savings, AEG also reviewed supporting documentation relating to measure life and incentives to identify any potential issues. Through this review, AEG verified that all projects used the correct measure life from the TRL.

Wattsmart Business

AEG was also able to verify savings for all sampled Wattsmart Business projects. In contrast to HES, only five of the sampled Wattsmart Business projects used deemed values, which AEG was able to verify against the values stored in the TRL. Of the remaining 45, 40 were standard offerings with site-specific calculations and five were custom projects, all of which were verified.

Overall, AEG found these projects to be well-documented, with an average rating of 4.25 out of 5. For custom projects, the actual savings calculation spreadsheets were not provided, but the projects' Savings Verification Reports (SVRs) were sufficient to verify the correct savings were claimed. AEG was also able to verify that measure lives assigned to all sampled projects in DSMC matched the TRL.

High-Level Cross-Check Analysis

AEG was able to confirm PacifiCorp's portfolio-level savings claim for the biennial period, by verifying that PacifiCorp appropriately:

- Aggregated measure-level savings to the program level,

- Applied line losses to convert from program-level savings at the meter to savings at the generator,
- Converted annual to biennial savings for the Home Energy Reports program, accounting for the two-year measure life, and
- Summed program-level savings to arrive at a portfolio-level savings value to compare to PacifiCorp's biennial target.

Recommendations

In summary, AEG has the following recommendations regarding portfolio savings verification:

- As discussed in the Findings subsection above, AEG found projects to be well-documented in general, however there are some opportunities to make project documentation more robust.
- While AEG was not able to conduct on-site verification as planned due to the COVID-19 virus, site visits are a valuable tool for verifying measure installation. AEG recommends PacifiCorp continue to consider including on-site verification in savings verification studies for future biennial periods.
- While PacifiCorp was ultimately able to provide supporting documentation for all sampled projects, the document acquisition process for this study was delayed as a result of data transfer processes during the HES implementation vendor transition. AEG understands that this type of major vendor transition does not occur often, so PacifiCorp may not need to review vendor transfer protocols again for several biennia. However, AEG recommends that the next time a major vendor transition does occur, PacifiCorp apply the lessons learned from this study's document acquisition process to ensure proper documentation is readily available.

A

ENGINEERING DESK REVIEW CHECKLIST

Table A-1 Engineering Desk Review Checklist

Verification Activity	Data Type	Parameter	Key Questions
General			Was complete project file readily available?
			Is info complete, well-organized, and understandable?
File Comparison w/Tracking Data	Identifiers	PacifiCorp project number	Match? (Y/N)
		Facility type	General sense of types of facilities
	Measure	Measure description	Described accurately enough to match documentation?
		Measure type	Match? (Y/N)
		Quantity	Match? (Y/N)
			Source of quantity info-invoices, other documents, inspections?
	Savings	Type of savings calculation	Deemed, Calculated, Custom
		kWh savings	Match? (Y/N)
		KWh ≠ reason	Note reason why savings values do not match
		Unit savings	If deemed, is UES correct for given measure?
		Measure life	Consistent across measure types?
	Costs	Measure cost	Match? (Y/N)
		Incentive Payment Amount	Match? (Y/N)
			Payment amount <= measure cost? Reasonable amount?
		Invoice Date	Date
			Contains appropriate detailed invoicing?
Verification/Inspection	PacifiCorp Site Visit	Inspection	Evidence of Pre / Post Inspection? (Y/N)
			Is location of business and measure(s) clearly described?
			Is the verification report complete and discrepancies documented?
Savings Detail	Deemed	Savings Values	Right value chosen?
			Deemed value up to date?
			Does UES * Qty. = Tracking savings?
	Typical	Savings Values	Appropriate calculator?
			Reasonable input(s)?
	Custom	Savings Values	Briefly describe data collection, calculation methods.
			Reasonable input(s)?
			Rely on measured data for baseline (where applicable)?
			Rely on measured data for as-built?

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