Home Energy Report Programs: Power from the People

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ABSTRACT

Information based programs that mail Home Energy Reports (HER) to residential households are growing both in number and interest among utilities as a cost-effective way to meet energy efficiency goals. There is particular interest in the long term viability of program savings and how savings are integrated into an energy efficiency portfolio. Puget Sound Energy's HER program is the first dual fuel HER program in its third year of operation to report evaluation results. This paper will address:

- Measured energy savings estimates over three years of the PSE HER Program;
- Impact of suspending the delivery of HER reports in the third program year;
- HER program impact on participation in other PSE programs;
- Energy saving behavior, purchases, and attitudes of program participants; and
- Credited energy savings estimates that eliminates double-counting.

Year three normalized savings were 2.6 and 1.4% of electric and gas consumption, respectively. Electric savings represented an increase over year two savings, while gas savings declined slightly from year two levels. In year three, HER reports were suspended for a subset of participating household and those households still realized 79 and 100% of the electric and gas savings, respectively, of the households that still received the reports. The HER program caused increases in therm savings from PSE rebate programs, but did not increase electric savings from PSE rebate or upstream CFL programs. The evidence for HER-related changes in purchasing behavior and other energy-related behaviors in the third year was sparse and inconsistent.

Introduction

In 2008, Puget Sound Energy (PSE) added a Home Energy Reports (HER) program to its portfolio of energy efficiency offerings. The program provides participating households in King County, Washington with periodic customized reports that compare its energy usage to that of neighboring homes. These comparisons are designed to motivate customers to reduce their energy use. In addition, the reports provide tips on actions that households can take to reduce energy consumption through behavioral changes and participation in other PSE energy efficiency programs.

PSE provided HER reports to approximately 35,000 households randomly selected from about 79,000 eligible households. Those households receiving reports constituted the treatment group, while the remainder served as a control group. To test savings persistence, PSE suspended the reports for roughly one-third of the treatment group at the start of program year three. This

split the treatment group in two: the "continued" treatment group and the "suspended" treatment group.

The third year program evaluation was designed to address multiple issues. First, it was a continuation of the previous two impact evaluations that measured energy savings using consumption data. This consumption based approach was expanded to take out weather related effects, resulting in a normalized savings estimate that is more consistent with evaluations of other program types. Second, the evaluation was designed to address double-counting of savings from PSE rebate and upstream programs. The rebate programs savings were addressed with a program tracking analysis; the upstream program through customer surveys. Finally, given the need for customer surveys, the evaluation addressed customer non-rebated purchases, and specific energy saving behaviors promoted through the program. This paper reports findings from each aspect of the evaluation.

Methods

DNV KEMA conducted an impact evaluation, a program tracking analysis, and a behavioral and process evaluation of PSE's 2011 HER program. The impact evaluation utilized a consumption analysis to measure the impact of HER reports on participating households' energy usage. The program tracking analysis utilized PSE's program tracking data to estimate the extent to which HER reports resulted in participation in PSE's other programs. The behavioral and process components used customer survey responses to behavioral, attitudinal, and purchasing questions to identify upstream lighting program participation and to answer the seemingly simple question: "where do the savings come from?" All three aspects of this evaluation combine to produce a final estimate of HER program credited savings that PSE will claim as part of its energy efficiency portfolio requirements for the state of Washington.

The random assignment of customers to various treatment levels and to the control group provided the basis for an evaluation that avoided the major validation threats common among savings estimates that rely on cross-sectional comparisons between participants and non-participants. The experimental design structure supported unbiased consumption estimates of program savings through the third year of the program. The design also supported unbiased estimates of joint savings—savings claimed by PSE's other programs, both rebate and upstream CFL programs. Finally, the design facilitated survey-based exploration of the behavioral effects yielded from the energy reports.

Consumption Analysis

KEMA used two consumption analysis methodologies to address overall HER program savings: a difference-in-difference approach and a site-level regression approach. The difference-in-difference approach is a simple, robust approach to measuring program-related savings in a randomized experimental design framework. The approach compares mean energy consumption between the pre- and post-report periods for both the treatment and the control groups. There were 29,371 original treatment group customers and 37,094 original control group customers still in the same houses at the end of 2011.

The site-level regression approach allowed DNV KEMA to estimate weather effects on energy consumption to estimate annual consumption under typical year weather conditions. This facilitates comparison of program savings year to year, and is consistent with normalized savings

estimates used for other program types. The combined randomized experimental design and large analysis populations make it possible to generate unbiased, statistically significant estimates of energy savings that are small as a percentage of overall consumption.

Program Tracking Analysis

One objective of the HER program is to promote participation in PSE's other energy efficiency programs, both rebate programs and upstream CFL programs. Increased participation in these other programs could be an important way that energy reports contribute to the utility's overall savings. On the other hand, the state of Washington is explicit that care must be taken to avoid double counting energy savings. For crediting purposes, it is important to either attribute these energy savings to the HER program or the other PSE energy efficiency programs. On the surface this appears be simple, but the HER program evaluation process suggests a more nuance approach to addressing the double counting issue.

DNV KEMA analyzed PSE's program tracking data to determine the extent to which the HER program increased participation in its residential rebate programs. If the reports were effective in promoting the rebate programs, treatment households would have a higher average rebate program savings than the control households. We refer to these additional savings as *joint program savings* because the rebate and HER programs share the credit for generating these savings. PSE, in agreement with the Conservation Resources Advisory Group[1], decided to net joint program savings out of the HER program savings estimates.

The experimental design of the HER Program makes it possible to accurately measure the savings resulting from the increased rebate program activity caused by the HER program. The most basic approach uses program tracking data estimates of measure-related annual savings to identify the average household savings installed by treatment and control groups. The difference in average household savings (treatment minus control) represents the average household increase in rebate program activity. This measure of joint saving would then be subtracted from the household HER program energy savings measured with the consumption analysis.

This approach has two important limitations. First, it does not take full advantage of information on when measure savings take place—when they start (installation date) and when they are used (measure load shapes). Second, this approach overlooks how long savings persist (measure life). These limitations are an issue because, unlike the rebate program deemed annual savings estimates, the HER program savings are measured in real time as they show up in the consumption data. This approach will seriously overestimate joint savings in the first year of the HER program. Just as importantly, this approach usually ignores the fact that ongoing joints savings from year one installations continue to be captured in the consumption analysis.

For this evaluation, we extended this basic approach to quantify joint savings in a way that approximates the way that the consumption analysis captures overall HER program savings. That is, we calculated how joint savings would accrue on a day-to-day basis, which approximates how savings enter into the measured savings from the consumption analysis.

[1] The CRAG was established as part of the settlement of PSE's 2001 General Rate Case, which the WUTC approved in Docket No. UE-11570 and UG-011571. The group works with PSE on development of energy efficiency plans, targets and budgets. The CRAG consists of ratepayer representatives, regulators, and energy efficiency policy organizations.

The improved approach calculates measure-level savings for each installed measure starting the day of installation. We use end-use measure-specific load shapes to pro-rate annual savings across the year following measure installation.[2] Finally, the analysis extends the measure-level savings, on this load shape-weighted basis, for each installed measure's entire measure life. As a result, each measure generates savings on its installation day and continues to do so, according to the average usage profile of that measure, until it reaches its average measure life.

With measure savings defined in this way, aggregation across households and differencing between the treatment and control groups is somewhat more complicated. As multiple measures are installed, the measure savings combine into aggregate savings shapes for the treatment and control groups that approximate when installed-measure related savings occurred. For each group, the level of savings fluctuates throughout the year depending on measure mix and installation rates but increases, on an annual basis, each year during the three years of the HER program because all the rebate-program measure lives are greater than three years. In aggregate, the treatment and control groups have savings shapes that realistically reflect the savings activity for all the measures installed since the HER program mailings started.

If the treatment group had not received the reports, the aggregate savings shapes for the two groups would be the same, within the range of natural sample variation. Because of the HER reports, we expect that treatment group savings would increase faster than control group savings. A positive difference in these accumulated savings between the treatment and control groups indicates additional rebate program activity related to HER reports, i.e., joint savings.

This approach to calculating joint savings captures the increased rebate program activity in a way that's consistent with consumption analysis measurement of overall HER program savings. These joint savings estimates are removed from the measured HER savings and accurately address potential counting for all years of the HER program.

Because HER programs are relatively new, and most published evaluations address the first year of the program, there has been limited discussion about accounting for joint savings beyond the first year of the HER program. Although PSE claims only first-year energy savings associated with its rebate program measures, it calculates cost-effectiveness over a measure's lifetime. Therefore, failing to adjust savings for installations in previous years will create misleading cost-effectiveness results.

Behavioral and Process Surveys

At the beginning of program year four, KEMA completed telephone surveys with 1,369 households, representing three HER program customer groups: continued treatment households (373), suspended treatment households (494), and control households (502). The surveys supported the joint savings analysis of PSE's upstream lighting program, the only program for which purchases are not tied to individual households. Regulators and PSE were concerned that some HER program credited electric savings resulted from increased installation of PSE-funded CFL bulbs and fixtures. If this were the case, then the savings would be double-counted. In addition to asking about CFL purchases, the surveys included questions on energy-related behaviors and purchase of efficient equipment outside of PSE's programs. The survey was

[2] This means, for instance, that a gas furnace generates gas savings during the winter when furnaces are used, but not during the summer.

particularly important to understanding participants' behavioral-based actions taken to reduce energy usage and measure-based installations that reduced energy usage.

Gross Savings Estimates

Annual Savings by Program Year

In this paper we focus on savings estimates over three full years of PSE's HER program, as measured using a site-level regression approach. Because the regression approach accounts for weather effects on consumption, it supports the comparison of annual savings estimates from year to year over the three-year period. We estimated savings utilizing usage records from 19,697 households that participated in the program for three years; 9,674 households that were suspended from the program after its second year of implementation; and roughly 37,000 control group households still valid after three years. Table 1 displays the average normalized electric and gas savings that treatment group customers achieved over three years of PSE's program. These savings were statistically significant in all three years.

Table 1. Normalized Electric and Gas Savings by Program Year

Year and Group	Treatment Group N*	Electric		Gas	
		kWh**	%***	therms**	%***
Year 1	29,371	170 (150)	1.6%	11 (9)	1.3%
Year 2	29,371	235 (207)	2.2%	14 (12)	1.6%
Year 3– Continued	19,697	274 (238)	2.6%	12 (10)	1.5%
Year 3–Suspended	9,674	216 (170)	2.1%	12 (9)	1.4%

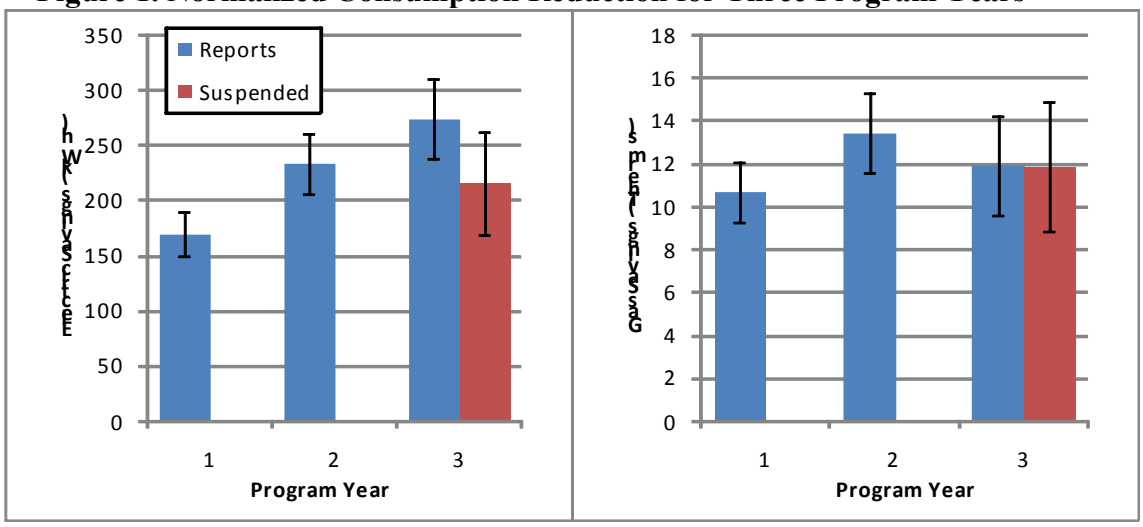
* 37,094 control group households. All counts are for households still intact at the end of 2011.
** Values provided in parentheses signify the lower bound of a one tail 95% test. The upper bound is not reported because a one-tailed, lower bound test provides no upper limit on savings.
*** Percentage of program year control group normalized consumption.

Persistence of Measured Savings–With and Without Reports

Figure 1 displays the normalized consumption reduction of households in the treatment group for each of the three HER program years. The findings show a declining rate of change in savings, and suggest that energy savings may be leveling off. Treatment group savings increased for both electricity and gas over the first two years of the program: households in the treatment group experienced a 38% increase in electric savings and a 26% increase in gas savings between the two years. These savings differences were significant at the 95% level. Electricity savings continued to increase in year three, but at a lower rate. Gas savings decreased slightly from year two to year three. The difference in savings between years two and three were not statistically significant.[3]

[3] The lack of significant savings changes, from year two to year three, are not surprising. The treatment group was split for year three to test the impact of suspending reports. As a result, the variance of each savings estimate is increased, meaning a greater difference or a much larger sample is needed to exhibit a statistically significant difference.

Figure 1. Normalized Consumption Reduction for Three Program Years



Confidence bands shown are at the 95% confidence level.

Households to which delivery of HER reports was suspended after year two still generated statistically significant savings in the program's third year (relative to the control group). Report suspension had a greater impact on electric savings than it did on gas savings. The suspended report households still generated 79% of to the electric savings of the continued households (that difference was significant at the 90% confidence level). Year-three gas savings were effectively identical for the "suspended" group and the "continued" group.

Participation in PSE's Other Programs

For PSE, promoting other energy efficiency programs is important for the HER program. The measured savings estimates (discussed earlier) capture savings supported by other PSE programs, as well as activities households undertook without such support; we referred to the former as joint savings. Joint savings are recognized in PSE's regulatory accounting based on participation and equipment purchase tracking records. The joint savings thus have the potential to be double counted if they are not accounted for appropriately through adjustments to the HER program consumption analysis' results.

Joint Rebate Program Savings

The tracking data analysis attempted to measure joint savings in real time. Table 3 provides the total joint savings estimates for each year and breaks those savings out for rebate installations that took place during each of the three program years. The "Total Joint Savings" rows provide the total annual estimates of gas and electric joint savings for each of three program years. The gas joint savings increased through the three years to 1.25 therms, approximately 10% of measured overall HER program gas savings. The electric joint savings were a much smaller percentage of HER program electric savings—less than half of 1%. The therm joint savings estimates were all statistically significant while none of the electric results were statistically significant.

Table 3. Per Household Annual Joint Savings, Continued Report Treatment Group

Installation Year	Measurement Year		
	Year 1	Year 2	Years 3
Gas: Annual Therms per Household			
Program Year One	0.2	0.5	0.5
Program Year Two		0.4	0.6
Program Year Three			0.2
Total Joint Savings	0.2	0.8	1.3
Electric: Annual kWh per Household			
Program Year One	0.1	0.5	0.5
Program Year Two		0.5	-0.5
Program Year Three			-0.4
Total Joint Savings	0.1	1.0	-0.4

The joint savings estimates in Table 3 capture rebate program measures' annual savings for their full measure life. First program year gas activity generated joint savings of only 0.2 therms in the first year of the program. Those installations generated 0.5 therms worth of savings in the subsequent years. Program year two results increased in both respects. The new installation savings in program year three dropped back to first year levels indicating a slowing of the gas joint savings effect. The electric results are effectively random noise.

This gas result is illustrative of the joint savings approach used in this analysis. First-year joint savings are relatively low compared to subsequent year savings because:

- Installation date matters. First-year installations occurred late in the first year of the program as a consequence of the reports' delayed effect on actual measure installation.
- The timing of the start of the HER program in November made it less likely that additional first-year gas installations would show savings during the first program year. For example, an additional treatment group furnace installed during the summer of the first program year would have been used infrequently before the program's first year ended in October. The load shape weighting means savings accrue only when a measure is being used.
- Carryover savings equal a full year of savings for the additional rebate program installations. Those measures generating the first-year joint savings will continue to generate savings until their respective measure lives are reached.

Joint Upstream Program Saving

Unlike rebate programs, upstream program purchases are not tracked to specific households. As a consequence, it is impossible to compare all purchases by treatment and control group households as was done for PSE rebate programs. Instead, we estimated the increased purchase of upstream program CFLs using the telephone surveys of PSE households.

The survey asked respondents how many bulbs and fixtures they purchased during 2011 and at what store and location to identify purchases made at locations that were participating in

PSE and the Northwest Energy Efficiency Alliance's upstream programs[4]. The survey focused on purchased CFLs, instead of installed CFLs, because PSE claims upstream program savings based on purchased bulbs.

Table 4 displays the estimates of CFL bulb and fixture purchases in 2011 for the continued and suspended report treatment groups. On average, customers in the treatment groups bought only 0.17 more bulbs than their counterparts in the control group, less than 3% of the average number purchased by control group customers. This difference is not statistically significant. CFL fixture purchases were negligible for both groups. The difference between the continued and suspended treatment groups is within the error band. To be consistent with the savings accounting approach, we deducted all of these savings from overall HER savings despite their lack of statistical significance.

Table 4. Average 2011 CFL Program Purchases Per Customer

Group	Program CFL Bulbs	Program CFL Fixtures
Control Group	6.0	0.1
Continued Treatment	5.9	0.2
Net Continued Treatment	**0.0**	**0.1**
Suspended Treatment	6.5	0.1
Net Suspended Treatment	0.6	0.0
Net: Total Treatment Group	**0.2**	**0.0**

Due to concerns about respondent recall, the survey, conducted in early 2012, asked only about CFL purchases in 2011. This was the first survey conducted of upstream CFL purchases for PSE's HER program. Ideally, upstream joint savings estimates would have been developed for each year of the program to fully address ongoing CFL savings. Instead, third year results were extrapolated to the first two program years to provide a CFL joint savings estimate starting with year one.

Final Savings Estimates

PSE will report HER program savings to the state of Washington for calendar year 2011 using the results in Table 5, which represent the final tally of savings. The specific numbers are different from the results discussed earlier because they cover a different time period and are based on the difference-of-differences approach and actual weather. Despite only gas joint savings being statistically significant, all joint savings estimates are incorporated into the final savings estimates credited to the HER program. This was done to have consistent approach across all estimates of joint savings regardless of statistical significance.

[4] The majority of CFLs at the participating stores would have benefitted from the upstream program. To the extent that we capture a treatment group increase in non-program CFL purchases we would over-estimate joint savings and remove too much joint savings from the consumption analysis estimate of savings.

Table 5. Annual per Household Calendar Year 2011 Credited Savings Estimates

Group	Savings Category	kWh/Year	Therms/Year
Continued Reports, Per Household	Measured Savings	278	13
	Joint Rebate Program Savings	0	1
	Joint Upstream Savings	2	n/a
	Savings Less Joint Savings	276	12
Suspended Reports, Per Household	Measured Savings	208	12
	Joint Rebate Program Savings	1	1
	Joint Upstream Savings	43	n/a
	Savings Less Joint Savings	164	11
Total Group Credited Savings		**GWh/Year**	**Million Therms/Year**
Continued Reports		5.4	0.22
Suspended Reports		1.6	0.11
HER Program Savings: Both Treatment Groups		7.0	0.33
Lower bound of 95% Confidence Interval (G)		*4.9*	*0.26*

Energy-Related Behaviors and Purchases

The primary reason for pursuing survey work under PSE's HER program evaluation was to measure upstream program joint savings. While fielding a survey, we also tackled the bigger question that has eluded energy report program evaluation to date: what is the source of program savings? Though the savings potential of HER-type programs is now well established, understanding of the behaviors and purchases that produce the savings remains incomplete. Understanding behaviors and actions that drive savings is important to maximize the potential of these programs. It may also be key to projecting the persistence of savings.

Survey Background

The evaluation survey was the first survey performed on PSE's HER program participants. It was fielded shortly after the program finished its third year. The combination of timing and other challenges inherent in self-reported actions shaped survey strategy. A senior analyst at DNV KEMA performed in-depth interviews to inform the survey design. We used these interviews to determine what information was realistic to expect from respondents and how to most effectively ask the questions.

The in-depth interviews further demonstrated how challenging it is to collect meaningful self-reported behavior. Many survey questions are prone to socially desirable responses. In this case, the treatment group might be more sensitive to the social desirability of the response, given the prompting by the HER reports. So, a higher incidence in self-reported energy efficiency behavior activities could reflect more behaviors or more sensitivity to the social desirability of the response. Also, many energy related behaviors are on-going, repeated behaviors (e.g. shutting off lights in unused rooms). The frequency of the activity and the baseline conditions (e.g. when the action started or frequency increased) are important, but not easily captured. During the qualitative interviews, most respondents reported engaging in many typical energy saving behaviors (e.g. turning of lights, changing temperatures at night or when no one is at home), and reported engaging in the activity for many years. Also, HER recommended actions

were generic, and did not lend themselves to specific question wording that would elicit meaningful responses.

As a result, the survey focused only on a single year of the program. The purchase questions focused on calendar year 2011, an easily identified time period two months offset from the official third year of the program which started in November. The behavior sequences referenced the past year. The survey addressed three key areas: energy efficiency purchases, energy efficiency related behaviors, and response to and assessment of the HER reports.

Energy efficiency is a product attribute that is generally identifiable, frequently through ENERGY STAR status. Purchases have the additional feature of yielding quantifiable evidence of the savings source. In particular, the purchasing question sequence sought to distinguish between energy consuming goods that were

- energy efficient and purchased with the assistance of a PSE rebate program
- energy efficient but not purchased with the assistance of a PSE program
- not energy efficient.

In addition, respondents were asked if the purchased goods replaced similar goods or were additional purchases. These questions were asked of all respondents for a wide range of energy consuming goods, including some electronic equipment. The survey began with very detailed sequences addressing CFL lamp and fixture questions to support the upstream joint-savings analysis estimates. This sequence addressed quantity, timing and location (store) of CFL related purchases to determine the extent to which purchased bulbs received rebates.

The survey included a range of behaviors with potential to save energy. We used the recommendations from the HERs to guide the energy savings action questions. These actions included one-time activities (e.g. “insulate your hot water pipes?” and on-going behaviors (e.g. “regularly turn off your computer at night?”. As the in-depth interviews showed, questions regarding energy saving behaviors were more difficult to define, to distinguish from background actions and to place within the appropriate timeframe. The behavior sequences were limited to a subset of respondents to keep the survey to 20 minutes or less.

The survey attempted to identify activities that were responsible for maintaining second year savings and additional small electric savings in the third year. We were particularly interested in finding differences between the continuing report and suspended report treatment groups. Once again, however, the associated savings difference between the two groups was small.

Finally, the survey was developed with the most current research available in mind. At the time, the most current analysis was an evaluation of a first-year HER program in the Northeast (ODC, 2011). This work showed tentative evidence of increased non-rebated energy efficiency purchases playing an important role in the program’s overall measured savings. A final survey goal was to see if the Northeast evaluation’s hypothesis was supported by the third-year data from a program in a milder climate.

Results Summary

DNV KEMA completed a total of 1,369 interviews (502 control, 373 continued treatment, and 494 suspended treatment). Despite ample sample sizes, differences in energy efficient equipment purchases were small and the surveys generated only a handful of statistically significant results. Both the continued and suspended treatment groups had some statistically significant differences from the control group, though few with each other. We found nothing in the survey results to explain the drop in electric savings in the suspended group. The suspended reports group actually had more statistically significant differences from the control group than the continued report group.

Results from behavior-related questions were similar. Relatively few of the behaviors produced statistically significant results, either individually or combined in categories. The two treatment groups have approximately equal numbers of statistically significant differences, but they are not necessarily for the same items. Smaller sample sizes for behavior questions, combined with the challenges associated with these types of questions, likely contribute to the dearth of significant differences.

The most compelling findings are in domestic hot water-related purchases and behaviors. There were a number of statistically significant results that occurred primarily within the continued treatment group. The continued treatment group bought more energy efficient water heaters, installed more energy efficient washing machines, and performed substantially more domestic hot water-related energy savings behaviors than the control group. These included turning down the water heater's temperature and, specifically, turning it down when not home for more than two days. Domestic hot water-related gas savings are a major component of gas baseload, which represents at least 25% of overall gas savings. This difference in self-reported purchases and behavior is not yet reflected in consumption analysis. It may be indicative, however, of decline in purchase and behavioral activities among the suspended group.

The remaining significant results were spread sparsely across a range of energy efficient purchases and behaviors. Both continued and suspended treatment groups bought more energy efficient washing machines. The suspended treatment group bought more energy efficient televisions and computers. The continued treatment group installed more insulation. Overall, there was little to support the hypothesis that savings are driven by non-program energy efficient purchases. With regard to behaviors, other than domestic hot water, the only statistically significant results indicated more frequent furnace filter changes.

The domestic hot water data illustrate another generalized finding that merits close consideration. Accelerated replacements, even if replaced with a standard efficiency measure, generate some savings for many energy-using measures. In general, new energy-using equipment is more efficient than older models, and new equipment is likely to perform better than used. In this case, the continued treatment group installed more energy efficient water heaters, and they also installed more non-energy efficient water heaters. This illustrates the importance of capturing whether purchases are replacement or additional.

Results for electronics items illustrate the complexity of interactions between the type of purchases, the amount of purchasing, and the baselines for those purchases. The suspended treatment group claimed to have installed almost 20% more energy efficient electronic items than the control group (and an even greater margin over the continued treatment group). But to counter this apparent positive trend, the suspended group was also more likely to purchase electronics in general and those electronic purchases were more likely to be additional electronic

items (not replacements of previous items). Given these countervailing electronics energy-consumption dynamics, it is impossible to know whether the continued group consumed more or less energy resulting from their actions.

Understanding the source of HER program savings is a daunting task. Total HER-related savings are a small percentage of overall energy consumption and are likely generated by savings activity spread across the full range of purchasing and energy usage behaviors. Our survey of third-year behaviors identified some statistically significant savings-oriented behaviors but they did not present a comprehensive or coherent picture of the source of HER program savings. Larger sample sizes, more targeted surveys (shorter and focused on few items) and continued improvement of questions would improve the reliability of the results.

Conclusion

The evaluation findings show that PSE HER program continued to generate both electric and gas savings in the third year of the program. Electric savings continued to increase in year three, but at a decreasing rate. Gas savings fell slightly in year three. Suspension of the reports lowered electric savings by 21%, but did not affect gas savings. This suggests that gas savings may be more equipment related. The savings measured by the consumption analysis for the continued and suspended treatment groups were both statistically significant.

HER program participants show statistically significant increases in therm savings from participation in PSE rebate programs. The HER participants did not increase electric savings from either rebate or upstream CFL programs. Therefore, concerns of double-counting upstream CFL savings are not warranted at this time. There was no evidence that savings resulted from non-rebated energy efficient purchases.

The joint savings finding were developed with an improved joint savings analysis approach that captured savings from other PSE programs based on when measures were installed, when measure-specific savings occurred during the year and multi-year measure lives. This approach produces joint savings estimates that are superior to previous approaches because they are consistent with the program savings measured by the consumption analysis and are consistent with utility cost-effectiveness calculations.

The evidence for HER-related changes in purchasing behavior and other energy-related behaviors in the third year was sparse and inconsistent. The survey results further illustrate the challenge of identifying the source of savings in a program such as the PSE HER program.

References

Allcott, H. 2011. "Social Norms and Energy Conservation." *Journal of Public Economics* 95: 1082–1095.

[DNV KEMA] DNV KEMA. 2012. "Puget Sound Energy's Home Energy Reports Program, Three Year Impact, Behavioral and Process Evaluation." https://conduitnw.org/_layouts/Conduit/FileHandler.ashx?RID=849 Madison WI: DNV KEMA.

[ODC] Opinion Dynamics Corporation. 2011. "Massachusetts Cross-Cutting Behavioral Program Evaluation". http://www.ma-eeac.org/docs/2011%20EM&V%20Studies/

MACC%20Behavioral%20Report%20Volume%201%20Final.pdf. Waltham, MA: Opinion Dynamics Corporation

[SEE] State and Local Energy Efficiency Action Network. 2012. "Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations." Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkeley National Laboratory. http://behavioranalytics.lbl.gov.