

Memo to:

Jim Perich-Anderson EES Evaluation (PSE)

From: DNV GL - Energy**Date:** 05-08-2020**Copied to:**

Jon Taffel

Geoff Barker

Ken Agnew

Prep. By: Lullit Getachew

Steven Chang

Chelsea Liddell

Subject: 2018 Home Energy Report Final Evaluation Results – Electric and Gas Savings

1 INTRODUCTION

This memo provides a summary of Puget Sound Energy's (PSE's) Home Energy Report (HER) legacy and expansion program savings for 2018. The HER program delivers customized information on energy consumption to participating households and compares the households' energy consumption to that of similar neighboring homes. In addition, the report provides personalized tips on how to save energy based on the energy usage and housing profile of recipients. The HER program was designed to motivate households to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

PSE first implemented the HER program in 2008. The program was structured as a randomized controlled trial (RCT) where the eligible population was randomly assigned to treatment and control groups. The RCT design results in precise and unbiased estimates of savings per household since the only systematic difference between randomly assigned treatment and control households is treatment.

Since the launch of the program, the number of households in and the composition of PSE HER groups have changed over time.

- The initial HER legacy group consisted of around 84,000 dual fuel, single family homes. Of these, 40,000 were randomly selected to receive the report while the remaining 44,000 homes were randomly assigned as the control group and did not receive the report. All households in the treatment group received the report either monthly or quarterly for two years.
- At the start of the third year, approximately 10,000 HER legacy treatment group households were randomly selected to stop receiving the reports. This created a second treatment group (suspended) designed to test the persistence of report-based savings after the termination of reports. The rest of the households in the treatment group (legacy current households) still receive the home energy reports either monthly or quarterly. By program year 2018, about 18,900 (47%) of the original treatment population remain as current or suspended HER treatment participants. Program attrition is due to customer moveouts.
- In March 2014, PSE expanded the HER program to include 140,000 additional households. The HER expansion program targeted relative high users, non-urban, and electric only groups. Like the HER legacy program, the HER expansion program followed an experimental design with 105,000 randomly selected treatment households and 35,000 randomly selected control group households. In 2018, 45% of the original expansion treatment households remain in the program.

- In May 2015, PSE added a refill group numbering about 25,000 treatment households and 10,500 control households to replace households lost due to customer attrition since the start of the program. Of these, close to 71% of the treatment households remain in the program in 2018.

1.1 Evaluation Objectives

The main goal of this impact evaluation is to estimate HER legacy and expansion program savings for 2018. Specifically, the main objectives are as follows:

1. Measure the reduction in electric and natural gas consumption for the HER treatment groups.
2. Quantify joint savings from HER-related increased uptake of other PSE energy efficiency programs which may be present in the measured consumption reduction, including:
 - An increase in the number of participants and/or extent of participation in PSE rebate programs due to HER
 - A HER-related increase in the number of purchased LED bulbs and fixtures supported by PSE upstream lighting programs
3. Provide an estimate of 2018 HER credited savings for legacy and expansion programs adjusted for joint savings resulting from participation in PSE rebate and upstream lighting programs in previous HER years.
4. Provide an estimate of electric and natural gas savings for an additional legacy treatment group that had been previously excluded from savings estimates due to lack of a randomly assigned control group (the unmatched treatment group).

This evaluation used historical consumption data to measure the difference in consumption between the treatment and control groups.¹ We measured savings estimates for the different treatment sub-groups, namely, the current and suspended groups for the HER legacy program and the relative high users, non-urban, electric only, refill, and manufactured home groups for the HER expansion program. To quantify joint savings, DNV GL used the PSE program tracking data for downstream programs and a web-based participant survey for upstream lighting.²

1.2 Findings – Measured Savings and Rebate Savings

DNV GL's primary goal for this evaluation is to develop the 2018 PSE HER program credited savings. The estimated credited savings have three components. The first is the HER program's measured savings that reflects the program's impact on average household consumption. It is the average reduction in energy consumption of HER treated households. The second and third components are the rebate downstream and upstream retail lighting joint savings. To avoid double counting, DNV GL calculates credited savings by removing the downstream rebate and upstream joint savings from the HER measured savings.

The downstream rebate joint savings are calculated from PSE tracking data while the upstream joint savings are estimated based on a survey. The 2018 upstream savings estimates are based on the 2018 online survey of PSE HER customers. We recommend updating the survey for the next program year to make sure that the upstream lighting estimates reflect current participation trends.

¹ DNV GL used daily consumption data obtained from Opower (the program administrator) to conduct the 2018 analysis.

² Results to quantify upstream savings are based on a 2018 online survey of PSE-sponsored LED lighting purchases.

The credited savings also include savings estimates for a group of legacy treatment households, mostly concentrated in the 98006-zip code, which were not assigned a random control group but have received HER reports since the start of the program. Initially numbering close to 5,000, the current analysis is based on 3,268 unmatched households that have remained at the same premise since the start of the program. We estimated the unmatched group's 2018 HER savings by applying the percentage savings of the legacy current group to the baseline consumption of the unmatched group. More details on this program are available in the 2017 PSE HER report.

Table 1-1 and Table 1-2 provide the group-level and overall electric and gas savings estimates, respectively. The overall electric savings were estimated at 90/20 precision and the gas savings were estimated at 90/22 precision. All HER groups except legacy suspended had statistically significant electric savings. Overall, PSE HER electric customers saved 19,717 MWh in 2018.

Table 1-1 Total credited electric savings for 2018 HER programs (kWh)

HER treatment group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in group	Total savings	Lower limit 90% CI	Upper limit 90% CI
Legacy - Current	276.97	9.25	267.72	12,599	3,373,026	2,498,737	4,247,314
Legacy - Suspended	52.56	2.45	50.11	6,294	315,389	-222,096	852,873
Legacy - Unmatched[^]			256.31	3,454	885,302	645,617	1,124,987
Expansion - Electric only	191.64	65.54	126.10	19,448	2,452,427	248,032	4,656,822
Expansion - High relative user	338.16	21.50	316.66	17,588	5,569,440	3,606,302	7,532,578
Expansion – Non-urban	148.22	48.75	99.47	26,314	2,617,384	632,376	4,602,392
Expansion - Refill	264.75	12.07	252.69	17,825	4,504,140	3,024,102	5,984,178
ALL			190.46	103,522	19,717,107	15,819,623	23,614,590

*For the purpose of aggregation, the negative value will be zeroed out.

[^]Note that we calculated the unmatched per household savings by multiplying the legacy current per household savings as a percentage of consumption (2.8%) by the average household consumption of the unmatched group (9,154 kWh).

All PSE groups generated statistically significant gas savings (Table 1-2). Overall, PSE HER customers saved 731,178 therms in 2018.

Table 1-2 Total credited gas savings for 2018 HER programs (therms)

HER treatment group	Per Household				Total		
	Measured Savings	Joint Savings	Claimed Savings	No. in group	Total savings	Lower limit 90% CI	Upper limit 90% CI
Legacy - Current	13.72	1.92	11.81	12,599	148,773	97,881	199,664
Legacy - Suspended	7.95	0.00	7.95	6,294	50,018	17,996	82,039
Legacy - Unmatched [^]			12.70	3,454	43,880	29,928	57,831
Expansion - High relative user	11.93	1.61	10.31	17,588	181,371	86,343	276,399
Expansion – Non-urban	6.83	0.17	6.66	26,314	175,188	79,233	271,143
Expansion - Refill	8.06	0.66	7.40	17,825	131,949	63,591	200,307
ALL			8.70	84,074	731,178	567,714	894,642

[^]Note that we calculated the unmatched per household savings by multiplying the legacy current per household savings as a percentage of consumption (1.6%) by the average household consumption of the unmatched group (794 therms).

The summary measured savings per household and joint savings results for legacy and expansion programs are presented in Table 1-3 and Table 1-4, respectively. The legacy current treatment group produced credited electric and gas savings of 2.8% and 1.6%, respectively. These savings were statistically significant and indicate average savings per household of 267.7 kWh and 11.8 therms for 2018. The suspended group had a statistically significant average reduction of 7.9 therms (1% savings per household) while producing no statistically significant kWh reduction. Gas savings declined only slightly when compared to 2017 for this group, suggesting that the program has a lasting effect on gas conservation. Gas savings from the program may be due to installation of more efficient hardware, while electric savings may depend more on behavioral changes, such as turning off lights and unplugging discretionary load. Efficient gas hardware remains after the program, while discretionary behaviors may attenuate.

Table 1-3 Summary of credited savings per household for PSE HER Legacy, 2018

Treatment Groups	Consumption	HER measured savings	Joint Savings	Credited savings	Percent credited savings
Electric (kWh)					
Current	9,685	277.0*	9.3*	267.7*	2.8%
		(207.9,346.1)	(2.7, 15.8)	(198.3, 337.1)	
Suspended		52.6	2.5	50.1	0.5%
		(-36.4,141.5)	(-6.0, 10.9)	(-35.3, 135.5)	
Gas (therms)					
Current	758	13.7*	1.9*	11.8*	1.6%
		(9.8,17.6)	(0.9, 2.9)	(7.8, 15.8)	
Suspended		7.9*	0.0	7.9*	1.0%
		(2.9,13.0)	(0.0, 0.0)	(2.9, 13.0)	

*Indicates statistically significant value at 90% confidence level. Values in parentheses show upper and lower bounds at 90% confidence level.

Each expansion group generated statistically significant credited electric and gas savings in 2018 (Table 1-4). Among the expansion groups, the high user group generated the largest credited electric and gas savings. The electric only group generated the largest joint electric savings, indicating that the HER program has a substantive impact on the uptake of downstream rebates and upstream lighting measures for single fuel, electric only households. Future analyses could investigate the joint savings mechanisms of the electric only group. PSE could take advantage of the educational messaging included in the HER program to augment the efficacy of its downstream and upstream energy efficiency programs.

Table 1-4 Summary of credited savings per household for PSE HER Expansion, 2018

Treatment Groups	Consumption	HER measured savings	Joint Savings	Credited savings	Percent credited savings
Electric (kWh)					
Electric Only	13,659	191.6* (83.0,300.3)	65.5* (33.4, 97.7)	126.1* (12.8, 239.4)	0.9%
High User	10,906	338.2* (236.6,439.7)	21.5 (-24.9, 67.9)	316.7* (205.0, 428.3)	2.9%
Non-urban	9,705	148.2* (78.5,218.0)	48.8* (20.1, 77.4)	99.5* (24.0, 174.9)	1.0%
Refill	11,827	264.8* (181.9,347.6)	12.1* (6.7, 17.5)	252.7* (169.7, 335.7)	2.1%
Gas (therms)					
High User	751	11.9* (6.6,17.3)	1.6* (0.7, 2.5)	10.3* (5.7, 15.0)	1.4%
Non-urban	672	6.8* (3.2,10.4)	0.2 (-0.4, 0.7)	6.7* (3.5, 9.8)	1.0%
Refill	789	8.1* (4.3,11.9)	0.7* (0.2, 1.2)	7.4* (4.1, 10.7)	0.9%

*Indicates statistically significant value at 90% confidence level. Values in parentheses show upper and lower bounds at 90% confidence level.

Table 1-5 presents baseline electric and gas consumption and the average savings per household as a percent of consumption for the unmatched households. For each fuel, we select the legacy current group's percentage savings per household and multiply these by the unmatched group's baseline consumption to generate the credited savings per household for the group.

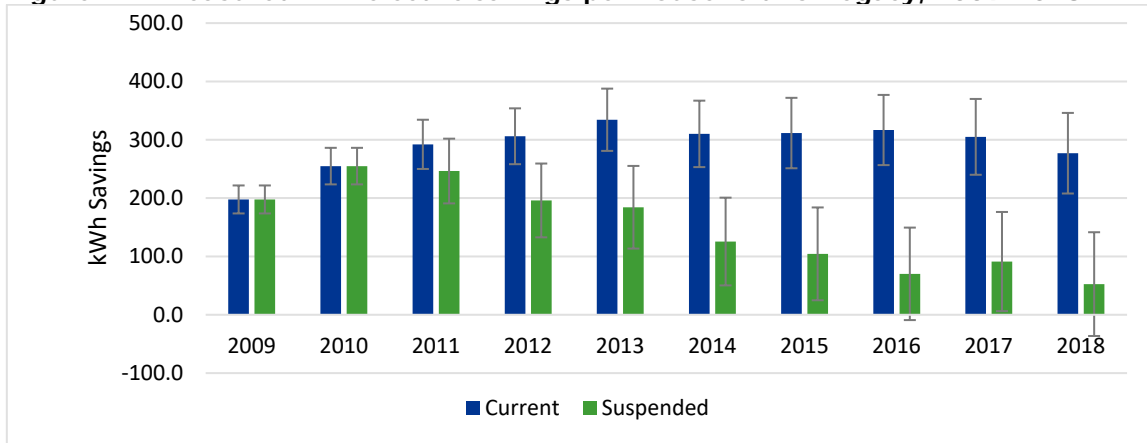
Table 1-5 Summary of credited savings for the unmatched group

	Electric (kWh)			Gas (therms)		
	Consumption	Savings	Percent	Consumption	Savings	Percent
Legacy unmatched	9,154	256.3 (186.9, 325.7)	2.8%	794	12.7 (8.7, 16.7)	1.6%

To put the 2018 findings in context, we provide measured electric and gas savings over time. Figure 1-1 provides measured electric savings and Figure 1-2 measured gas savings for the legacy program from 2009 to 2018. The current legacy group has continually registered electricity savings since the start of the HER program. While the savings for this group have persisted over the entire period, their upward trend has stalled since 2013 (the fifth year of the program) and decreased since 2017. The electric savings of the suspended group have generally been in decline since the group stopped receiving HERs in 2011. Since 2015, the electric savings among the suspended households remained on the edge of statistical significance.

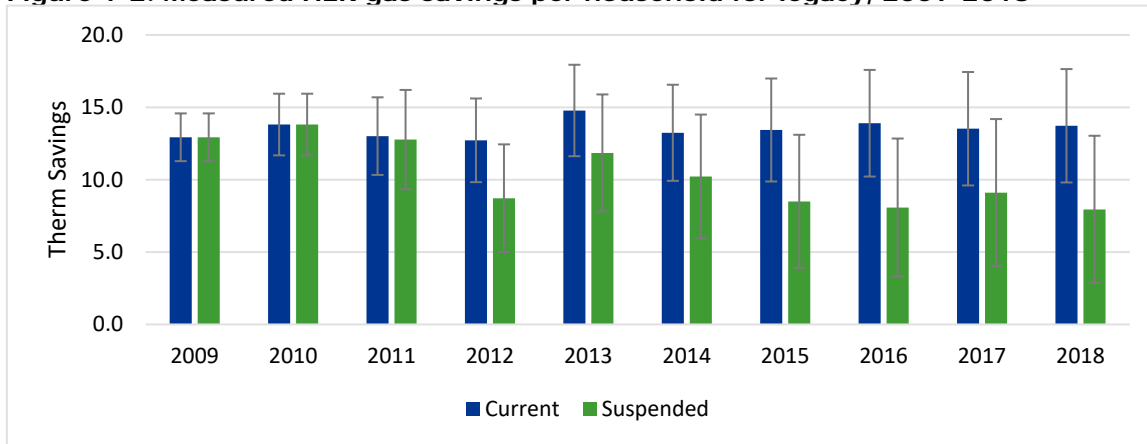
Gas savings also persist both for the current and suspended legacy groups. Gas savings do not have a marked trend and are not statistically different over the years. While legacy suspended gas savings have decreased since PSE discontinued HER messaging, 2018 measured savings of the suspended group are about 57% of those of the legacy current households' gas savings.

Figure 1-1. Measured HER electric savings per household for legacy, 2009-2018



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

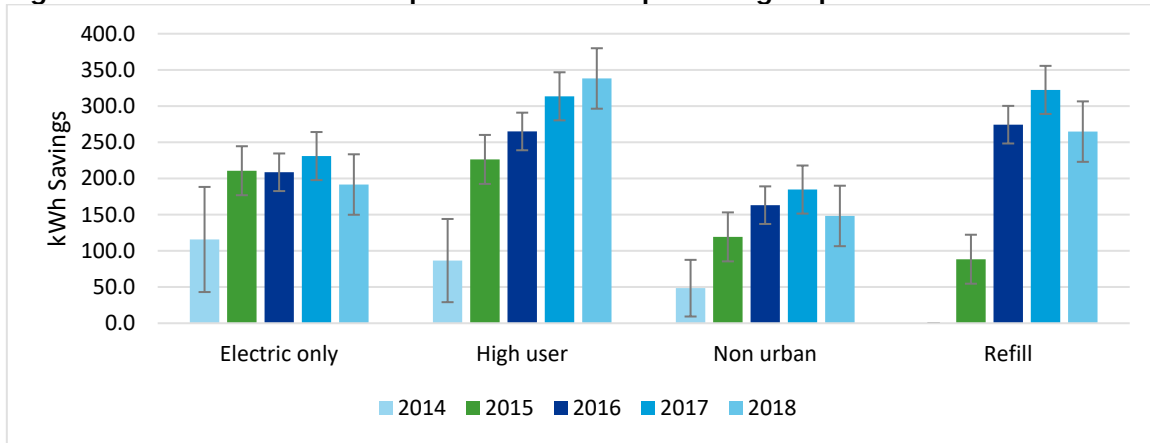
Figure 1-2. Measured HER gas savings per household for legacy, 2009-2018



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

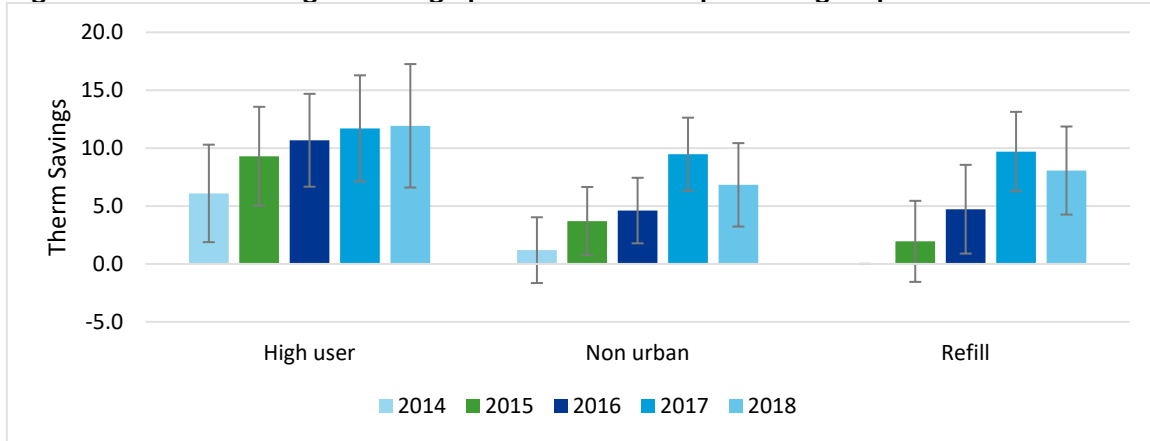
We provide expansion group electricity measured savings over time in Figure 1-3 and gas measured savings over time in Figure 1-4. The savings for 2014 reflect partial year HER messaging as the program began in March 2014 for high users, electric-only, and non-urban households, all of which were in their fourth full-year of the program in 2018. The refill group is in its third full year since the program for this group began in May 2015. Measured electric and gas savings generally indicate an increasing trend for all expansion groups over time. The increasing trend in savings for both electricity and gas follow patterns exhibited by other HER programs in their early years.

Figure 1-3. Measured electric per household expansion groups from 2014 to 2018



Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

Figure 1-4. Measured gas savings per household expansion groups from 2014 to 2018




Note: The graph above shows the savings with upper and lower bounds at the 90% confidence level.

2 CONCLUSIONS

We note the following general results:

- Measured electric savings are declining but still persist for the active legacy group.
- The legacy current group’s measured electric savings trend has decreased since the fifth year of the program while its measured gas savings have had no discernible trend and are not statistically significantly different from one another over time.



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- The suspended legacy group's electric and gas savings have been on a downward trend since households in the group stopped receiving HER, with statistically insignificant electric savings and gas savings about 50% of the current group's savings in 2018.
 - All expansion groups continue to save electricity with the high-user group generating an increase from the previous year.
 - All previous expansion groups continue to save gas, with the non-urban and refill groups saving less than in 2018 than in the prior year.
 - Total PSE HER 2018 electric savings are 19.7 million kWh and gas savings are 731,178 therms.
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