Appendix 1
Program and Portfolio-Level Cost-Effectiveness

MEMORANDUM

Date: October 25, 2013

To: Don Jones, Jr.

From: Aaron Jenniges and Ken Lyons

Re: WA Low Income Weatherization 2014-2015 Cost-Effectiveness

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The tables below present the cost-effectiveness findings of the Washington Low Income Weatherization program based on 2014-15 costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "CE inputs for tying to Table 1 business plan for 2014-2015 period 102213.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 49% load factor west residential whole house decrements. Table 1 shows the input assumptions.

Table 1: Low Income Weatherization Inputs

Input Description	2014-15
Discount Rate	6.88%
Residential Line Loss	9.67%
Inflation Rate	1.90%
Net-to-Gross	100%
Program Delivery and Administration	$1,840,000
Gross Site Savings (kWh)	475,272
Average Measure Life (years)	37

Table 2 shows the 2014-15 combined cost-effectiveness results. The WA Low Income Weatherization program was not cost-effective from any test perspective.

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Table 2: Low Income Weatherization 2014-15 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.250	$1,780,762	$709,079	($1,071,683)	0.40
Total Resource Cost Test (TRC) No Adder	$0.250	$1,780,762	$644,618	($1,136,145)	0.36
Utility Cost Test (UCT)	$0.250	$1,780,762	$644,618	($1,136,145)	0.36
Rate Impact Test (RIM)		$2,420,164	$644,618	($1,775,546)	0.27
Participant Cost Test (PCT)		$0	$639,401	$639,401	N/A
Lifecycle Revenue Impact ($/KWh)	0.000117906				
Discounted Participant Payback (years)	N/A				

These results do not include the non-energy benefits analyzed in the 2012 program evaluation, including the program's arrearage reduction, economic, and home repair benefit impacts. These benefits are shown in Table 3.

Table 3: Low Income Weatherization Non-Energy Benefits

Non-Energy Benefit	Program Impact	Perspective Adjusted
Arrearage Reduction	$7,125	PTRC, TRC
Economic Impact	$689,360	PTRC, RIM, UCT, TRC
Home Repair Benefits	$107,842	PCT, PTRC, TRC
Total	**$804,327**	

Table 4 shows the cost-effectiveness results of the program with the non-energy benefits included. The program is not cost-effective from any test perspective.

Table 4: Low Income Weatherization 2014-15 Cost-Effectiveness including Non-Energy Benefits

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.250	$1,780,762	$1,513,406	($267,356)	0.85
Total Resource Cost Test (TRC) No Adder	$0.250	$1,780,762	$1,448,945	($331,818)	0.81
Utility Cost Test (UCT)	$0.250	$1,780,762	$1,333,978	($446,785)	0.75
Rate Impact Test (RIM)		$2,420,164	$1,333,978	($1,086,186)	0.55
Participant Cost Test (PCT)		$0	$747,243	$747,243	N/A

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MEMORANDUM

Date: October 25, 2013

To: Don Jones, Jr.

From: Aaron Jenniges and Byron Boyle

Re: WA See-Ya-Later Refrigerator (SYLR) 2014-2015 Cost-Effectiveness

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The tables below present the cost-effectiveness findings of the Washington SYLR program based on 2014-15 costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "WA SYLR 2014-2015 Forecast_GHS for CE inputs 102213.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 49% load factor west residential whole house decrements. Table 1 show the input assumptions. Table 2 shows the 2014-15 combined cost-effectiveness results. The WA SYLR program was cost effective from all test perspectives except for the RIM.

Table 1: SYLR Inputs

Input Description	2014	2015	Total
Discount Rate	6.882%	6.882%	6.882%
Line Loss	9.67%	9.67%	9.67%
Inflation Rate	1.90%	1.90%	1.90%
Net-to-Gross	100%	100%	100%
Total Program Admin Costs	$192,749	$192,749	$385,498
Total Incentives	$45,633	$45,633	$91,266
Participant Measure Costs	$0	$0	$0
Gross Site Savings (kWh/year)	900,915	900,915	1,801,829
Average Measure Life (years)	6.59	6.59	6.59

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Table 2: WA SYLR 2014-15 Cost Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.035	$373,087	$785,681	$412,594	2.11
Total Resource Cost Test (TRC) No Adder	$0.035	$373,087	$714,256	$341,168	1.91
Utility Cost Test (UCT)	$0.044	$461,415	$714,256	$252,841	1.55
Rate Impact Test (RIM)		$1,373,842	$714,256	($659,587)	0.52
Participant Cost Test (PCT)		$0	$1,000,755	$1,000,755	N/A
Lifecycle Revenue Impacts ($/kWh)	$0.000019250				
Discounted Participant Payback (years)	N/A				

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MEMORANDUM

Date: October 25, 2013

To: Don Jones, Jr.

From: Aaron Jenniges

Re: WA Home Energy Savings (HES) 2014-2015 Cost-Effectiveness

---

The tables below present the cost-effectiveness findings of the Washington HES program based on 2014-15 costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "WA HES State Savings Summary 2014_Proposed - used for CE inputs 102313 EM.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 49% load factor west residential whole house decrements. Table 1 show the input assumptions.

Table 1: HES Inputs

Input Description	2014	2015	Total
Discount Rate	6.88%	6.88%	6.88%
Residential Line Loss	9.67%	9.67%	9.67%
Inflation Rate	1.90%	1.90%	1.90%
Net-to-Gross	100%	100%	100%
Utility Admin Costs	$140,000	$140,000	$280,000
Implementation Costs	$616,143	$660,376	$1,276,519
Incentives	$1,015,920	$1,296,154	$2,312,074
Participant Measure Costs	$2,395,829	$2,859,827	$5,255,657
Gross Site Savings (kWh/year)	7,312,374	8,677,822	15,990,196
Average Measure Life (years)	11.82	11.82	11.82

Table 2 shows the 2014-15 combined cost-effectiveness results. The WA HES program was cost effective from all test perspectives except for the RIM.

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Table 2: HES 2014-15 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.046	$6,576,499	$11,689,831	$5,113,332	1.78
Total Resource Cost Test (TRC) No Adder	$0.046	$6,576,499	$10,627,119	$4,050,620	1.62
Utility Cost Test (UCT)	$0.026	$3,733,600	$10,627,119	$6,893,519	2.85
Rate Impact Test (RIM)		$16,650,500	$10,627,119	($6,023,381)	0.64
Participant Cost Test (PCT)		$5,071,515	$15,145,516	$10,074,001	2.99
Lifecycle Revenue Impact ($/KWh)	0.000119763				
Discounted Participant Payback (years)	2.63				

These results do not include non-energy benefits (operations and maintenance and water savings) from showerheads, clothes washers, and lighting measures. The present value of these non-energy benefits and the test perspectives adjusted are shown in Table 3.

Table 3: HES Non-Energy Benefits

Non-Energy Benefit	Program Impact (Present Value)	Perspective Adjusted
Total	$5,640,857	PTRC, TRC, and PCT

Table 4 shows the cost-effectiveness results of the program with the non-energy benefits included. The program is cost-effective from all test perspectives except the RIM.

Table 4: HES 2014-15 Cost-Effectiveness including Non-Energy Benefits

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.046	$6,576,499	$17,330,687	$10,754,188	2.63
Total Resource Cost Test (TRC) No Adder	$0.046	$6,576,499	$16,267,975	$9,691,476	2.47
Utility Cost Test (UCT)	$0.026	$3,733,600	$10,627,119	$6,893,519	2.85
Rate Impact Test (RIM)		$16,650,500	$10,627,119	($6,023,381)	0.64
Participant Cost Test (PCT)		$5,071,515	$20,786,373	$15,714,858	4.10

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Washington
Home Energy Reporting Program
18 Month Evaluation Report
(8/1/2012 – 1/31/2014)

Presented to
Pacific Power
June 18, 2014

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E. Executive Summary

E.1. Program Description

Pacific Power's (PP) Home Energy Reporting (HER) program in Washington is designed to generate energy savings by providing residential customers with sets of information about their specific energy use and related energy conservation suggestions and tips. The information is provided in the form of Home Energy Reports that give customers various types of information, including: a) how their recent energy use compares to their energy use in the past; b) tips on how to reduce energy consumption, some of which are tailored to the customer's circumstances; and c) information on how their energy use compares to that of neighbors with similar homes. In other studies, this type of information has shown that customers are stimulated to reduce their energy use, creating average energy savings in the 1% to 2% range, depending on local energy use patterns.

E.2. Key Impact Findings

The HER program savings for the first year of the program are presented in Table E-1. Findings include:

- Total verified net program savings during the first 18 months of the program were 8,125 MWh.
- On average, participants reduced their electricity usage by 1.80% during the first 18 months of the program.
- As expected, savings "ramped up" over time, increasing from 1.42% in 2012 to 1.97% in 2013.
- Double counting of savings with Washington's Home Energy Savings and Appliance Recycling programs is relatively small –16 MWh, or 0.2% of total savings.
- Program savings at site, both in terms of MWh and percentage, increase with customer energy usage.

Table E-1. Program Electric Savings†

Type of Statistic	2012	2013	18 Months
Number of Participants		13,286	
Reported Savings (MWh)	1,778	5,516	-
Verified Savings (MWh)	1,675	5,841	8,141
Realization Rate	0.94	1.06	-
Percent Savings	1.42%	1.97%	1.80%
Verified Net Savings (MWh)‡	**1,670**	**5,830**	**8,125**

† All savings are at site.
‡Verified net savings are savings after netting out savings double counted with other EE programs.
Source: Navigant analysis.

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E.3. Program Cost Effectiveness

The cost effectiveness of utility-funded programs in Washington is typically analyzed using tests prescribed by the California Standard Practice Manual.[1] Overall the program is cost effective as determined by various industry-accepted tests. The program was found to be cost effective over its first 18 months for four of five standard cost-effectiveness tests: the Participant Cost Test (benefit/cost ratio ($0 participant cost), the Utility Cost Test (benefit/cost ratio of 2.24), the Total Resource Cost Test (benefit/cost ratio of 2.24), and the PacifiCorp Total Resource Cost Test (benefit/cost ratio of 2.46). The exception is the Rate Impact Test (benefit/cost ratio of 0.60), which restricts the cost-effectiveness analysis to the effect of a program on ratepayer bills. These tests generated qualitatively similar results for 2012 and for 2013. Section 6 presents the analysis of program cost effectiveness.

E.4. Recommendations

In light of the observed savings, Navigant recommends the following:

- Expand the program, especially to high usage customers. If the program is expanded, Navigant (or another third party) should receive the billing data for the new treatment and control households for the year before these households are added to the program, *before* the home energy reports are initially sent to the new treatment households. Navigant (or another third party) can verify that the allocation of households across the two groups is consistent with a randomized controlled trial.

- Consider evaluation of program demand savings. It is possible that customer energy savings are greater than average during peak demand hours. If the interval data necessary to estimate these savings is available, a fairly simple statistical analysis that takes advantage of the experimental design of the program could be used to estimate peak demand savings.

[1] The California Standard Practice Manual is an industry accepted manual; it identifies the cost and benefit components and cost-effectiveness calculation procedures from five major perspectives: Participant, Ratepayer Impact Measure (RIM), and Total Resource Cost (TRC). Definitions and methodologies of these cost-effectiveness tests can be found at http://www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF.

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1. Introduction

1.1 Program Description

Washington's Home Energy Reporting (HER) program is designed to generate energy savings by providing residential customers with information about their specific energy use and related energy conservation suggestions and tips. The information is provided in the form of home energy reports that illustrate: a) how customers' recent energy use compares to their energy use in the past; b) tips on how the customers can reduce energy consumption, some of which are tailored to each customer's unique circumstances; and c) information on how the customers' energy use compares to that of neighbors with similar homes. In other studies, this type of information has stimulated customers to reduce their energy use, creating average energy savings in the 1% to 2% range, depending on local energy use patterns.

An important feature of the program is that it is a randomized controlled trial (RCT). Eligible customers are randomly assigned to a participant group and a control group for the purpose of estimating changes in energy use due to the program.

The HER program was launched in August 2012, with the first reports generated on August 7, 2012. The initial deployment of the program involved 13,286 participants and 13,299 control customers. [2] There are two sources of decay in program participation over time. The first is customers who opt out of the program. Figure 1-1 shows the monthly number of participants choosing to opt out of the program, and the cumulative percentage of opt-outs, since the start of the program. Over the first 18 months, 1.09% of participants chose to opt out of the program. The second is customers who move from the residence. Figure 1-2 shows the cumulative percentage of move-outs over the course of the program for both participants and controls. The rate of program customer loss due to move outs is about 0.6% per month, and is virtually the same for participants and controls. Over the 18-month period of the program covered by this evaluation, 11.2% of both participant and control accounts had been shed from the program due to move outs.

[2] The initial dataset indicated records for 13,523 participants and 13,508 controls. The reduction to the actual number of participants and controls reported here is explained in section 2.4.

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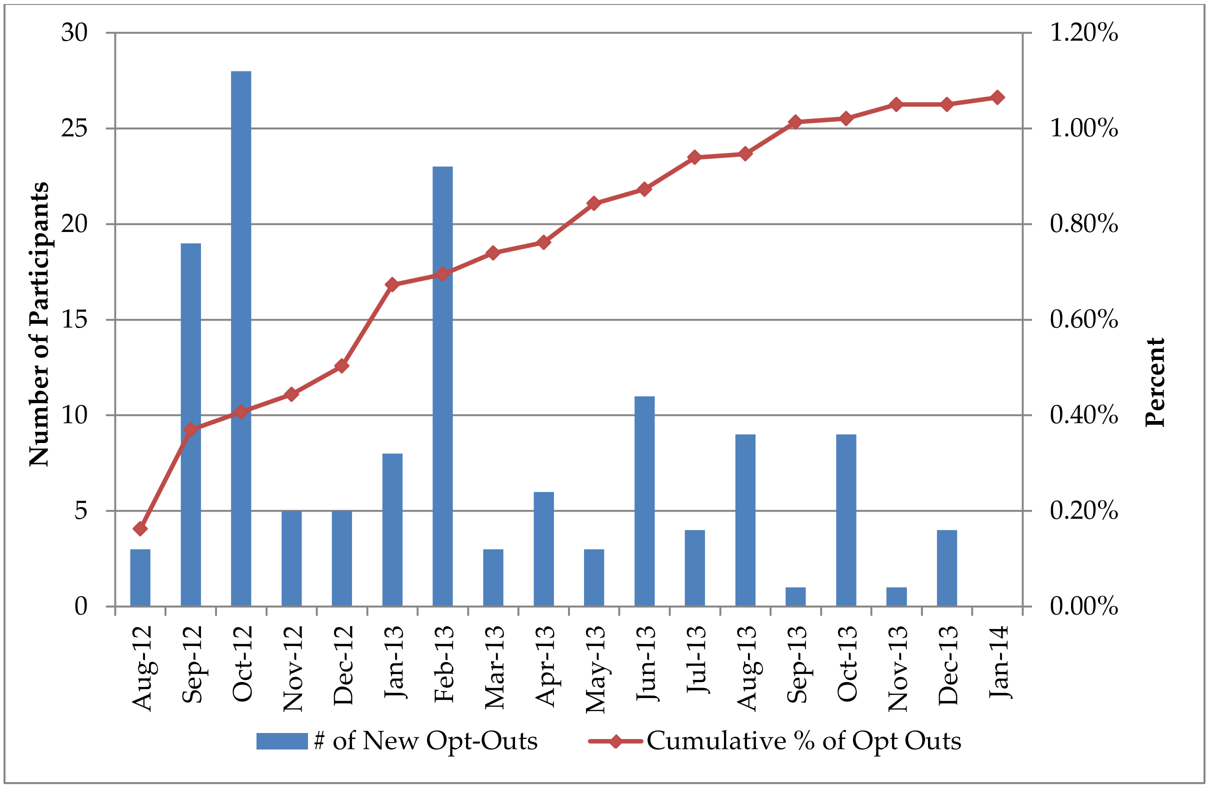
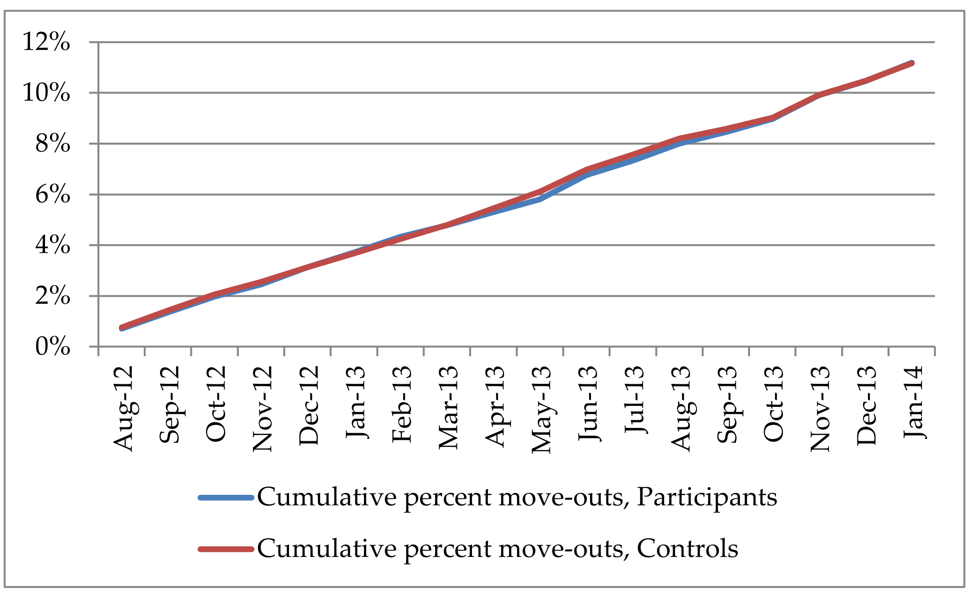
Figure 1-1. Customers Opting Out of the HER Program, First 18 Months



Source: Navigant analysis

Figure 1-2. Cumulative Percentage of Move-Outs, First 18 Months



Source: Navigant analysis

1.2 Evaluation Objectives

The primary objective of the analysis in this report is to determine the extent to which participants in the HER program reduced their energy consumption due to the program.

Secondary objectives are to report on customer satisfaction with the HER program, and on behavioral and information effects of the HER program, including effects on customer awareness and purchase of energy efficient appliances and customer awareness of Pacific Power's energy efficiency programs.

2. Impact Evaluation Approach

The impact evaluation approach Navigant employed in this analysis is consistent with the methodology described in the SEE Action report,[3] relying on statistical analysis appropriate for RCTs. This evaluation has three primary components: 1) checking the allocation of customers to the treatment and control groups for consistency with an RCT, 2) regression analysis to quantify program savings, and 3) quantification of double-counted savings from participation uplift in other energy efficiency programs. This section describes these components in more detail.

2.1 Statistical Consistency of the Program with an RCT

Navigant compared the monthly energy usage of the participant and control groups during the 12 month period prior to the start of the program (July 2011 through June 2012). If the allocation of the households across the participant and control groups is truly random, the two groups should have the same distribution of energy usage for each of the 12 months before the start of the program. For this analysis, Navigant compared the mean usage for each of the 12 months before the start of the program.

The results of the analysis indicate that the allocation of program households across the participant and control groups is consistent with an RCT design. Figure 2-1 depicts the average energy usage for participant and control households for the 12 months prior to the start of the HER program. The blue line indicates the average energy usage for the control group and the red dashed line indicates the average energy usage for the participant group. The two lines in each graph are nearly identical, indicating no difference in average usage patterns for the participant and control groups.

Navigant conducted a statistical test on the difference in the mean energy usage in each of the twelve months. Navigant found the difference to be statistically significant at the 90% confidence level in October 2011 and insignificant in all other months.[4] As an additional check, Navigant conducted a regression analysis in which average daily usage in the pre-program was a function of monthly binary variables and a binary participation variable. The parameter on the participation variable was not significant at the 90% confidence level, indicating no statistical difference in energy use between the participant and control groups prior to the start of the program. In light of these results, and as detailed in the next section, Navigant used a statistical method appropriate for use with RCTs to quantify the energy savings for the program.

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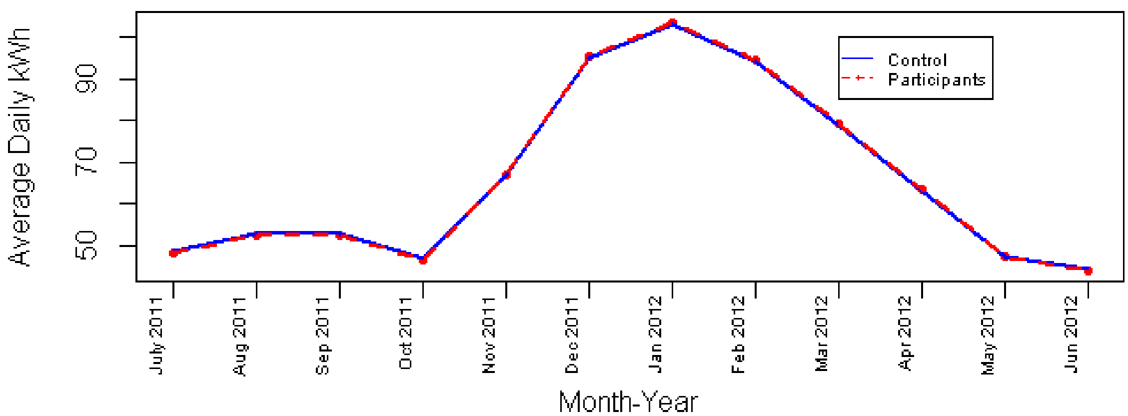
[3] Todd, A., E. Stuart, S.Schiller, and C. Goldman. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.* Lawrence Berkeley National Laboratory. May 2012. Available at: http://behavioranalytics.lbl.gov/

[4] The p-value for October 2011 was 0.098 –just significant at the 90% level. The percent difference in energy use between the two groups was 0.76% --i.e., less than 1%. Note that using a 90% confidence interval we would expect that, due to random chance alone, on average one out of every ten months will have a statistically significant difference in average consumption between treatment and control customers.

Figure 2-1. Average Daily Energy Use during the Pre-Program Year



Source: Navigant analysis

2.2 Net Impact Evaluation Methodology

Navigant estimated program impacts using two approaches: linear fixed effects regression (LFER) analysis applied to monthly billing data, and a simple post-program regression (PPR) analysis with lagged controls. We run both models as a robustness check. Although the two models are structurally very different, both generate unbiased estimates of program savings in an RCT.

A key feature of the RCT design of the HER program is that the analysis estimates net savings, not gross savings. While some customers receiving reports may have taken energy conserving actions or purchased high efficiency equipment in the absence of the program, the random selection of program participants (as opposed to voluntary participation) assures that on average their behavior in this regard would have been no different in the absence of the program than the actual average behavior of the control group. Thus, there is no free ridership, and no "net-to-gross" adjustment is necessary.

The LFER model combines both cross-sectional and time series data in a panel dataset. The regression essentially compares pre- and post-program billing data for participants and controls to identify the effect of the program. The customer-specific constant term ("fixed effect") is a key feature of the LFER analysis and captures all customer-specific effects on energy usage that do not change over time, including those that are unobservable. The fixed effect represents an attempt to control for any small systematic differences between the participant and control customers that might occur due to chance. Specifically, Navigant estimated the following regression model:

Equation 2-1. LFER Model

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Participant_k \cdot Post_t + \varepsilon_{kt} \,,$$

where,

ADC_{kt} = The average daily usage in kWh for customer *k* during billing cycle *t*. This is the dependent variable in the model.

$Post_t$ = A binary variable indicating whether bill cycle *t* is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).

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$Participant_k$	= A binary variable indicating whether customer k is in the participant group (taking a value of 1) or in the control group (taking a value of 0).
α_{0k}	= The customer-specific fixed effect (constant term) for customer k. The fixed effect controls for all customer-specific effects on energy usage that do not change over time.
α_1, α_2	= Regression parameters corresponding to the independent variables.
ε_{kt}	= The cluster-robust error term for customer k during billing cycle t. Cluster-robust errors account for heteroscedasticity and autocorrelation[5] at the customer level.

Average daily savings are indicated by the parameter α_2. Program savings are the product of the average daily savings estimate, the number of days in the post-period[6], and the number of participants.

As with the LFER model, the PPR model combines both cross-sectional and time series data in a panel dataset, but it uses the post-program data only, with lagged energy use for the same calendar month of the pre-program period replacing the customer-specific fixed effect as a control for any small systematic differences between the participant and control customers. In particular, energy use in calendar month m of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Formally, the model is,

Equation 2-2. PPR Model

$$ADC_{kt} = \beta_0 + \beta_1 ADClag_{kt} + \beta_2 Participant_k + \sum_j \beta_{3j} Month_j + \varepsilon_{kt} \ ,$$

where ADC_{kt} and $Participant_k$ are defined as in the LFER model, $ADClag_{kt}$ is customer k's energy use in the same calendar month of the pre-program year as the calendar month of month t, and $Month_j$ is a binary variable taking a value of 1 if the observation is in Month j and 0 otherwise. In this model β_2 is the estimate of average daily energy savings due to the program.

A minor complication to the use of this model in the analysis of 18-month savings is that the time lapse to the same pre-program calendar month is 12 months for the first 12 months of the program (August 2012-July2013), and 24 months for the last six months of the program (August 2013-January 2014). Concerned that the effect on post-program consumption of the pre-program variable can be different for a 12-month lag than for a 24-month lag, we used $ADClag1_{kt}$ for the case where the time lapse to the same pre-program calendar month was 12 months, and $ADClag2_{kt}$ for the case where it was 24 months. As it turns out, there was no statistically different effect across the two lag lengths.

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[5] Ordinary Least Squares (OLS) regression models assume the data are homoscedastic and not autocorrelated. If either of these assumptions is violated, the resulting standard errors of the parameter estimates are likely underestimated. A random variable is heteroscedastic when the variance is not constant. A random variable is autocorrelated when the error term in one period is correlated with the error terms in at least some previous periods.

[6] Savings accrue for participants with active accounts.

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Finally, to investigate how savings vary with usage level, Navigant divided the program participants and control customers into three equal-sized segments based on their usage during the pre-program year and estimated Equation 2-1 separately for each segment (high, medium, and low).

2.3 Uplift Analysis Methodology

The HERs include energy saving tips, some of which encourage participants to enroll in other energy efficiency (EE) programs offered by Pacific Power. If participation rates in other energy efficiency programs are the same for HER participants and controls, the savings estimates from the regression analysis are already "net" of savings from the other programs, as this indicates the HER program had no effect on participation in the other EE programs. However, if the HER program affects participation rates in other energy efficiency programs, then portfolio savings differ from the simple summation of savings in the HER and EE programs. For instance, if the HER program increases participation in other EE programs, the increase in savings may be allocated to either the HER program or the energy efficiency program, but cannot be allocated to both programs simultaneously. On the other hand, if the HER program generates *negative* participation in other EE programs –a negative spillover—as might happen, for instance, if the HER program encourages behaviors or actions that reduce the value to customers of participating in other EE program—then there is no double counting of savings. The negative savings associated with this negative spillover should be included as HER program savings because they represent a downward bias in the statistical estimate of HER program savings. In other words, because the statistical analysis does not account for the lower rate of EE participation by HER participants, estimated savings are lower than actual savings by an amount equal to the negative savings. Net verified savings are equal to the program savings less uplift savings.

Navigant used a difference-in-difference (DID) approach to estimate uplift in Washington's EE programs over the first 18 months of the HER program. This method uses differences between the participant and control groups in the rate of change in EE program participation to calculate the uplift in EE program participation due to the HER program. For instance, if the average annualized rate of participation in an EE program during the HER program is 5% for the participant group and 3% for the control group, and the rate of participation during the year before the start of the HER program is 2% for the participant group and 1% for the control group, then the annualized rate of uplift due to the HER program is 1%, as found in the calculation (5%-2%)-(3%-1%)=1%. Converting this annual rate of uplift to 18 months generates a value of 1.5%. The DID statistic generates an unbiased estimate of uplift when the baseline average rate of participation is the same for the participant and control groups, or when they are different due only to differences between the two groups in time-invariant factors.

Navigant examined the uplift associated with two energy efficiency programs: Appliance Recycling and Home Energy Savings (HES). It is not possible to state definitively the double-counted savings of the HER program and the portion of the HES program involving upstream energy efficient lighting (EEL) because it is not feasible to develop appropriate tracking data. A survey conducted as part of the program evaluation included two questions designed to provide an upper bound on the double counting of these savings. The first asked about the number of installed CFLs in the room in which the respondent is located while answering the survey. The second asked the respondent to walk through the residence, counting first the number of all lights turned on, and then counting the number of lights turned on that are CFLs (importantly, all surveys were done in the evening). If there is a statistical difference between participant and control customers in the average deployment and/or use of energy efficient lighting, and we assume that this difference is due *entirely* to the EEL program, and these observed differences are then extrapolated to average annual differences in energy use in a way that is reasonable and yet generous in the energy savings attributable to the EEL program, then we obtain an upper bound on the estimate of double counted savings. The specifics of these questions and the comparisons of responses for participants and controls are presented in section 4.2.1.

2.4 Data Used in the Impact Analysis

In preparation for the impact analysis, Navigant cleaned the data provided by the HER program implementer, Opower. The initial dataset indicated records for 13,523 participants and 13,508 controls. Navigant reached the count of verified customers used in the analysis –13,286 participants and 13,299 controls –as follows:

- Removed non-random "test" participants (7 participants);
- Removed duplicate records (6 participants, 6 controls);
- Removed customers for whom no observations remained after removing observations where bills were longer than the maximum allowed (40 days) or shorter than the minimum allowed (20 days) (0 participants, 1 control);
- Removed participants with no "first generation date" indicating a report was sent, and remove controls with a similar indication (224 participants, 202 controls).

In addition, Navigant removed the following observations:

- Observations with less than 20 days or more than 40 days in the billing cycle. These observations were removed because long and short bills can be an indication of an issue in the recording of energy use;
- Observations outside of the evaluation period, including the twelve month pre-program period and the post-program period;
- Outliers, defined as observations with average daily usage at least ten times larger or ten times smaller than the median usage.[7]

For the 18-month analysis, the removal of these additional observations reduced the total number of available observations from 771,311 to 763,233 total bills, a reduction of 1.1%. The percentage reductions for the 2012 and 2013 analyses were each 1.2%.

[7] As an example, the median usage for the 18-month analysis is 59.31 kWh per day, and so observations with usage greater than 593.1 kWh or less than 5.931 kWh per day were excluded from the analysis.

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3. Approach to Understanding Behavioral and Information Effects

Navigant conducted a telephone survey as part of the analysis of Washington's Home Energy Reporting program. The primary objective of the survey was to investigate the effect of the HER program on participation in the upstream energy efficient lighting program, in order to provide a basis for estimating double-counted savings with the lighting program. Secondary objectives included determining customer satisfaction with the HER program, and determining the effect of the HER program on customer awareness and purchase of energy efficient appliances and customer awareness of Pacific Power's energy efficiency programs. The survey was written by Navigant and programmed and fielded by The Dieringer Research Group (DRG) in March and April 2014. The survey instrument is presented in Appendix A.

3.1 Survey Sample Size

Based on prior studies performed by Navigant, the expected value of answers to the proposed survey questions, and a desired confidence/precision of 90/10 on binary questions, Navigant targeted 400 completed surveys divided evenly between participants and controls. The focus on the *difference* in responses between participants and controls reflects the understanding that it is this difference that indicates the effect of the HER program on respondent behaviors and attitudes.

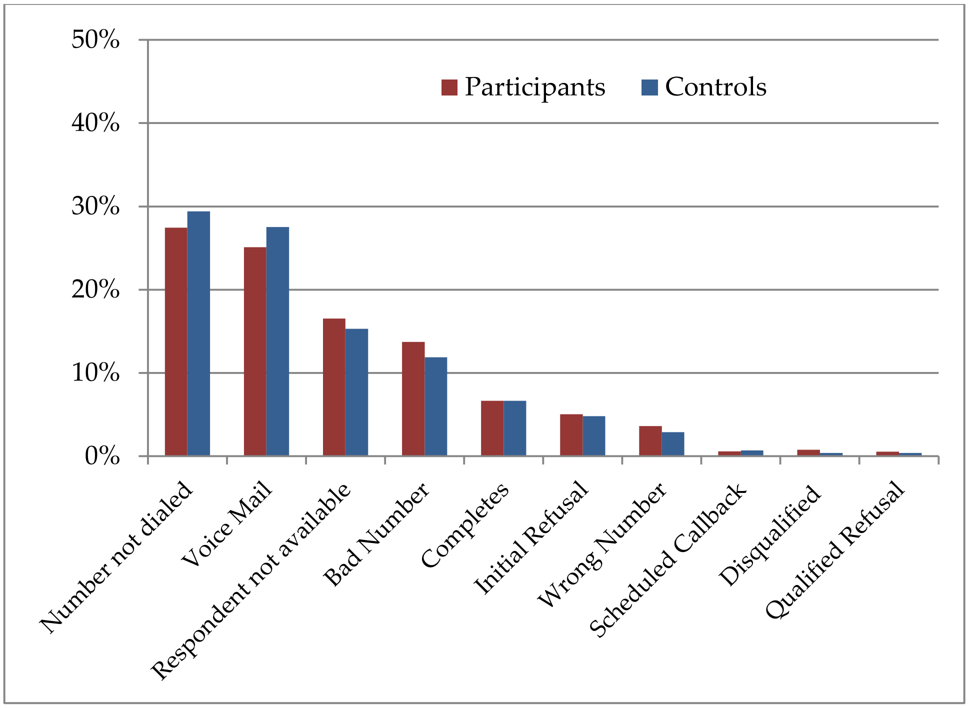
3.2 Survey Response Rates and Demographic Balance of Participant and Control Customers

To achieve the targeted sample of 200 surveys completed by participant households and 200 surveys completed by control households, Navigant provided DRG with a list of 3,000 randomly selecting participants and 3,000 randomly selected controls from the program. Figure 3-1 below presents the proportional dispensation of these 6,000 customers provided to DRG. If we define the response rate as the proportion of phone numbers dialed that generated a completed survey, then the response rate was about 9.2% for participants and 9.4% for controls.[8] If we instead define the response rate in terms of actually speaking to a household member, the response rate rises to 22.7% for the participants and 23.9% for the controls.[9]

[8] This value is found by dividing the proportion of the sample of 3,000 participant or control customers for which a survey was completed by the proportion for which a phone number was actually dialed. For instance, 27.4% of the sample of 3,000 participants were never dialed before the quota of 200 completed surveys was attained. It follows that 72.6% of customers were dialed. Dividing the 6.7% completes (200/3,000) by 72.6% gives a completion rate of 9.2%.

[9] This value is found by dividing the proportion of the sample of 3,000 participant or control customers for which a survey was completed (6.67% for both participants and controls) by the proportion for which a household member was reached –the sum of the proportions for "Completes" , "Respondent not available", "Initial refusal", "Scheduled Callback", and "Qualified refusal". For instance, for participants this involves dividing 6.7% by the sum of 6.7%, 16.5%, 0.6%, and 0.5% , generating a response rate of 22.7%.

Figure 3-1. Disposition of the 6,000 Customers in Survey Sample



Source: 2014 Navigant HER Program Survey

The participant and control groups are reasonably well balanced in the demographic variables. The mean square footage of survey participant and control customers is 2,124 and 2,069, respectively; the mean number of household members is 2.83 and 2.87, respectively. Survey respondents were asked about their annual household incomes using income categories. The two groups have similar percentages of customers with annual household incomes in the lowest category (<$25,000; 22% vs. 25%), and the highest category (>$250,000; 2% vs. 2%), and for both groups the median income lies in the income category $35,000-$50,000.

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4. Impact Evaluation Results

Navigant estimated the LFER and PPR models for three time periods:

- The first 18-months of the program (August 1, 2012 through January 31, 2014);
- 2012 (August 1, 2012 through December 31, 2012);
- 2013 (January 1, 2013 through December 31, 2013).

The LFER and PPR models generate very similar results for program savings in all three time periods. We use LFER results for reporting total program savings. Overall verified net program savings for the first 18-months of the program after excluding double-counted savings are 8,125 MWh.

4.1 Impact Parameter Estimates

Parameter estimates for the estimated models are presented Appendix B. Key findings include:

- For all three analysis periods the LFER *Post*Participant* parameter estimate is statistically significant at the 90% confidence level, as is the PPR *Participant* parameter estimate.
- The parameter estimates concerning 18-month energy savings generated by the LFER and PPR models are quite close, -1.187 and -1.189, respectively, and not statistically significantly different at the 90% confidence level.

Section 4.3 explains the calculation program savings.

4.2 Uplift of Savings in Other EE programs

LFER program savings include savings resulting from the uplift in participation in other energy efficiency programs caused by the HER program. To avoid double-counting of savings, program savings due to this uplift must be counted towards either the HER program or the other EE programs, but not both programs. The uplift of savings in other EE programs was a small proportion of the total savings: 16 MWh or 0.2 %.

Table 4-1 presents the details of the calculation of the double-counted savings due to uplift in other EE programs. The programs included in the uplift analysis were the Appliance Recycling program and the Home Energy Savings program.

Table 4-1. Estimated Double-Counted Savings from Uplift in other EE Programs, First 18 Months

	Program	
	Appliance Recycling	Home Energy Savings
Median program savings (annual kWh per participant)	1,215	203
# HER participant households	13,516	13,516
annualized rate of participation (%)	1.52%	1.66%
Change in annualized rate of participation from pre-program year (%)	-0.03%	-0.85%
# HER control households	13,508	13,508
annualized rate of participation	1.36%	1.57%
Change in annualized rate of participation from pre-program year (%)	-0.11%	-0.78%
annualized DID statistic	0.08%	-0.07%
DID statistic for 18 months	0.12%	-0.11%
Change in program participation due to HER program	16	-15
Statistically significant at the 90% confidence level?	No	Yes
Savings attributable to other programs (kWh)	**19,456**	**-3,026**

Source: Navigant analysis.

Note: Median program savings are equal to the median kWh impact for HER participants during the post-period.

The estimate of double-counted savings is surely an *overestimate* because it presumes participation in the other EE programs occurs at the very start of the program year. Under the more reasonable assumption that participation occurs at a uniform rate throughout the year, the estimate of double-counted savings would be approximately 8 MWh, half the estimated value of 16 MWh. The upshot is that double counting of savings with other PP energy efficiency programs for which tracking data is available is not a significant issue for the HER program.

4.2.1 Double-counting of savings with the HES upstream energy efficient lighting program

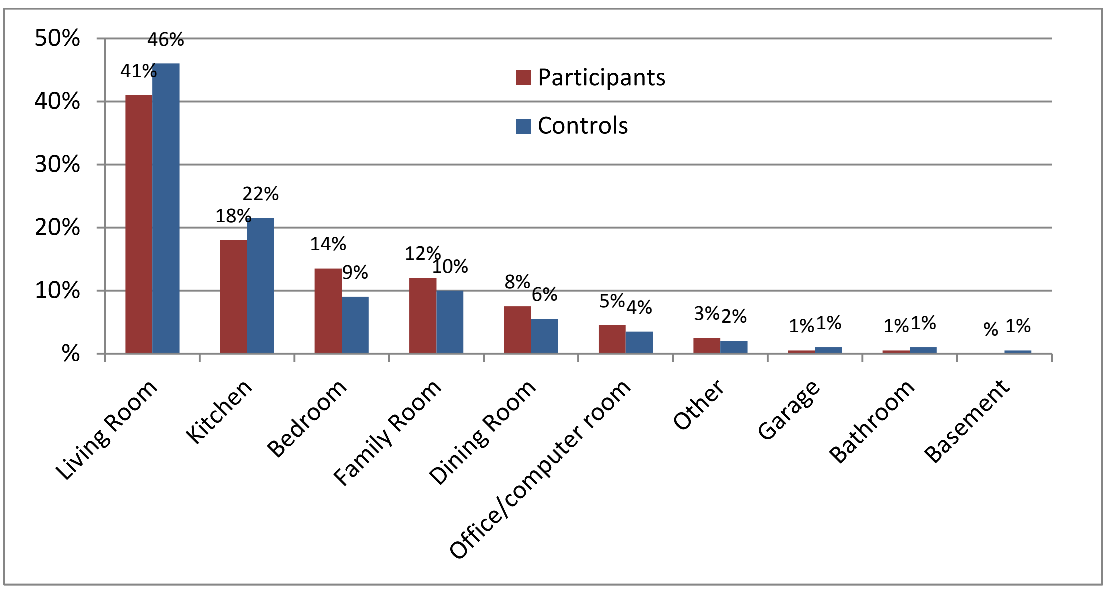
Due to a lack of tracking data, it is not possible to state definitively the double-counted savings of the HER program and the Home Energy Savings upstream energy efficient lighting (EEL) program. Navigant's approach to this issue is to use a set of survey questions to examine whether the HER program is in fact serving to increase the use of energy efficient lighting, and, if so, to derive an upper bound on the double-counting of savings, as described in section 2.3.

The first survey question relevant to this poses the following question about the lights in the room in which the survey respondent is located (question 2 in the survey, see the Appendix):

> *Please look around at the lights. How many of the light bulbs in the room are compact fluorescent lights, which are often called "CFL's"? I can wait if you need a minute to look around the room.*

The average installation of CFLs/room was 2.00 for participants and 1.87 for control customers; the difference between these values is not statistically different at the 90% significance level. Possibly this result is confounded by differences between participant and control customers in the distribution of types of rooms in which respondents were located; one might be concerned, for instance, that participants were more often in rooms with fewer lights, or with a lower likelihood of a CFL installation. To address this possibility, the survey asked respondents about the type of room in which they were located. Figure 4-1 shows that the distribution of rooms for both treatment and control customers was quite similar. Still, to address the possibility that even these small differences were a source of bias in the group-wise average difference in CFL installations, we also calculated a weighted average estimate of CFLs/room, where the weighting is based on the sample distribution of room types. The objective is to remove differences between participants and controls in the distribution of rooms as a source of differences between them in the average number of CFLs. So, for instance, because 18.6% of all respondents took the survey in their kitchen, the weight allocated to the average installed CFLs for kitchens—2.14 for the treatment group and 1.90 for the control group—is 0.186. This sample-weighted average is virtually no different than the unweighted average: 2.01 for participants and 1.87 for control customers.

Figure 4-1. Room Where Respondent Took the Survey



Source: 2014 Navigant HER Program Survey

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The second question used for this analysis is based on the actual use of CFLs, rather than their installation. The survey was conducted entirely in the evening hours between 6 PM and 10 PM, and asked the respondent to walk through the residence, counting the total number of all lights turned on, and to then repeat the walk-through, counting the number of CFLs turned on. In particular, the first of this pair of questions (question 3 in the survey, see the Appendix) stated,

> *Now I want to ask about the total number of lights that are currently **turned on** in your home, and the number of those that are CFL's.*
>
> *Let's begin with the **total** number of lights that are currently on. Beginning with the room you're currently in, please walk through your home and count the number of lights **of any type** that are **currently** turned on. Please don't turn off any of the lights that are currently on, because when you're done I'm going to ask you another question about the light bulbs that are currently on. If you need to put down the phone for this, I can wait.*

This was followed by the question (question 4 in the survey),

> *Next, please count the number of CFL's currently turned on in your home. Please don't include any lights you turned on as part of your walk-through.*

Double counting of savings is complicated by a potential behavioral response to the HER treatment: CFLs may be in lower use in participant households because these households are turning lights off more frequently. In fact, we found good evidence of this. The average number of lights turned on in participant households was 3.67, and the average number of lights turned on in control households was 4.57, a difference that is statistically significant at the 90% level. The HER program appears to cause customers to reduce their use of lighting by 20% in the evening. This behavioral effect tends to diminish the energy savings of the uplift in the EEL program due to the HER program; the HER program may increase the installation of CFLs in participant households, but their use may be no greater or even less than in control households due to behavioral effects. The survey revealed that indeed on average participants had *fewer* CFLs turned on than did control customers, 1.42 compared to 1.95, a statistically significant difference at the 90% confidence level, though the average *proportion* of CFLs in use by participants and controls was not statistically different, 38.6% for participants and 42.6% for controls.

Navigant also asked customers whether (a) they had seen materials encouraging them to purchase CFLs (question 5 in the survey), and (b) whether they had purchased at least one CFL in 2014 (question 6 in the survey). 65% of participants and 63% of control customers answered "Yes" to the first question, and 38% of treatment customers and 37% of control customers answered "Yes" to the second question. In neither case is the difference between treatment and control customers statistically significant.

In summary, there appears to be virtually no difference between participants and control customers in their installation of CFLs, nor in the proportion of lighting actually used in the evening that is provided by CFLs. Due to behavioral effects of the HER program, the level of use of CFLS by participants is lower than their use by control customers. There appears to be no difference between the two groups in the purchase of CFLs since the start of the year, or in awareness of messaging to purchase CFLs. Navigant concludes from these survey results that the savings estimate for the HER program is not double counting savings attributable to the upstream lighting program.

4.3 Verified Net Program Impact Results

Table 4-2 presents verified net savings results from the HER program. Savings are slightly higher than typical for first year behavior programs. On average participants reduced their usage by 1.80% during the first 18 months of the program. Verified net savings are calculated via the following equation:

Equation 4-1. Calculation of Verified Net Savings

$$Verified\ Net\ Savings = \frac{-\alpha_2 * Number\ of\ Program\ Days}{1000} - Double\ Counted\ Savings$$

Where α_2 is the parameter from Equation 2-1 that indicates average daily impacts from the LFER model in kWh (thus division by 1000 to convert the value to MWh), and the number of program days is the sum across all participants of the number of days during the specified period that a participant's account is active and they are receiving reports.[10] Total verified net program savings during the first 18 months of the program is 8,125 MWh.

[10] Customers who opt out of the program remain in the analysis because they might continue to generate savings after they opt out.

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Table 4-2. Net Program Savings and Uplift of Savings in Other EE programs

Type of Statistic	2012	2013	18 Months
Number of Participants†	13,286		
Number of Control Customers†	13,299		
Percent Savings	1.42%	1.97%	1.80%
Standard error:	*0.22%*	*0.20%*	*0.18%*
90% confidence bound:	*[1.06%, 1.78%]*	*[1.65%, 2.29%]*	*[1.51%, 2.09%]*
Average savings per customer (kWh)	124	432	602
Standard error:	*19*	*43*	*59*
90% confidence bound:	*[93, 155]*	*[362, 503]*	*[505,700]*
Verified Net Savings, Prior to Uplift Adjustment (MWh)‡	1,675	5,841	8,141
Standard error:	*257*	*578*	*801*
90% confidence bound:	*[1,253, 2,097]*	*[4,890, 6,793]*	*[6,824, 9,458]*
Savings Uplift in other EE programs (MWh)	4*	11*	16
Verified Net Savings (MWh)	**1,671**	**5,830**	**8,125**

†The initial data set contained records for 13,523 participants and 13,508 controls. See Section 2.4 for the derivation of the customer counts presented here (and used in the analysis) from the raw customer counts.
‡Net savings in units of kWh are provided in Appendix C.
**Savings uplift is a prorated value based on the analysis for the first 18 months of the program.*
Source: Navigant analysis.

4.4 Realization Rates for 2012 and 2013

Reported savings are 1,778 MWh for 2012 and 5,516 MWh for 2013.[11] Comparing these to the verified net savings prior to uplift reported in Table 4-2 (1,675 MWh for 2012 and 5,841 MWh for 2013) generates realization rates of 0.94 for 2012 and 1.06 for 2013.

[11] Reported savings are available in annual reports at www.pacificorp.com/es/dsm.html.

4.5 Analysis of Savings by Usage Level

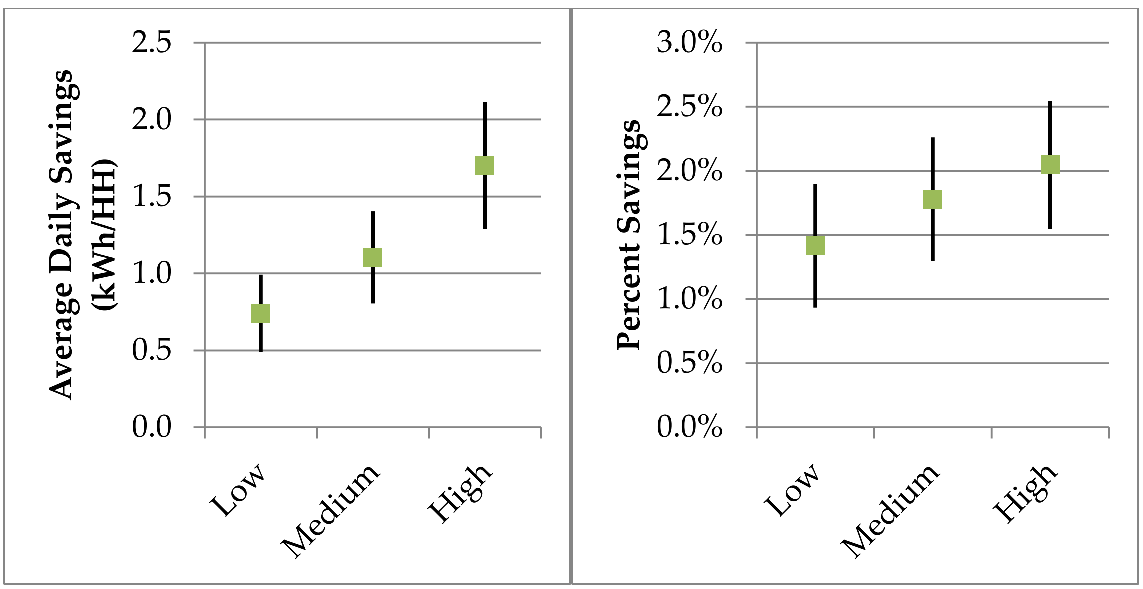
Navigant analyzed how program savings in the first 18 months of the program vary with usage level by segmenting program participants and controls into three equal-sized groups based on their pre-program usage level. Table 4-3 provides descriptive statistics and savings values for each of the three segments. Both actual and percentage savings increase with usage, as illustrated in Figure 4-2.

Table 4-3. 18-month Savings by Usage Level

Type of Statistic *Standard errors are provided in italics*	**Low Usage**	**Medium Usage**	**High Usage**
Number of Participants	4,423	4,398	4,465
Number of Controls	4,395	4,466	4,438
Pre-Program Annual Usage (kWh)	9,944 - 20,780	20,780 - 25,280	25,280 - 75,280
18-month Percent Savings	1.42% *0.29%*	1.78% *0.29%*	2.05% *0.30%*
Average 18-month savings per customer (kWh)	405 *84*	605 *100*	931 *138*

Source: Navigant analysis.

Figure 4-2. Absolute and Percent Savings by Usage Level, with 90% Confidence Interval



Source: Navigant analysis

5. Survey Results

The primary objective of the survey was to determine whether program savings are double counting savings from the HES upstream energy efficient lighting program. Results pertaining to this objective were presented in section 4.2.1. Here we present a discussion of results pertaining to secondary objectives for the survey.

5.1 Energy Efficiency Awareness and Purchase Behavior

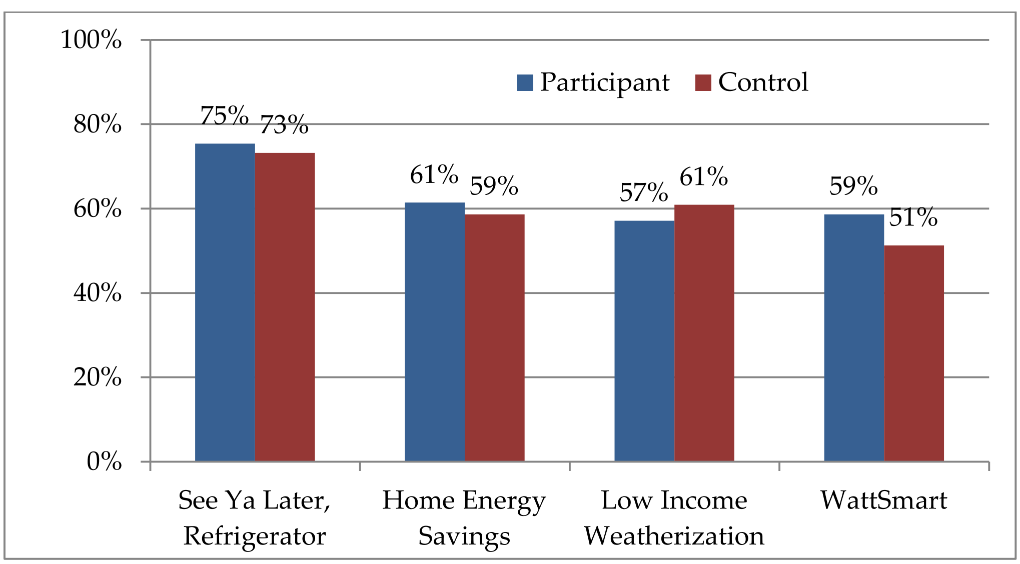
Navigant found no statistical differences between participants and controls with respect to the following:

- Recollection of seeing material from Pacific Power encouraging the purchase of CFLs (65% of treatment customers and 63% of control customers);
- Purchase of any CFLs since the start of 2014 (38% vs. 37%);
- The average number of bulbs purchased, conditional on a purchase since 2014 (6.69 bulbs vs. 6.75 bulbs);
- The presence of LEDs in the home (25% vs. 29%)
- Familiarity with the Energy Star label (79% vs. 82%)
- New television has an Energy Star label, conditional on having purchased a television over the past year (96% vs. 95%)

5.2 Awareness of Pacfic Power's Energy Efficiency Programs

Figure 5-1 compares treatment and control customers with respect to awareness of Pacific Power's energy efficiency programs. In no case was there a statistically significant difference between the two groups at the 90% significance level. Customers were most aware of the 'See Ya Later, Refrigerator' Program.

Figure 5-1. Proportion of Customers Aware of Pacific Power Energy Efficiency Programs



Source: 2014 Navigant HER Program Survey

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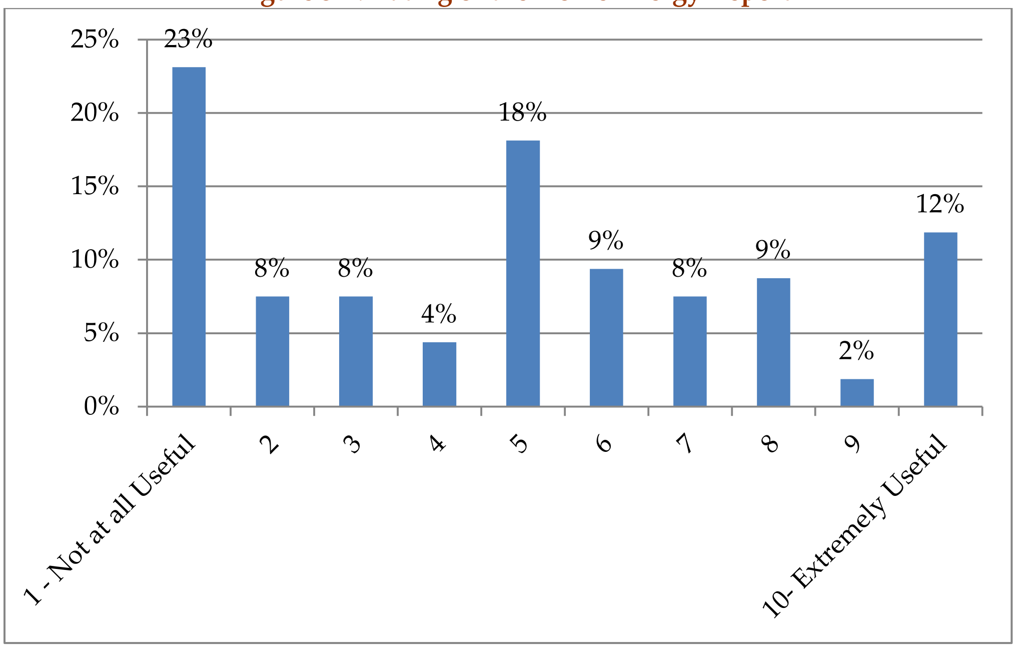
5.3 Satisfaction with the HER program

Eighty-eight percent of the treatment group remembered receiving the HER reports. As illustrated in Figure 5-2, customers were fairly evenly split in terms of their perception of the usefulness of the reports. Of those customers receiving the reports, 42% rated the report low (1-4 on the 10-point scale), 28% gave the reports an average rating, and 30% rated the report high (7-10 on the 10-point scale).

Figure 5-2. Rating of the Home Energy Report



Source: 2014 Navigant HER Program Survey

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6. Program Cost Effectiveness

Program cost effectiveness was evaluated for 2012, 2013, and the first 18 months of the program, August 2012-January 2014. The cost effectiveness of utility-funded programs in the state is typically analyzed using tests prescribed by the California Standard Practice Manual.[12] For the purposes of this evaluation, Pacific Power specifically required the following cost-effectiveness tests:

- Participant Cost Test (PCT);
- Utility Cost Test (UCT);
- Ratepayer Impact (RIM);
- Total Resource Cost Test (TRC); and
- PacifiCorp's Total Resource Cost Test (PTRC).

Table 6-1 presents details of these tests.

The evaluation team initialized and validated the cost-effectiveness model used for this evaluation. This model was calibrated using prior inputs and outputs from the previous evaluation cycle to ensure that similar inputs yielded similar outputs. The evaluation team worked through a range of input assumptions pertaining to avoided cost data formats, financial assumptions regarding discount and escalation rates, participant costs and benefits, and other input parameters.

Cost-effectiveness inputs were provided by Pacific Power staff, including data obtained from the 2011 IRP (for the 2012 analysis) and the 2013 IRP (for all other analyses), and include program cost inputs, program savings by measure, and measure life. Table 6-2 provides an overview of cost-effectiveness input values used by the evaluation team in the cost-effectiveness analysis.

[12] The California Standard Practice Manual is an industry-accepted manual; it identifies the cost and benefit components and cost-effectiveness calculation procedures from five major perspectives: Participant, Ratepayer Impact Measure (RIM), and Total Resource Cost (TRC). Definitions and methodologies of these cost-effectiveness tests can be found at http://www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF.

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Table 6-1. Details of Cost Effectiveness Tests[13]

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
Utility Cost Test	UCT	Will utility revenue requirements increase?	Comparison of program administrator costs to supply-side resource costs
Ratepayer Impact Measure	RIM	Will utility rates increase?	Comparison of program 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
PacifiCorp Total Resource Cost Test	PTRC	Will the total costs of energy in the utility service territory decrease when a proxy for benefits of conservation resources is included?	Comparison of program administrator and customer costs to utility resource savings with a 10% benefits adder.

Source: Navigant analysis

Table 6-2. HER Program Cost Effectiveness Evaluation Input Values

Variable	2012	2013	2014	18 months
	Input			
Discount Rate	6.88%	6.88%	6.88%	6.88%
Inflation Rate	1.90%	1.90%	1.90%	1.90%
Residential Line Loss	9.67%	9.67%	9.67%	9.67%
Residential Retail Rate	$0.0817	$0.0833	$0.0849	$0.0831
Gross Customer Costs	$0	$0	$0	$0
Program Costs	$100,257	$139,002	$13,009	$252,268
Utility Administrative	$28,976	$13,121	$550	$42,647
Program Delivery	$71,281	$125,881	$12,459	$209,621
Incentives Costs	$0	$0	$0	$0

Source: Navigant analysis

[13] "Understanding Cost Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy – Makers" NAPEE, November 2008. http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf.

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6.1 Cost Effectiveness Evaluation Results

The evaluation team calibrated and updated the cost-effectiveness models based on evaluated net savings prior to uplift adjustment, as reported in Table 4-2. We do not use saving after uplift adjustment because the adjustment reflects an issue of double counting with other programs, rather than an issue of overstating program savings. As Tables 6-3 to 6-5 indicate, for all three evaluation periods the program is cost effective for four of the five standard cost tests, with the exception being the Rate Impact Test (RIM).

Table 6-3. HER Program 2012 Benefit-Cost Ratios

Benefit/Cost Test Performed	Evaluated Gross Savings	Evaluated Net Savings	Evaluated Costs	Evaluated Benefits	B/C Ratio
PacifiCorp Total Resource Cost Test (PTRC)	1,675,000	1,675,000	$100,257	$148,499	1.48
Total Resource Cost Test (TRC)	1,675,000	1,675,000	$100,257	$134,999	1.35
Utility Cost Test (UCT)	1,675,000	1,675,000	$100,257	$134,999	1.35
Rate Impact Test (RIM)	1,675,000	1,675,000	$239,734	$134,999	0.56
Participant Cost Test (PCT)	1,675,000	1,675,000	$0	$139,477	N/A

Source: Navigant analysis

Table 6-4. HER Program 2013 Benefit-Cost Ratios

Benefit/Cost Test Performed	Evaluated Gross Savings	Evaluated Net Savings	Evaluated Costs	Evaluated Benefits	B/C Ratio
PacifiCorp Total Resource Cost Test (PTRC)	5,841,000	5,841,000	$139,002	$426,167	3.07
Total Resource Cost Test (TRC)	5,841,000	5,841,000	$139,002	$387,424	2.79
Utility Cost Test (UCT)	5,841,000	5,841,000	$139,002	$387,424	2.79
Rate Impact Test (RIM)	5,841,000	5,841,000	$634,801	$387,424	0.61
Participant Cost Test (PCT)	5,841,000	5,841,000	$0	$495,800	N/A

Source: Navigant analysis

Table 6-5. HER Program 18-Month Benefit-Cost Ratios

Benefit/Cost Test Performed	Evaluated Gross Savings	Evaluated Net Savings	Evaluated Costs	Evaluated Benefits	B/C Ratio
PacifiCorp Total Resource Cost Test (PTRC)	8,141,000	8,141,000	$252,268	$621,367	2.46
Total Resource Cost Test (TRC)	8,141,000	8,141,000	$252,268	$564,879	2.24
Utility Cost Test (UCT)	8,141,000	8,141,000	$252,268	$564,879	2.24
Rate Impact Test (RIM)	8,141,000	8,141,000	$941,604	$564,879	0.60
Participant Cost Test (PCT)	8,141,000	8,141,000	$0	$689,337	N/A

Source: Navigant analysis

7. Key Findings and Recommendations

7.1 Impact Key Findings and Recommendations

This section summarizes the key findings and associated recommendations.

Finding 1. The treatment and control groups had similar usage prior to the start of the program. Therefore Navigant employed a statistical method appropriate for use with RCTs to quantify the energy savings for the program.

Finding 2. The program generated 8,125 MWh of electric energy savings during the first 18 months of the program. On average, participants reduced their electricity usage by 1.80%. The savings appear to be typical for behavioral programs of this type.

Finding 3. The program is cost-effective.

Recommendation. Expand the HER program in its current form. If the program is expanded, Navigant (or another third party) should receive the billing data for the new treatment and control households for the year before these households are added to the program, *before* the home energy reports are initially sent to the new treatment households. Navigant (or third party) can verify that the allocation of households across the two groups is consistent with a randomized controlled trial.

Finding 4. Program savings, both in terms of kWh and percentage, increase with customer usage.

Recommendation. Future expansions of the program should continue to target high users to achieve the greatest program savings.

Recommendation. Consider an evaluation of program demand savings. It is possible that customer energy savings are greater than average during peak demand hours. If the interval data necessary to estimate these savings is available, a fairly simple statistical analysis that takes advantage of the experimental design of the program could be used to estimate peak demand savings.

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Appendix A. Survey Instrument

Pacific Power HER Program Pilot Participant and Non-participant Telephone Survey Guide, March 4, 2014

Introduction I

Hello, I'm [YOUR NAME] of Dieringer Research, calling on behalf of Pacific Power about energy efficiency programs that Pacific Power offers its customers to save energy. I want to emphasize that this is not a sales call; Pacific Power has asked that we ask their customers some questions for research purposes only.

May I speak with [CONTACT NAME]? (**IF NOT AVAILABLE, SAY:** May I speak with the person within the [LAST NAME] household who is most knowledgeable about your energy bill?) **[IF NO ONE AVAILABLE FROM HOUSEHOLD, SCHEDULE A CALL BACK.] [IF AVAILABLE INDIVIDUAL IS NOT FROM THE HOUSEHOLD LISTED IN THE CONTACT LIST, THANK AND TERMINATE]**

Introduction II

[**SKIP THIS SECTION IF THE PERSON WHO INITIALLY ANSWERED THE PHONE IS ALSO THE RESPONDENT**]

Hello, I'm [YOUR NAME] of Dieringer Research, calling on behalf of Pacific Power about energy efficiency programs that Pacific Power offers its customers to save energy. I want to emphasize that this is not a sales call; Pacific Power has asked that we ask their customers some questions for research purposes only.

Introduction III

Pacific Power is interested in how to better design energy efficiency programs to save their customers money on their utility bills. They have found that one of the best sources of information is to survey customers like you.

Several of the questions that we ask concern the amount of energy efficient lighting in the home. We know from past experience that responses to these questions are most accurate when respondents are free to walk around their home looking at the lighting. Is this a good time for that, or should we schedule a call for later? **[(IF RESPONDENT ASKS, SAY: The survey will take about 10** minutes, depending on your answers.) **IF NECESSARY, SCHEDULE A CALL BACK. THE CALL BACK NEEDS TO BE IN THE EVENING, WHEN LIGHTS ARE ON.] IF THERE IS A QUESTION ABOUT THE LEGITIMACY OF THE SURVEY THE PARTICIPANT MAY CALL SHAWN GRANT AT 801-220-4196.**

Your responses to our questions are strictly confidential. They will be averaged with those of other customers to evaluate the usefulness of Pacific Power's energy efficiency programs. This call may be monitored for quality assurance purposes.

CFL Bulbs

1. I want to start by asking you about the lights in the room that you're currently in.

   What type of room is it? (Don't Read)

   1-Kitchen

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2-Dining Room
3-Living Room
4-Bedroom
5-Family Room
6-Bathroom
7-Basement
8-Garage
9-Other: _____________

2. Please look around at the lights. How many of the light bulbs in the room are compact fluorescent lights, which are often called "CFL's"? I can wait if you need a minute to look around the room.

   Number: ____

3. Now I want to ask about the total number of lights that are currently **turned on** in your home, and the number of those that are CFL's.

   Let's begin with the ***total*** number of lights that are currently on. Beginning with the room you're currently in, please walk through your home and count the number of lights ***of any type*** that are ***currently*** turned on. Please don't turn off any of the lights that are currently on, because when you're done I'm going to ask you another question about the light bulbs that are currently on. If you need to put down the phone for this, I can wait. **[IF RESPONDENT ASKS ABOUT WHETHER TO COUNT LIGHTS THEY TURN ON TO HELP THEM GO THROUGH THE HOME, THE ANSWER IS NO –ONLY COUNT LIGHTS THAT ARE ALREADY ON].**

   Number of lights on: ____
   88 - Don't Know
   99 - Refused

4. Next, please count the number of CFL's currently turned on in your home. Please don't include any lights you turned on as part of your walk-through.

   Number of CFL's on: _____
   88 - Don't Know
   99 - Refused

5. Since the start of 2014, do you recall seeing information from Pacific Power that encourages you to replace traditional incandescent light bulbs with CFLs to save energy?

   1-Yes
   2-No
   88 - Don't Know

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99 - Refused

6. To the best of your recollection, has your household purchased Compact Fluorescent Light Bulbs (CFLs) since the start of 2014?

   1-Yes
   2-No
   88 - Don't Know
   99 - Refused

7. [IF YES on question 6, ask:] About how many CFLs has your household purchased in 2014?

   Number of CFL's purchased in 2014: _____

   88 - Don't Know
   89 99 - Refused

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8. Do you have any LED lights installed?
   1-Yes
   2-No
   88 - Don't Know
   99 - Refused

9. Are you familiar with the "Energy Star" label for appliances that meet national energy efficiency standards? Energy Star appliances could include such as televisions, dishwashers, washers and dryers.

   1-Yes - CONTINUE
   2-No – GO TO Q12
   88 - Don't Know – GO TO Q12
   99 - Refused – GO TO Q12

IF YES TO Q9:

10. Did you purchase a new television since January, 2013?
    1-Yes
    2-No – GO TO Q12
    88 - Don't Know – GO TO Q12
    99 - Refused - GO TO Q12

IF YES TO Q10:

11. Did the new television carry the Energy Star label?

    1-Yes
    2-No
    88 - Don't Know
    99 - Refused

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Usefulness of Home Energy Reports (SKIP THIS SECTION FOR NON-PARTICIPANTS)

12. Some customers of Pacific Power are in a program in which they receive home energy reports every two months. These reports provide customers with information on their energy use, how their energy use compares to similar customers, and gives customers energy-saving tips. Do you recall receiving any of these reports in the past 12 months?

    1-Yes
    2-No – GO TO Q14
    88 - Don't Know – GO TO Q14
    99 – Refused – GO TO Q14

13. If "Yes" on Question 12: On a scale of 1 to 10, with 1 being "not at all useful" and 10 being "extremely useful," how would you rate the average usefulness of the home energy reports for helping you to save energy? You may use any number from 1 to 10.
    -

Not at all useful									Extremely useful
1	2	3	4	5	6	7	8	9	10

88 – Don't Know (DO NOT READ)
99 – Refused (DO NOT READ)

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Satisfaction with Pacific Power

14. How would you rate your overall satisfaction with Pacific Power? Would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied or Very Dissatisfied?

1-Very Satisfied

2-Somewhat Satisfied

3-Neither Satisfied nor Dissatisfied

4-Somewhat Dissatisfied

5-Very Dissatisfied

88 - Don't Know

99 - Refused

Awareness of Pacific Power's other energy efficiency programs

15. Have you ever heard of the following energy efficient programs offered by Pacific Power?

1. **Home Energy Savings:** Pacific Power offers cash incentives to customers who install or upgrade the insulation in their home, buy energy-efficient electrical appliances and lighting for their home.

    - 1-Yes
    - 2-No
    - 88 - Don't Know
    - 99 – Refused
    -

2. **See Ya Later, Refrigerator/Refrigerator Recycling:** Company picks up and recycles your old working refrigerator or freezer. Participants receive $30

    - 1-Yes
    - 2-No
    - 88 - Don't Know

    99 – Refused

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3. **Low Income Weatherization:** Pacific Power works with local agencies to provide free weatherization services to income-qualifying customers.

- 1-Yes
- 2-No
- 88 - Don't Know

99 – Refused

4. **Wattsmart:** Pacific Power campaign to promote energy-efficiency and conservation and to educate customers on saving money on their utility bills.

- 1-Yes
- 2-No
- 88 - Don't Know
- 99 – Refused

Just a few more questions and we will be finished.

Demographics

16. What is the total square footage of your home's living space? Your best estimate will be fine.

___________ Square feet

88 - Don't Know
99 - Refused

17. How many people lived in your home during 2013?

Number: ____
88 - Don't Know
99 - Refused

18. What was your approximate household income in 2013? Please stop me when I say the answer that best reflects your approximate household income.

1. Up to $24,999
2. $25,000 - $34,999
3. $35,000 - $49,999
4. $50,000 - $74,999
5. $75,000 - $99,999
6. $100,000-$124,999

7. $125,000-$149,999
8. $150,000-$199,999
9. $200,000-$249,999
10. $250,000 or more

88 - Don't Know

99 - Refused

That is all of the questions I have for you today. Thank you very much for your time.

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Appendix B. Regression Coefficient Estimates

Table B-1. LFER Parameter Estimates

Variable	2012		2013		18 Months	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Post	-4.151	-46.02	-0.423	-4.64	-0.466	-5.65
Post * Participant	-0.836	-6.53	-1.301	-10.10	-1.187	-10.17

Source: Navigant analysis.

Note: T-statistics greater than 1.645 in absolute value indicate results are statistically significant at the 90% confidence level.

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Table B-2. PPR Parameter Estimates

Variable	2012		2013		18 Months	
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
ADClag1	0.766	192.46	0.810	179.81	0.790	216.59
ADClag2	-	-	0.833	182.05	0.824	184.63
Participant	-0.885	-7.13	-1.283	-10.10	-1.189	-9.99
August 2012	17.592	81.78	-	-	16.478	79.42
September 2012	9.242	43.87	-	-	8.123	40.16
October 2012	10.643	55.72	-	-	9.675	53.61
November 2012	8.334	31.61	-	-	6.867	27.80
December 2012	7.716	20.85	-	-	5.574	16.50
January 2013	-	-	18.656	41.92	20.647	56.75
February 2013	-	-	16.113	39.75	17.928	53.88
March 2013	-	-	9.581	28.10	11.097	39.58
April 2013	-	-	5.630	20.05	6.835	29.37
May 2013	-	-	10.183	46.51	11.079	60.42
June 2013	-	-	8.908	42.38	9.745	55.35
July 2013	-	-	13.517	60.04	13.879	61.88
August 2013	-	-	13.815	56.95	14.216	59.02
September 2013	-	-	8.121	33.91	8.527	35.92
October 2013	-	-	9.369	42.74	9.723	45.08
November 2013	-	-	4.506	14.85	5.033	17.05
December 2013	-	-	17.647	41.49	18.400	44.71
January 2014	-	-	-	-	14.993	33.25

Source: Navigant analysis.

Note: T-statistics greater than 1.645 in absolute value indicate results are statistically significant at the 90% confidence level.

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Appendix C. Program Savings in kWh

Type of Statistic *Standard errors are provided in italics*	**2012**	**2013**	**18 Months**
Number of Participants	13,286		
Number of Control Customers	13,299		
Percent Savings	1.42% *0.22%*	1.97% *0.20%*	1.80% *0.18%*
Average savings per customer (kWh) †	124 *19*	432 *43*	602 *59*
Verified Net Savings, Prior to Uplift Adjustment (kWh)	1,674,797 *256,578*	5,841,197 *578,369*	8,141,078 *800,558*
Savings Uplift in other EE programs (kWh)	4,564	10,953	16,430
Verified Net Savings (kWh)	**1,670,234**	**5,830,244**	**8,124,648**

†*All reported savings in this table are at site*

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1375 Walnut Street
Suite 200
Boulder CO 80302
303.728.2500 phone
303.728.2501 fax

Memorandum

To: **Don Jones Jr., PacifiCorp/Rocky Mountain Power**

From: **David Basak, Navigant**

Date: **July 15, 2014**

Re: **OPOWER Residential Program Cost Effectiveness and Program Design – Washington**

Navigant has developed this memo in response to PacifiCorp's proposed OPOWER program cost effectiveness modeling needs for the residential sector in the state of Washington.

This memo presents the cost effectiveness results of individual analysis runs and a compilation of combined years for the state of Washington. Each scenario is analyzed using the expected results for the 35K Expansion Only option with modeled assumptions provided by OPOWER. These scenarios utilize the following assumptions:

- ***Avoided Costs:*** All scenarios use the "West - Residential Whole House" decrement value stream provided in the 2013 PacifiCorp Integrated Resource Plan.
- ***Modeling Inputs:*** Navigant utilized measure savings and costs provided by OPOWER to PacifiCorp. The program savings are assumed to include a 2-4% discount for overlap with existing rebate programs.
- ***Net-to-Gross:*** Along with OPOWER's discount, an additional Net-to-Gross Ratio of 99% was used to account for a conservative estimate of 1% attribution to other DSM programs.
- ***Energy Rates:*** Navigant utilized the 2013 rates provided by PacifiCorp and applied an escalation of 1.9% to arrive at estimated rates for PY2014-2017.
- ***Incremental Costs:*** $0 incremental costs were assumed for customers, because all net impacts are assumed to be zero-cost behavioral actions.
- ***Lifetime:*** This analysis ran two separate scenarios for the measure lifetime associated with behavioral measures; the first made a conservative assumption of a one-year measure life and the second assumed a two-year measure life.

This memo will begin by addressing the inputs for PY2014-2017 for the OPOWER program. The cost-effectiveness inputs are as follows:

Table 1 –Cost Effectiveness Analysis Inputs

Parameters	2014	2015	2016	2017
Discount Rate for all B/C Tests	6.88%	6.88%	6.88%	6.88%
Line Loss Factor - Energy (%)	9.67%	9.67%	9.67%	9.67%
Residential Energy Rate ($/kWh)	$0.085	$0.086	$0.088	$0.090
Net-to-Gross Ratio	99%	99%	99%	99%
Escalation Rate	1.9%	1.9%	1.9%	1.9%

Table 2 –Annual Program Costs for PY 2014-2017 1 Year and 2 Year Measure Life (Source: PacifiCorp)

Scenario	Incentives ($)	OPower ($)	Randomization ($)	PC Internal - Admin ($)	Total Program Costs ($)
Program Year 2014	$0	$133,096	$5,868	$11,360	**$150,324**
Program Year 2015	$0	$288,244	$0	$27,264	**$315,508**
Program Year 2016	$0	$299,276	$0	$27,264	**$326,540**
Program Year 2017	$0	$316,428	$0	$27,264	**$343,692**
Program Year 2014-2017	$0	$1,037,044	$5,868	$93,152	**$1,136,064**

Table 3 –Annual Program Savings at Site for PY 2014-2017 in kWh (Source: OPOWER)

Scenario	Gross Annual Energy Savings at Site (kWh)	Net Annual Energy Savings at Site (kWh)	Gross Annual Energy Savings at Generator (kWh)	Net Annual Energy Savings at Generator (kWh)
1 Year Measure Life - PY2014	584,000	578,160	640,473	634,068
1 Year Measure Life - PY2015	5,831,004	5,772,694	6,394,862	6,330,913
1 Year Measure Life - PY2016	7,083,996	7,013,156	7,769,018	7,691,328
1 Year Measure Life - PY2017	6,891,000	6,822,090	7,557,360	7,481,786
1 Year Measure Life - PY2014-2017	**20,390,000**	**20,186,100**	**22,361,713**	**22,138,096**
2 Year Measure Life - PY2014	584,000	578,160	640,473	634,068
2 Year Measure Life - PY2015	5,831,004	5,772,694	6,394,862	6,330,913
2 Year Measure Life - PY2016	12,331,000	12,207,690	13,523,408	13,388,174
2 Year Measure Life - PY2017	6,891,000	6,822,090	7,557,360	7,481,786
2 Year Measure Life - PY2014-2017	**25,637,004**	**25,380,634**	**28,116,102**	**27,834,941**

The PY 2014-2017 cost/benefits results for the 35K Expansion Option assuming a 1-Year Measure Life are as follows:

Table 4 –PY 2014 Cost/Benefit Test Results - 35K Expansion (1-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.2730	$150,324	$43,202	($107,122)	0.29
Total Resource Cost Test (TRC) No Adder	$0.2730	$150,324	$39,274	($111,050)	0.26
Utility Cost Test (UCT)	$0.2730	$150,324	$39,274	($111,050)	0.26
Rate Impact Test (RIM)		$200,332	$39,274	($161,058)	0.20
Participant Cost Test (PCT)		$0	$50,513	$50,513	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000040128	
Discounted Participant Payback (years)				n/a	

Table 5 – PY 2015 Cost/Benefit Test Results - 35K Expansion (1-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0574	$315,508	$443,537	$128,029	1.41
Total Resource Cost Test (TRC) No Adder	$0.0574	$315,508	$403,216	$87,708	1.28
Utility Cost Test (UCT)	$0.0574	$315,508	$403,216	$87,708	1.28
Rate Impact Test (RIM)		$824,307	$403,216	($421,091)	0.49
Participant Cost Test (PCT)		$0	$513,938	$513,938	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000104853	
Discounted Participant Payback (years)				n/a	

Table 6 – PY 2016 Cost/Benefit Test Results - 35K Expansion (1-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0489	$326,540	$564,144	$237,604	1.73
Total Resource Cost Test (TRC) No Adder	$0.0489	$326,540	$512,858	$186,318	1.57
Utility Cost Test (UCT)	$0.0489	$326,540	$512,858	$186,318	1.57
Rate Impact Test (RIM)		$956,416	$512,858	($443,558)	0.54
Participant Cost Test (PCT)		$0	$636,239	$636,239	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000109939	
Discounted Participant Payback (years)				n/a	

Table 7 – PY 2017 Cost/Benefit Test Results - 35K Expansion (1-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0529	$343,692	$583,504	$239,812	1.70
Total Resource Cost Test (TRC) No Adder	$0.0529	$343,692	$530,459	$186,767	1.54
Utility Cost Test (UCT)	$0.0529	$343,692	$530,459	$186,767	1.54
Rate Impact Test (RIM)		$968,050	$530,459	($437,591)	0.55
Participant Cost Test (PCT)		$0	$630,664	$630,664	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000108543	
Discounted Participant Payback (years)				n/a	

Table 8 – PY 2014-2017 Cost/Benefit Test Results - 35K Expansion (1-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0591	$1,136,064	$1,634,387	$498,323	1.44
Total Resource Cost Test (TRC) No Adder	$0.0591	$1,136,064	$1,485,806	$349,742	1.31
Utility Cost Test (UCT)	$0.0591	$1,136,064	$1,485,806	$349,742	1.31
Rate Impact Test (RIM)		$2,949,105	$1,485,806	($1,463,298)	0.50
Participant Cost Test (PCT)		$0	$1,831,354	$1,831,354	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000090912	
Discounted Participant Payback (years)				n/a	

The PY 2014-2017 cost/benefits results for the 35K Expansion Option assuming a 2-Year Measure Life are as follows:

Table 9 –PY 2014 Cost/Benefit Test Results - 35K Expansion (2-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.1398	$150,324	$44,422	($105,902)	0.30
Total Resource Cost Test (TRC) No Adder	$0.1398	$150,324	$40,384	($109,940)	0.27
Utility Cost Test (UCT)	$0.1398	$150,324	$40,384	($109,940)	0.27
Rate Impact Test (RIM)		$248,009	$40,384	($207,626)	0.16
Participant Cost Test (PCT)		$0	$98,672	$98,672	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000051730	
Discounted Participant Payback (years)				n/a	

Table 10 – PY 2015 Cost/Benefit Test Results - 35K Expansion (2-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0294	$315,508	$464,360	$148,852	1.47
Total Resource Cost Test (TRC) No Adder	$0.0294	$315,508	$422,145	$106,637	1.34
Utility Cost Test (UCT)	$0.0294	$315,508	$422,145	$106,637	1.34
Rate Impact Test (RIM)		$1,309,389	$422,145	($887,244)	0.32
Participant Cost Test (PCT)		$0	$1,003,921	$1,003,921	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000220926	
Discounted Participant Payback (years)				n/a	

Table 11 – PY 2016 Cost/Benefit Test Results - 35K Expansion (2-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0144	$326,540	$1,044,144	$717,604	3.20
Total Resource Cost Test (TRC) No Adder	$0.0144	$326,540	$949,222	$622,682	2.91
Utility Cost Test (UCT)	$0.0144	$326,540	$949,222	$622,682	2.91
Rate Impact Test (RIM)		$2,468,265	$949,222	($1,519,044)	0.38
Participant Cost Test (PCT)		$0	$2,163,359	$2,163,359	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000376507	
Discounted Participant Payback (years)				n/a	

Table 12 – PY 2017 Cost/Benefit Test Results - 35K Expansion (2-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0271	$343,692	$550,009	$206,317	1.60
Total Resource Cost Test (TRC) No Adder	$0.0271	$343,692	$500,008	$156,316	1.45
Utility Cost Test (UCT)	$0.0271	$343,692	$500,008	$156,316	1.45
Rate Impact Test (RIM)		$1,563,304	$500,008	($1,063,297)	0.32
Participant Cost Test (PCT)		$0	$1,231,932	$1,231,932	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000263748	
Discounted Participant Payback (years)				n/a	

Table 13 – PY 2014-2017 Cost/Benefit Test Results - 35K Expansion (2-Year Measure Life)

Benefit/Cost Test Performed	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conversation Adder	$0.0241	$1,136,064	$2,102,934	$966,870	1.85
Total Resource Cost Test (TRC) No Adder	$0.0241	$1,136,064	$1,911,758	$775,694	1.68
Utility Cost Test (UCT)	$0.0241	$1,136,064	$1,911,758	$775,694	1.68
Rate Impact Test (RIM)		$5,588,968	$1,911,758	($3,677,210)	0.34
Participant Cost Test (PCT)		$0	$4,497,883	$4,497,883	n/a
Lifecycle Revenue Impacts ($/kWh)				$0.000228459	
Discounted Participant Payback (years)				n/a	

CADMUS

MEMORANDUM

Date: October 29, 2013

To: Don Jones, Jr.

From: Aaron Jenniges

Re: WA Business Program 2014-2015 Cost-Effectiveness Summary

The tables below present the cost-effectiveness findings of the Washington Business Program based on 2014-15 costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "Copy of 2014-2015 Business Plan Tables 10232013 - REV for Energy management 102613.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 71% load factor west system decrements. Table 1 shows the financial input assumptions.

Table 1: Business Program Financial Inputs

Input Description	2014	2015	2014-15
Discount Rate	6.88%	6.88%	6.88%
Commercial Line Loss	9.53%	9.53%	9.53%
Industrial Line Loss	8.16%	8.16%	8.16%
Irrigation Line Loss	9.67%	9.67%	9.67%
Inflation Rate	1.90%	1.90%	1.90%

Table 2 shows the 2014-15 utility and participant costs by program component. Table 3 shows the 2014-15 KWh savings, realization rates, and measure lives by program component.

Table 2: 2014-15 Utility and Participant Costs by Scenario

Scenario	Year	Program Delivery Costs	Utility Delivery Costs	Incentives	Total Utility Costs	Participant Measure Costs
Portfolio - Business As Usual	2014	$1,430,462	$414,423	$2,532,628	$4,377,512	$7,906,221
	2015	$1,498,275	$438,215	$2,691,103	$4,627,594	$8,335,340
Increase Custom Incentive Project Cost Cap	2014	$14,221	$5,034	$136,751	$156,006	$90,570
	2015	$15,643	$5,537	$150,426	$171,606	$99,627
Eliminate kW $ and Fund Cx	2014	$68,543	$0	($41,815)	$26,728	($68,543)
	2015	$75,397	$0	($45,996)	$29,401	($75,397)
Food Service	2014	$2,294	$538	($850)	$1,982	$30,198
	2015	$5,837	$1,370	$4,531	$11,738	$54,836
HVAC	2014	$1,446	$339	$5,000	$6,785	$42,500
	2015	$2,726	$640	$9,500	$12,865	$77,650
Irrigation	2014	$11,254	$2,641	$7,800	$21,694	$27,083
	2015	$11,254	$2,641	$7,841	$21,735	$27,056
Compressed Air	2014	$10,433	$2,448	$17,958	$30,840	$43,510
	2015	$10,433	$2,448	$17,958	$30,840	$43,510
Potato storage Van VFD	2014	$2,683	$630	$4,650	$7,963	$9,900
	2015	$2,683	$630	$4,650	$7,963	$9,900
Adaptive Refrigeration Control	2014	$8,512	$2,510	$17,100	$28,122	$34,000
	2015	$8,917	$2,629	$18,000	$29,546	$37,200
Fast Acting Door	2014	$3,513	$1,036	$7,800	$12,349	$32,500
	2015	$7,836	$2,310	$17,400	$27,547	$72,500
End Use Compressed Air Reduction	2014	$3,895	$914	$6,750	$11,560	$11,200
	2015	$4,112	$965	$7,125	$12,202	$11,800
Wastewater - Low Power Mixing	2014	$5,998	$1,727	$13,500	$21,225	$40,000
	2015	$5,998	$1,727	$13,500	$21,225	$40,000
Energy Management	2014	$117,355	$35,436	$10,506	$163,297	$27,086
	2015	$156,364	$59,116	$21,055	$236,535	$54,727

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Table 3: 2014-15 Energy Savings and Measure Lives by Scenario

Scenario	Year	Gross KWh Savings	Realization Rate	Adjusted Gross KWh Savings	Net-to-Gross Ratio	Net Adjusted KWh Savings	Measure Life (Years)
Portfolio - Business As Usual	2014	20,395,389	97%	19,742,722	100%	19,742,722	14
	2015	21,664,015	97%	20,949,831	100%	20,949,831	14
Increase Custom Incentive Project Cost Cap	2014	269,268	95%	256,040	100%	256,040	14
	2015	296,195	95%	281,644	100%	281,644	14
Eliminate kW $ and Fund Cx	2014	0	95%	0	100%	0	14
	2015	0	95%	0	100%	0	14
Food Service	2014	26,500	97%	25,705	100%	25,705	12
	2015	67,438	97%	65,414	100%	65,414	12
HVAC	2014	22,500	72%	16,200	100%	16,200	15
	2015	42,425	72%	30,546	100%	30,546	15
Irrigation	2014	130,000	97%	126,100	100%	126,100	6
	2015	130,000	97%	126,100	100%	126,100	6
Compressed Air	2014	120,525	97%	116,909	100%	116,909	9
	2015	120,525	97%	116,909	100%	116,909	9
Potato storage Van VFD	2014	31,000	97%	30,070	100%	30,070	10
	2015	31,000	97%	30,070	100%	30,070	10
Adaptive Refrigeration Control	2014	126,000	94%	118,440	100%	118,440	14
	2015	132,000	94%	124,080	100%	124,080	14
Fast Acting Door	2014	52,000	94%	48,880	100%	48,880	14
	2015	116,000	94%	109,040	100%	109,040	14
End Use Compressed Air Reduction	2014	45,000	97%	43,650	100%	43,650	9
	2015	47,500	97%	46,075	100%	46,075	9
Wastewater - Low Power Mixing	2014	90,000	95%	85,500	100%	85,500	14
	2015	90,000	95%	85,500	100%	85,500	14
Energy Management	2014	525,293	95%	499,028	100%	499,028	3
	2015	1,033,105	95%	981,450	100%	981,450	3

Table 4 shows the cost-effectiveness results for the WA 2014-15 Business Program. The program is cost-effective (benefit/cost ratio greater than 1.0) from all test perspectives except the RIM.

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Table 4: WA 2014-15 Business Program Portfolio

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.049	$20,771,445	$32,999,523	$12,228,078	1.59
Total Resource Cost Test (TRC) No Adder	$0.049	$20,771,445	$29,999,567	$9,228,122	1.44
Utility Cost Test (UCT)	$0.023	$9,769,411	$29,999,567	$20,230,156	3.07
Rate Impact Test (RIM)		$41,612,376	$29,999,567	($11,612,810)	0.72
Participant Cost Test (PCT)		$16,449,077	$37,290,008	$20,840,931	2.27
Lifecycle Revenue Impact ($/KWh)	0.000198969				
Discounted Participant Payback (years)	4.26				

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MEMORANDUM

To: Don Jones, Jr.

From: Brian Hedman and Ken Lyons

Subject: Washington Small Business Lighting Three-Year Plan Cost-Effectiveness

Date: June 26, 2014

The tables below present the cost-effectiveness findings of the Washington Small Business Lighting Three-Year Plan based on costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "SBL C-E Scenarios 061714 - WA.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Three-year cost-effectiveness inputs and results for small business lighting individual years and combined years are presented in this memo.

For all measures and scenarios, cost-effectiveness was tested using the 2013 IRP 70% load factor west system decrements and the large office lighting load shape. Table 1 lists the discount rate, line losses, and retail rates; Table 2 lists the measure group costs and incentives; Table 3 lists savings; Table 4 lists benefit cost ratios for the combined years and individual years; and Table 5 to Table 8 show the complete cost-effectiveness results for the combined years and individual years.

The small business lighting three-year plan is cost-effective from the PTRC perspective for all program years and all years combined. The program is cost-effective from the TRC perspective for all years except for 2014.

Table 1. WA Small Business Lighting Plan: Financial Inputs

Parameter	Value
Discount Rate	6.88%
Commercial Lines Loss	9.53%
Commercial Energy Rate ($/kWh) - 2013 base rate	$0.0772
Inflation Rate[1]	1.90%

[1] Future rates determined using a 1.9% annual escalator.

Table 2. WA Small Business Lighting Plan: Program Costs

Measure	Year	Utility Admin	Incentives	Total Utility Costs	Participant Incremental Cost
Small Business Lighting	1	$31,622	$49,910	$81,532	$62,388
	2	$86,082	$269,080	$355,162	$336,350
	3	$125,772	$442,680	$568,452	$553,350

Table 3. WA Small Business Lighting Plan: Annual Energy Savings

Measure	Year	Gross KWh Savings	Realization Rate	Adjusted KWh Savings	Net-to-Gross Percentage	Net KWh Savings	Measure Life
Small Business Lighting	1	124,775	98%	122,280	100%	122,280	14
	2	672,700	98%	659,246	100%	659,246	14
	3	1,106,700	98%	1,084,566	100%	1,084,566	14

Table 4. WA Small Business Lighting Plan: Benefit-Cost Ratios by Year

Measure	PTRC	TRC	UCT	RIM	PCT
Small Business Lighting 2014-2016	1.34	1.22	1.45	0.56	2.46
Small Business Lighting 2014	1.06	0.97	1.12	0.50	2.41
Small Business Lighting 2015	1.32	1.20	1.42	0.56	2.44
Small Business Lighting 2016	1.39	1.27	1.51	0.58	2.47

Table 5. WA Small Business Lighting Plan: 2014-2016 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.062	$1,083,724	$1,449,078	$365,354	1.34
Total Resource Cost Test (TRC) No Adder	$0.062	$1,083,724	$1,317,343	$233,619	1.22
Utility Cost Test (UCT)	$0.052	$911,431	$1,317,343	$405,912	1.45
Rate Impact Test (RIM)		$2,339,945	$1,317,343	($1,022,602)	0.56
Participant Cost Test (PCT)		$861,465	$2,117,687	$1,256,221	2.46
Discounted Participant Payback (years)	2.94				
Lifecycle Revenue Impact ($/KWh)	$0.00002398				

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Table 6. WA Small Business Lighting Plan: 2014 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.075	$94,010	$100,079	$6,069	1.06
Total Resource Cost Test (TRC) No Adder	$0.075	$94,010	$90,981	($3,029)	0.97
Utility Cost Test (UCT)	$0.065	$81,532	$90,981	$9,449	1.12
Rate Impact Test (RIM)		$182,118	$90,981	($91,137)	0.50
Participant Cost Test (PCT)		$62,388	$150,496	$88,108	2.41
Discounted Participant Payback (years)	1.31				
Lifecycle Revenue Impact ($/KWh)	$0.00000230				

Table 7. WA Small Business Lighting Plan: 2015 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.062	$422,432	$556,452	$134,020	1.32
Total Resource Cost Test (TRC) No Adder	$0.062	$422,432	$505,866	$83,433	1.20
Utility Cost Test (UCT)	$0.052	$355,162	$505,866	$150,703	1.42
Rate Impact Test (RIM)		$907,753	$505,866	($401,888)	0.56
Participant Cost Test (PCT)		$336,350	$821,671	$485,321	2.44
Discounted Participant Payback (years)	1.29				
Lifecycle Revenue Impact ($/KWh)	$0.00001052				

Table 8. WA Small Business Lighting Plan: 2016 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.061	$679,122	$946,317	$267,195	1.39
Total Resource Cost Test (TRC) No Adder	$0.061	$679,122	$860,288	$181,166	1.27
Utility Cost Test (UCT)	$0.051	$568,452	$860,288	$291,836	1.51
Rate Impact Test (RIM)		$1,494,826	$860,288	($634,538)	0.58
Participant Cost Test (PCT)		$553,350	$1,369,054	$815,704	2.47
Discounted Participant Payback (years)	1.26				
Lifecycle Revenue Impact ($/KWh)	$0.00001657				

CADMUS

MEMORANDUM

Date: October 28, 2013

To: Don Jones, Jr.

From: Aaron Jenniges and Byron Boyle

Re: WA NEEA 2014-2015 Cost-Effectiveness

The tables below present the cost-effectiveness findings of the Washington NEEA funding based on 2014-15 costs and savings estimates provided by PacifiCorp in a spreadsheet entitled "Copy of Pacific_6thAND7thPPSavingsReport_2014-2015_20130920_wMeasureLife_Costs_Sent_KB+ DLJ CE calculations 102513.xlsx". The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 49% load factor west residential whole house decrements for residential savings and the 2013 IRP 71% load factor west system decrements for commercial and industrial savings. Table 1 shows the input assumptions.

Table 1: NEEA Inputs

Input Description	2014	2015	2014-15
Discount Rate	6.88%	6.88%	6.88%
Commercial Line Loss	9.53%	9.53%	9.53%
Industrial Line Loss	8.16%	8.16%	8.16%
Residentiial Line Loss	9.67%	9.67%	9.67%
Inflation Rate	1.90%	1.90%	1.90%
Net-to-Gross	100%	100%	100%
Utility Costs	$1,225,843	$1,115,256	$2,341,099
Gross Generation Savings (kWh/year)	7,088,896	7,224,424	14,313,320
Average Measure Life (years)	6	6	6

Table 2 shows the savings shares by sector. These shares are used to divide the savings by sector so that appropriate retail rates and line losses are applied.

Table 2: NEEA Sector Shares

Sector	Share
Commercial	13.71%
Industrial/Agriculture	1.46%
Residential	84.83%

Table 3 shows the 2014-15 combined cost-effectiveness results. The WA NEEA funding was cost-effective from the UCT (Utility Cost Test) perspective but not the RIM (Ratepayer Impact) perspective.

Table 3: WA NEEA 2014-15 Cost-Effectiveness

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Utility Cost Test (UCT)	$0.032	$2,269,289	$4,712,309	$2,443,020	2.08
Rate Impact Test (RIM)		$8,258,542	$4,712,309	($3,546,233)	0.57
Lifecycle Revenue Impact ($/KWh)	0.000115825				

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CADMUS

MEMORANDUM

Date: October 29, 2013

To: Don Jones, Jr.

From: Aaron Jenniges

Re: WA 2014-2015 Total Company, Residential, and Commercial and Industrial Portfolio Cost-Effectiveness

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The tables below present the cost-effectiveness findings of the Washington total company, residential, and commercial and industrial portfolios based on 2014-15 costs and savings estimates provided by PacifiCorp. The utility discount rate is from the 2013 PacifiCorp Integrated Resource Plan.

Cost-effectiveness was tested using the 2013 IRP 49% load factor west residential whole house decrements for residential savings and the 2013 IRP 71% load factor west system decrements for commercial and industrial savings. Table 1 shows the input assumptions.

Table 1: Portfolio Financial Inputs

Input Description	Value
Discount Rate	6.88%
Residential Line Loss	9.67%
Commercial Line Loss	9.53%
Industrial Line Loss	8.16%
Irrigation Line Loss	9.67%
Inflation Rate	1.90%

Table 2 shows portfolio level costs.

Table 2: Portfolio Costs

Cost Type	2014	2015
Energy Education in Schools	$60,000	$60,000
Customer Outreach and Communication	$250,000	$250,000
Program Evaluations	$640,000	$328,000
Administration of Prior Programs	$1,500	$1,500

Cost-effectiveness was tested for six portfolio scenarios:

1. Residential Portfolio (Table 4): Home Energy Savings, Home Energy Reporting, See-Ya Later Refrigerator, and Low Income Weatherization
2. Commercial & Industrial Portfolio (Table 5): Business Program
3. Total Company Portfolio (Table 6): Residential Portfolio, Commercial & Industrial Portfolio, and Portfolio Costs from Table 2
4. Total Company Portfolio including Non-Energy Benefits (Table 9)
5. Total Company Portfolio including NEEA (Table 10)
6. Total Company Portfolio including NEEA and Non-Energy Benefits (Table 11)

Table 3 provides a summary of the benefit/cost ratios for the six portfolio scenarios. The total company and sector specific portfolios are cost-effective from all perspectives except the RIM (Ratepayer Impact Test)

Table 3: Summary of Benefit/Cost Ratios

Scenario	PTRC	TRC	UCT	RIM	PCT
Residential Portfolio	1.54	1.40	2.02	0.59	3.48
C&I Portfolio	1.59	1.44	3.07	0.72	2.27
Total Portfolio	1.50	1.36	2.43	0.66	2.55
Total Portfolio + NEBs	1.70	1.57	2.47	0.67	2.82
Total Portfolio + NEEA	1.50	1.36	2.39	0.65	2.55
Total Portfolio + NEBS & NEEA	1.70	1.57	2.42	0.66	2.82

Table 4: WA 2014-15 Residential Portfolio

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.053	$9,009,077	$13,910,655	$4,901,579	1.54
Total Resource Cost Test (TRC) No Adder	$0.053	$9,009,077	$12,646,050	$3,636,974	1.40
Utility Cost Test (UCT)	$0.037	$6,254,505	$12,646,050	$6,391,545	2.02
Rate Impact Test (RIM)		$21,592,377	$12,646,050	($8,946,327)	0.59
Participant Cost Test (PCT)		$5,071,515	$17,654,816	$12,583,301	3.48
Lifecycle Revenue Impact ($/KWh)	0.000095896				
Discounted Participant Payback (years)	1.87				

Table 5: WA 2014-15 Commercial and Industrial Portfolio

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.049	$20,771,445	$32,999,523	$12,228,078	1.59
Total Resource Cost Test (TRC) No Adder	$0.049	$20,771,445	$29,999,567	$9,228,122	1.44
Utility Cost Test (UCT)	$0.023	$9,769,411	$29,999,567	$20,230,156	3.07
Rate Impact Test (RIM)		$41,612,376	$29,999,567	($11,612,810)	0.72
Participant Cost Test (PCT)		$16,449,077	$37,290,008	$20,840,931	2.27
Lifecycle Revenue Impact ($/KWh)	0.000198969				
Discounted Participant Payback (years)	4.26				

Table 6: WA 2014-15 Total Company Portfolio Including Portfolio Costs

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.053	$31,330,345	$46,910,179	$15,579,834	1.50
Total Resource Cost Test (TRC) No Adder	$0.053	$31,330,345	$42,645,617	$11,315,272	1.36
Utility Cost Test (UCT)	$0.030	$17,573,739	$42,645,617	$25,071,878	2.43
Rate Impact Test (RIM)		$64,754,577	$42,645,617	($22,108,960)	0.66
Participant Cost Test (PCT)		$21,520,592	$54,944,824	$33,424,232	2.55
Lifecycle Revenue Impact ($/KWh)	0.000236986				
Discounted Participant Payback (years)	3.36				

Table 6 does not include non-energy benefits from the Home Energy Savings and Low Income Weatherization programs. Table 7 and Table 8 show the non-energy benefits from these programs.

Table 7: WA 2014-15 Home Energy Savings Non-Energy Benefits

Non-Energy Benefit	Program Impact (Present Value)	Perspective Adjusted
Home Energy Savings	$5,640,857	PTRC, TRC, and PCT

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Table 8: WA 2014-15 Low Income Weatherization Non-Energy Benefits

Non-Energy Benefit	Program Impact	Perspective Adjusted
Arrearage Reduction	$7,125	PTRC, TRC
Economic Impact	$689,360	PTRC, RIM, UCT, TRC
Home Repair Benefits	$107,842	PCT, PTRC, TRC
Total	**$804,327**	

Table 9 shows the total portfolio cost-effectiveness with non-energy benefits included. The portfolio is cost-effective from all perspectives except the RIM. Table 10 shows the cost-effectiveness of the total portfolio including NEEA funded savings. Table 11 shows the cost-effectiveness of the total portfolio including both NEEA funded savings and non-energy benefits.

Table 9: WA 2014-15 Total Company Portfolio Including Portfolio Costs and Non-Energy Benefits

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.053	$31,330,345	$53,355,363	$22,025,018	1.70
Total Resource Cost Test (TRC) No Adder	$0.053	$31,330,345	$49,090,801	$17,760,456	1.57
Utility Cost Test (UCT)	$0.030	$17,573,739	$43,334,977	$25,761,238	2.47
Rate Impact Test (RIM)		$64,754,577	$43,334,977	($21,419,600)	0.67
Participant Cost Test (PCT)		$21,520,592	$60,693,523	$39,172,931	2.82

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Table 10: WA 2014-15 Total Company Portfolio Including Portfolio Costs and NEEA Funded Savings

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.053	$31,330,345	$46,910,179	$15,579,834	1.50
Total Resource Cost Test (TRC) No Adder	$0.053	$31,330,345	$42,645,617	$11,315,272	1.36
Utility Cost Test (UCT)	$0.030	$19,843,028	$47,357,926	$27,514,898	2.39
Rate Impact Test (RIM)		$73,013,119	$47,357,926	($25,655,193)	0.65
Participant Cost Test (PCT)		$21,520,592	$54,944,824	$33,424,232	2.55
Lifecycle Revenue Impact ($/KWh)	0.000295247				
Discounted Participant Payback (years)	3.36				

Table 11: WA 2014-15 Total Company Portfolio Including Portfolio Costs, NEEA Funded Savings, and Non-Energy Benefits

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.053	$31,330,345	$53,355,363	$22,025,018	1.70
Total Resource Cost Test (TRC) No Adder	$0.053	$31,330,345	$49,090,801	$17,760,456	1.57
Utility Cost Test (UCT)	$0.030	$19,843,028	$48,047,286	$28,204,258	2.42
Rate Impact Test (RIM)		$73,013,119	$48,047,286	($24,965,833)	0.66
Participant Cost Test (PCT)		$21,520,592	$60,693,523	$39,172,931	2.82

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