

Home Energy Reports of Low-Income vs. Standard Households: A Parable of the Tortoise and the Hare?

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ABSTRACT

PPL Electric Utilities, serving more than a million residential customers in eastern and central Pennsylvania, implemented one of the nation's first low-income behavioral-based demand-side management programs in 2014. Low-income customers face significant barriers to making energy efficiency improvements, as they have few financial resources, are more likely to rent than own their home, and are geographically mobile. This paper presents findings from an evaluation of the first 18 months of this program, comparing key metrics to the utility's general residential behavioral-based program.

PPL implemented a randomized control trial with about 26,500 control group customers, and mailed home energy reports (HER) to approximately 87,000 low-income customers every other month. Reports provided a summary of household energy use, a social-normative neighbor comparison, and three recommendations for energy-saving action steps. HER recipients reduced household electricity usage by an average of 1.3%. Savings ramped up gradually through the first 12 months, ultimately reaching 1.5% of consumption. Compared to control group customers, low-income HER recipients participated more in other programs and reported higher levels of satisfaction with the utility. Overall, this program saved 10,622 MWh per year and proved cost-effective.

The evaluation revealed that low-income HER recipients saved electricity at a much slower pace than general residential customers enrolled in another HER program. Low-income customers showed higher satisfaction with the HERs, and a greater belief in the accuracy of the neighbor comparison. PPL Electric also learned that their low-income HER recipients had Internet access barriers preventing them from receiving additional behavioral encouragement available through e-mail.

Introduction

PPL Electric implemented this low-income program to help this segment save energy, in addition to the company's other low-income programs such as direct-install (lighting, weatherization, HVAC, water heating measures) and energy efficiency kits. As part of the impact evaluation, the evaluator determined electric savings. PPL was also interested in determining whether sending HERs to low-income customers would have similar impacts on electric consumption, participation rates in other DSM programs, and customer satisfaction, among other metrics, as those of its general residential HER program over the past six years. To evaluate this low-income HER program, Cadmus leveraged several analysis techniques—including billing analysis and customer surveys—to determine the program energy savings, customer engagement impacts, and cost-effectiveness. (Cadmus 2014, Cadmus 2015)

Background

Although low-income customers have large potential for energy savings, there are often significant barriers for implementation of DSM programs. Often, low-income residential customers face a burden of living in older housing with an aging infrastructure and inefficient HVAC equipment and appliances, not having adequate disposable income to invest in efficiency upgrades or weatherization. In addition, low-income customers are often

renters who are not the decision makers for upgrades to appliances, HVAC, water heating, and the building envelope.

Considering the need to support low-income customers, many public utility commissions and other state and local regulatory bodies across North America require their constituent energy companies to provide a minimum amount of energy efficiency services and programs that specifically target low-income residential electricity customers. The federal and state governments often contribute funding for these efforts.

In response, utilities commonly offer modified versions of traditional DSM programs to low-income customers, such as whole-home weatherization, multifamily housing prescriptive equipment, or direct-install programs. These programs have been implemented for many years with varying degrees of success. While utilities offer a variety of direct-install and weatherization programs for low-income customers, the wait list can be long and the extent of services varies. This can mean that these customers have high energy bills during peak heating or cooling seasons, owing proportionally higher electricity bills than other residential customers, leading to higher risks of payment defaults, service disconnects, and health and safety concerns.

Meanwhile, over the past decade, utilities have implemented behavior-based energy efficiency programs among their general residential electricity customers. These programs combine strategies from psychology and behavioral economics—including normative comparisons, targeted messaging, reciprocity, data insights, feedback mechanisms, and gamification—to achieve energy savings by influencing customers' decisions and actions. In particular, HER behavior-based DSM programs have proven successful in reducing electric energy use among the general residential participants by 1% to 3%, on average. (Cadmus 2014, 2015, Navigant 2015)

PPL Electric has operated an HER behavior-based DSM program with approximately 130,000 of its general residential customers since 2010, achieving between 1.5% and 2.0% electric savings. This general residential program includes three distinct waves of customers and is an established model to expand the program to low-income customers.

Administering a HER program specifically for low-income customers had been done by few or no other utilities before, and was a rich opportunity to explore. The hypothesis was that the approach could engage this customer segment to save electric energy, and therefore money, through no-cost behavior changes, and that customers would respond well to this program design. The program did not provide any financial incentives.

In the autumn of 2014, PPL Electric launched a low-income HER program (the Low-Income Energy-Efficiency Behavior & Education Program), sending approximately 87,000 low-income customers a print HER by mail every other month (six over the program year). Customers with a valid e-mail address also received electronic HERs via e-mail every month. This program differed from standard residential HER programs by targeting customers at or below the 150% of the federal income poverty level and reports only featured no-cost energy-saving action steps.

The objectives of the Low-Income Energy-Efficiency Behavior & Education Program were to:

- Educate targeted customers about no-cost products and behavior changes that may reduce their electric consumption or demand
- Educate customers about the utility's online resources for ways to save energy
- Encourage customers to adopt more energy-efficient behaviors and to install energy-efficient products in their home by becoming more aware of how their behavior and practices impact their electric use
- Promote payment assistance and other energy efficiency programs, such as direct-install programs, offered by PPL Electric for low-income customers
- Obtain participation of approximately 90,000 customers through 2016, with a total reduction of approximately 8,300 MWh per year.

Each home energy report provided a summary of the customer's household electricity usage, a neighbor comparison of electricity usage, and three electric energy-saving action steps. The action steps emphasized no-cost, rather than low-cost, energy-saving actions.

Because HERs were customized, the energy-saving action steps and program promotions often differed from report to report and customer to customer. However, report modules promoted the same action steps during the same period. Additionally, the utility added two targeted modules, *Winter of 68* and *Low-Income Home Energy Assistance Program (LIHEAP)*, to the HERs in 2016. These modules were specifically intended to elicit a behavior change in setting the thermostat temperature and to increase participation in LIHEAP.

Randomized Control Trial

PPL Electric implemented the program as a randomized control trial, where their independent evaluator randomly assigned eligible low-income customers to either a treatment group (recipients of HERs) or a control group. The control group did not receive HERs and provided a baseline for measuring the treatment group’s electric savings attributable to the program.

PPL Electric selected two study populations, or “waves,” for the program, launching the first in 2014 and the second in 2015. The first wave (Wave 1) contained approximately 87,000 customers, 67,000 of whom were randomly assigned to the treatment group and 20,000 to the control group. The second wave (Wave 2) contained approximately 27,000 customers, with 17,000 in the treatment group and 10,000 in the control group (Table 1).

Table 1. Study population by wave

Group and Wave	Year First Launched	Delivery Frequency	Number of Customers at Start of Evaluation ^[1]
Treatment Group			
Low-Income Wave 1	2014	Six bimonthly paper reports; 12 monthly e-mail reports	66,760
Low-Income Wave 2	2015	Six bimonthly paper reports; 12 monthly e-mail reports	20,616
Total Treatment Group			87,376
Control Group			
Low-Income Wave 1	2014	-	16,926
Low-Income Wave 2	2015	-	9,657
Total Control Group			26,583

^[1] This column reflects the number of participants remaining following the wave launch date, accounting for annual account attrition and opt-outs as of May 2016.

Impact Evaluation Overview

Cadmus estimated the electricity savings by comparing the post-treatment consumption of customers in the randomized treatment and control groups, while controlling for differences between customers in consumption before treatment. We included customers who had 12 months of billing consumption data prior to the start of the treatment in the billing analysis. Table 2 shows the counts of treatment and control group homes in the analysis sample by wave.

Table 2. Low-income treatment and control group counts by wave

Group	Low-Income Wave 1	Low-Income Wave 2
Treatment Group Homes	66,760	20,616
Control Group Homes	16,926	9,657
Total Homes ^[1]	83,686	30,273

Before estimating the savings, Cadmus verified that the pre-treatment average daily electric consumption of the randomized treatment and control groups was statistically equal and that the groups were well balanced. Table 3 presents the average annual pre-treatment electricity consumption of customers in both waves. No

significant differences existed between the pre-treatment consumption of treatment and control groups in each wave.¹

Table 3. T-tests to confirm balance in treatment and control groups

Statistic	Wave 1	Wave 2
Treatment Group Pre-Treatment Period Annual Consumption (kWh)	11,894	8,172
Control Group Pre-Treatment Period Annual Consumption (kWh)	11,843	8,248
Difference (kWh)	51	-76
Percentage Difference	0.4%	-0.9%
t-value	0.9	0.8
p-value (Pr>t)	0.37	0.45

Electric Energy Savings

Overall, this program saved 10,622 MWh per year. Figure 1 shows estimates of electric savings for low-income customers in Wave 1 and Wave 2 between June 2015 and May 2016. Wave 1 customers had average daily savings of 0.42 kWh, while Wave 2 customers only saved one-third that amount, with an average daily savings of 0.14 kWh. This difference is likely driven by the longer treatment duration for and higher average pre-treatment consumption of Wave 1 customers. Across the two waves, the program’s mean average daily savings per customer was 0.36 kWh.²

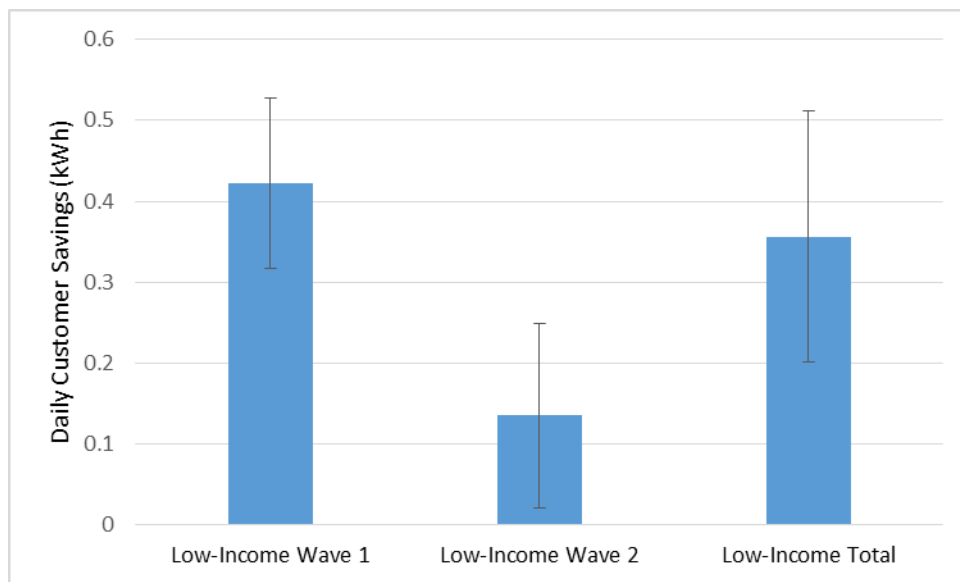


Figure 1. Per-customer daily savings (kWh) by wave

Note: The Low-Income Total is the mean per-customer daily savings, weighted by the waves’ sum of treatment days (sum of all days treatment group customers were active, meaning they were exposed to effect of HERs). The error bars represent the 85% confidence interval surrounding the point estimates.

¹ By contrast, the average pre-treatment annual electricity consumption of the general residential HER program’s treatment group was 23,194 kWh/yr. and the control group was 23,195 kWh/yr.

² The average per-customer daily savings rate for the three general residential program’s waves was nearly 2.5 times higher, at 0.868 kWh in the same program year.

Figure 2 shows estimates of the electricity savings as a percentage of baseline consumption for each wave.³ As a percentage of consumption, Low-Income Wave 1 customers saved more than double that of Low-Income Wave 2 customers. Again, this difference likely reflects differences in the duration of treatment, as Wave 2 customers may have been in the process of ramping up savings. Wave 2 may be expected to reach similar percentage savings levels by the end of its next program year. Overall, the two waves saved 1.3% of consumption, which is within the expected 1% to 3% range for HER programs.

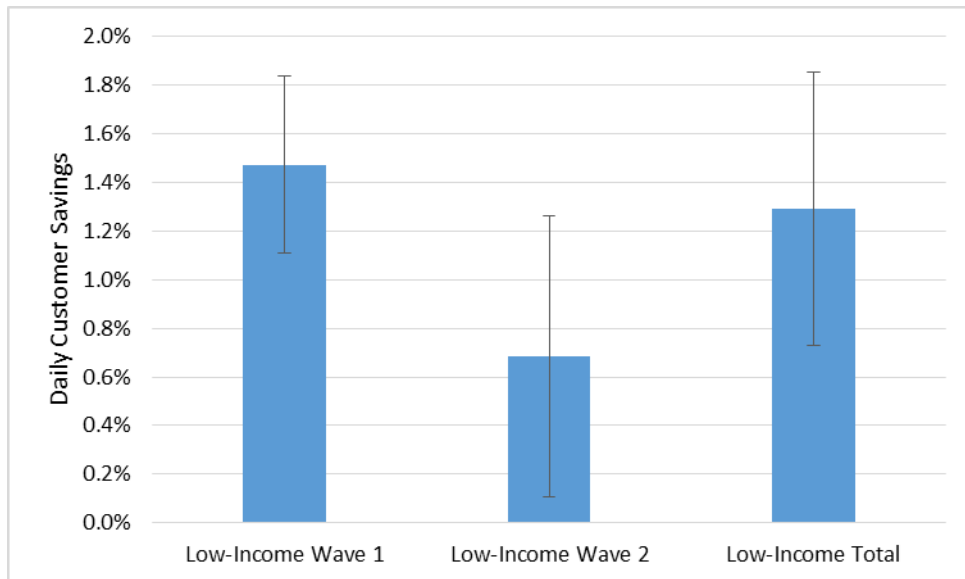


Figure 2. Per-customer daily savings (percentage) by wave

Note: Cadmus calculated the percentage savings as the quotient of daily savings (kWh) over the baseline daily usage, defined as the mean control group customers’ daily consumption (kWh). The program total is the mean per-customer daily savings, weighted by the waves’ sum of treatment days, defined as the sum of all treatment group customers’ number of days being active (i.e., exposed to the treatment effect of the HERs). The error bars represent the 85% confidence interval surrounding the point estimates.

Ramp-Up Rate

Cadmus also estimated the electricity savings of the two waves for each treatment month to identify savings trends. Figure 3 shows the average daily electricity savings per treated customer by month for each wave. The figure shows that Low-Income Wave 1 began saving electricity after December 2014, with savings increasing steadily through 2015 and 2016. It appears that savings may have begun to reach a “steady state” after about 20 months of treatment. The steady state savings for the Low-Income Wave 1 was less than that for the general residential behavior-based program, suggesting that this group of low-income customers had less potential to save as much electricity or did not respond to the HERs as enthusiastically as the general residential program customers. Additionally, the general residential HERs included low-cost action steps to save electricity which were not included in the low-income HERs.

Figure 3 also shows the savings trend for Low-Income Wave 2 customers during their first year. Savings reached about 1% of consumption in fall 2016, decreased slightly during winter, then increased again to about 1.2% of consumption by May 2016.

Low-Income Wave 1 (launched in 2014) drove 90% of the program savings, large enough that the program would still have achieved its planned savings without Low-Income Wave 2.

³ Cadmus defined the waves’ baseline energy usage as the control group’s daily mean consumption (kWh) in the program year; that is, the customers’ typical consumption in the absence of the program.

Figure 3 shows that both waves increased savings during the first program year. Also, they appear to have followed similar seasonal trends in savings during the second program year. They both increased in percentage savings between August 2015 and October 2015, decreased or held constant percentage savings through January 2016, then gradually increased savings through May 2016.

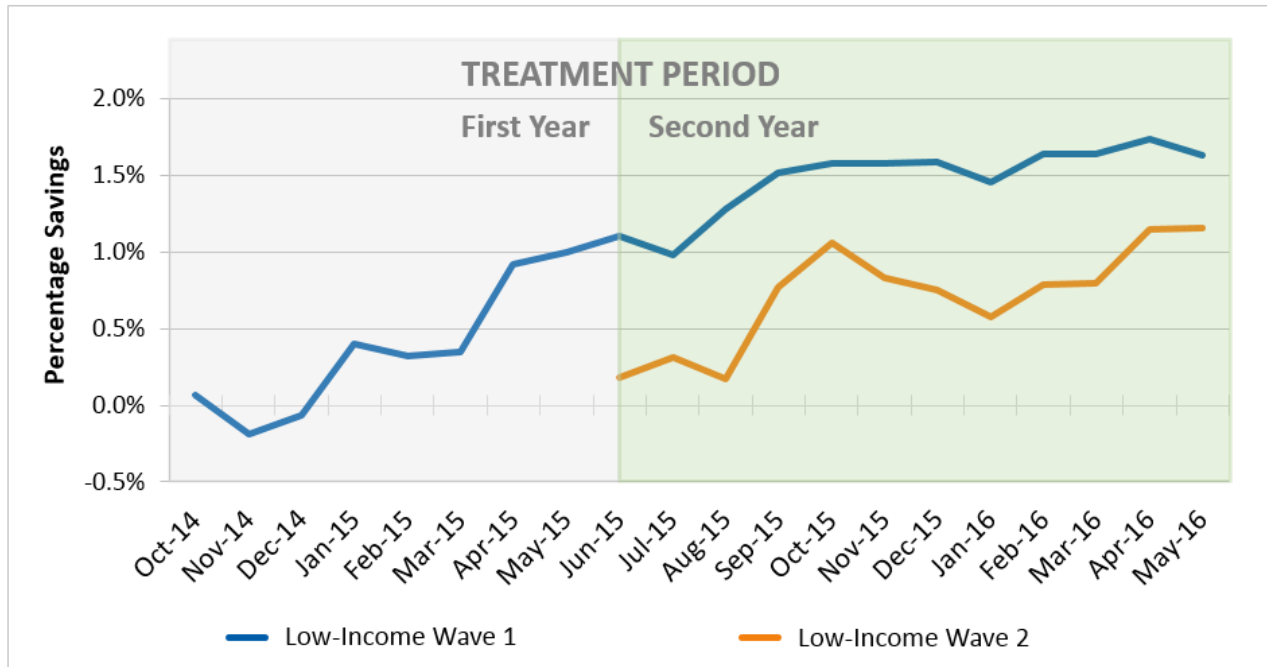


Figure 3. Low-income waves' percentage savings by calendar month

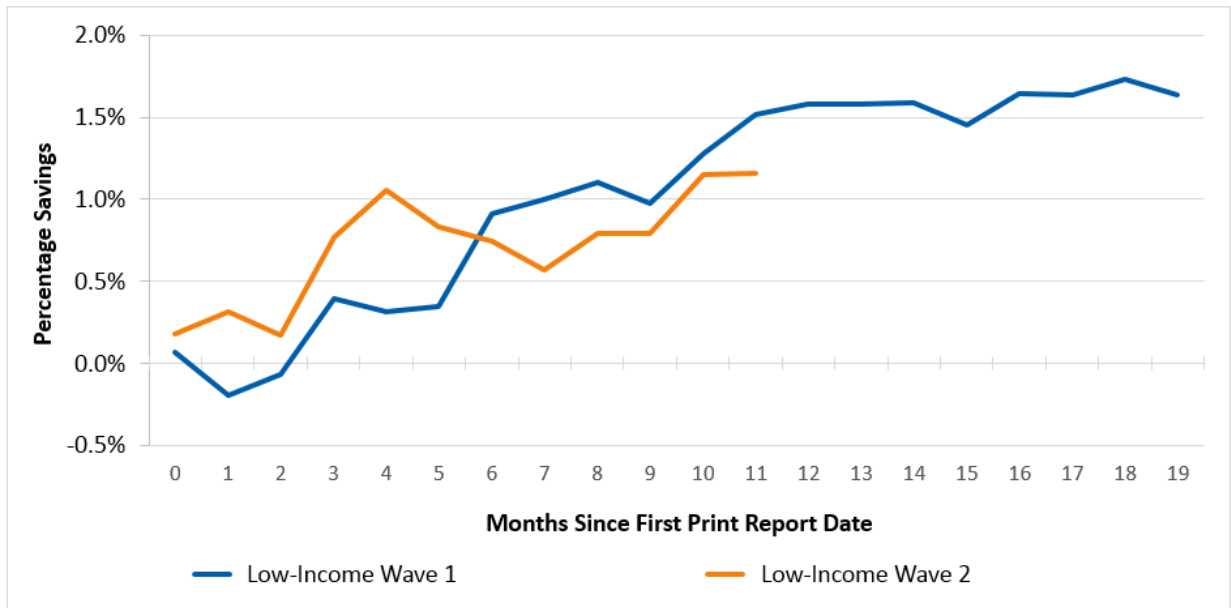


Figure 4. Percentage savings by month

Figure 4 overlays the percentage electricity savings of Wave 1 and Wave 2 customers, starting with the first month of treatment. Both waves gradually increase savings, although Low-Income Wave 2 experienced a decrease of savings between the fourth and seventh months that the Low-Income Wave 1 did not experience.

Nevertheless, the trends are similar and suggest that Wave 2 customer may save about the same percentage of consumption as Wave 1 customers during the second year.

Uplift

The low-income program savings, determined through the RCT, reflected customer behavior changes such as turning off lights in unoccupied rooms and adjusting thermostat settings, as well as energy efficiency home improvements such as upgrading insulation levels or installing high-efficiency equipment. We estimated the impacts of the low-income HER program on participation in PPL Electric's other low income and residential rebate programs and the resulting electricity savings.⁴ Cadmus matched customers in the randomized treatment and control groups to PPL Electric's energy efficiency program tracking database and compared their program participation and energy savings. Cadmus adjusted the annualized deemed savings reported in the tracking database to account for the dates that measures were installed, and when savings from weather-sensitive measures occurred.

The program increased participation in other energy efficiency programs of Low-Income Wave 1 customer by 9.9% and of Low-Income Wave 2 customer by -4.1%. The negative impact for Wave 2 indicates that control group customers participated at a higher rate than treatment group customers. In aggregate, the program increased participation by 6.2%. The savings from this additional participation was about 2.1% (223 MWh) of the total annual electricity savings for Wave 1 and Wave 2.

Customer Surveys

In winter 2016, Cadmus conducted two surveys over the telephone, one with the low-income program's treatment group customers (n=151) and the other with control group customers (n=150), to correspond with the program's experimental design.⁵ One year prior, Cadmus had conducted similar surveys with customers in the general residential behavior program (n=361 treatment, n=180 control). The two programs and nearly identical survey designs allowed us to evaluate engagement differences not only between the treatment and control group customers, but also between the low-income and general residential customers.

Cadmus selected a random sample of treatment and control group customers, stratified by participation wave (discussed above). In both treatment and control group surveys, we asked questions about familiarity with energy efficiency and other PPL Electric's programs, recent energy-saving improvements made, energy-saving behaviors taken, attitudes toward and barriers to energy efficiency, and satisfaction with the utility. We also asked the treatment group customers about the HERs such as their readership, recall of content, and satisfaction.

Cadmus applied group and wave-level statistical weights to the low-income survey data to reflect actual program population proportions (because the actual population size of the treatment group is about three times larger than the control group). Weighted survey data are indicated by the notation n_w in this paper. We then used a t-test to compare proportions and means to determine if statistically significant differences exist between two independent groups at the 5% ($p \leq 0.05$) and 10% ($p \leq 0.10$) significance levels.

⁴ Cadmus conducted an uplift analysis for downstream rebate programs, tracking participation at the individual customer level. Cadmus did not estimate the impact of the Low-Income Energy-Efficiency Behavior & Education Program on participation in PPL Electric's upstream lighting program. (Cadmus 2015)

⁵ Cadmus contacted about 3,000 low-income HER treatment group customers and about 2,500 control group customers.

Survey Findings

Readership

The surveys revealed that 89% of low-income treatment group respondents ($n_w=220$) read, partially read, or skimmed the last print HER received—a lower readership level than the general residential behavior program, in which 95% ($n=358$) of general residential respondents reported that they read, partially read, or skimmed the last report received. Specifically, 44% of low-income respondents said they *read the report thoroughly*, 21% said they *read some of the report*, 24% said they *skimmed the report*, and 11% said they *did not read the report*.

Reception to the Home Energy Report

Surveyed treatment group respondents provided attitudinal ratings for three statements on a 10-point scale, where 1 meant *strongly disagree* and 10 meant *strongly agree*. On average, low-income respondents gave these ratings to the three statements:

- 8.0 for *The reports are easy to understand* ($n_w=205$)
- 7.6 for *The information in the reports is useful* ($n_w=203$)
- 5.7 for *The reports get others in my household involved in saving energy* ($n_w=196$)

The mean attitudinal ratings showed that low-income respondents found the HERs easy to understand and useful, but respondents were neutral about the reports getting other household members involved in saving energy. These low-income findings did not differ from the general residential findings.

Each HER contains a neighbor comparison of electric energy use, which compares the customer's usage to that of similar homes in the vicinity. A large majority of low-income respondents (79%; $n_w=231$) remembered seeing the neighbor comparison in the HERs. Those who remembered seeing the neighbor comparison gave a mean attitudinal rating of 6.9 for the statement *I believe the neighbor comparison is accurate* ($n_w=160$). Interestingly, the respondents from the low-income behavior program exhibited a significantly stronger belief in the accuracy of the neighbor comparison than the respondents from the residential behavior program, who gave a mean rating of 4.8 ($n=292$).

Thirty-eight percent of low-income respondents reported they were *very satisfied* with the HERs, and 41% reported they were *somewhat satisfied* ($n_w=231$). This proportion of low-income respondents reporting being *very satisfied* was significantly higher than the proportion of general residential program survey respondents (28%; $n=355$) (difference is statistically significant, $p\leq 0.05$). One plausible explanation was the low-income respondents' stronger belief in the accuracy of the neighbor comparison.

Changes in Energy-Saving Behaviors

Even though the impact evaluation revealed the treatment group saved electricity, the surveys did not reveal significant differences in self-reported energy-saving improvements compared to respondents in the control group. However, survey data indicated that the HERs had some influence on low-income customers' taking energy-saving behaviors more frequently. Cadmus asked survey respondents how often they took the seven common energy-saving actions shown in Figure 5. Overall, treatment and control group respondents reported similar frequencies, with only one statistically significant difference (turning down the thermostat) (difference is statistically significant, $p\leq 0.10$).

Winter of 68 and the LIHEAP Modules

PPL Electric included two modules in the low-income HERs specifically intended to elicit a behavior change. *Winter of 68* encouraged customers to adjust the thermostat temperature, and the *Low-Income Home Energy Assistance Program* promoted LIHEAP to spur awareness and elicit participation. These are both shown in Figure 6. The HERs for the general residential program did not feature these two modules, which were tailored to boost savings among low-income customers.

Because the HERs had featured *Winter of 68* (a behavioral action of lowering the thermostat to 68 degrees during the winter), Cadmus expected to see a significant difference between the treatment and control groups for this behavior. The survey results did show that a significantly higher proportion of treatment group respondents (47%; $n_w=206$) than control group respondents (36%; $n_w=57$) reported *always turning down the heating thermostat temperature when leaving or sleeping*, which could be attributed to the HER's *Winter of 68* module.

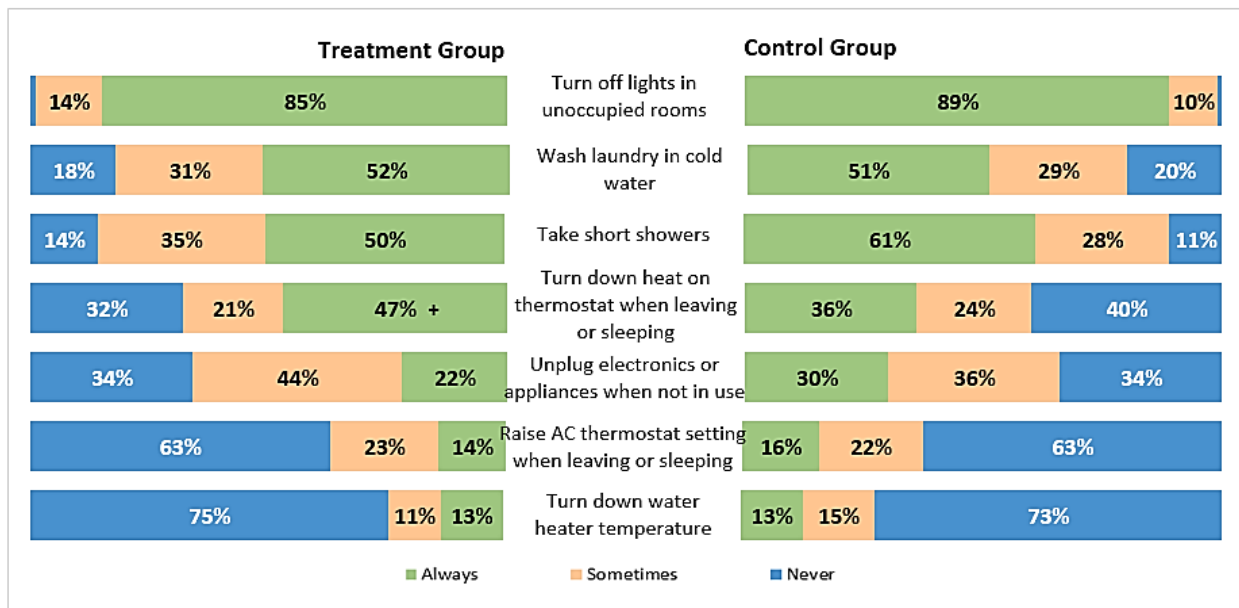


Figure 5. Low-income customer frequency of taking energy-saving behaviors

+ Difference is statistically significant, $p \leq 0.10$.

Source: Survey question, "I will read through some energy-saving actions you may have heard or read about. Please let me know if you always, sometimes, or have never taken these actions in your home." (treatment group $n_w=206$, control group $n_w=57$)

When asked, 59% of treatment group respondents ($n_w=231$) said they remembered seeing information about *Winter of 68* in the HERs. Of these, 29% ($n_w=130$) reported turning down their thermostat to 68 degrees after seeing the information, and 23% said they had already set their thermostat to 68 degrees. However, 40% said they did not change the thermostat temperature.

All treatment customers received the LIHEAP module in their HER, even those who may have already applied to the program. Following this promotion, Cadmus expected to see a significant difference between the treatment and control groups in awareness of LIHEAP. Treatment group respondents showed a slightly greater ability to name LIHEAP (21%) compared to the control group (15%), but this was not a statistically significant difference.

When asked, 47% of treatment group respondents ($n_w=231$) said they remembered seeing information about LIHEAP in the HERs. When asked, 40% ($n_w=231$) said they heard about LIHEAP for the first time through the

HERs. A total of 94 treatment group respondents in the survey sample reported that they had applied to LIHEAP. Of these, 11% said they applied because of the information in the HERs.

Cut energy costs with the touch of a button

It's simple: set your thermostat to 68°F this winter. You can save up to 5% on heating costs for each degree you lower the thermostat.

For a full season of savings, remember: **68 is great!**

Don't get left in the cold this winter. Help is available.

Apply for \$100 to \$1,000 to help towards your heating bill with LIHEAP (Low-Income Home Energy Assistance Program).

You may qualify if you meet the following guidelines:

Household size	Max yearly income
1	\$17,655
2	\$23,895
3	\$30,135
4	\$36,375

Add \$6,240 for each additional person.

There are two types of grants:

- Cash Grants:** Direct payments to your account for current and past-due bills
- Crisis Grants:** Help with a shutoff notice, broken equipment, or lack of fuel

Note that this program is only available in winter.

Funds are limited! Start your application today by visiting ppl electric.com/heatinghelp, or call 1-800-342-5775 to learn more.

Figure 6. Winter of 68 and LIHEAP report modules

Awareness of Energy Efficiency Programs

The HERs appeared to have influenced low-income customers' awareness of PPL Electric's energy efficiency programs. A significantly higher proportion of treatment group respondents (14%; $n_w=220$) than control group respondents (6%; $n_w=64$) reported they were *very familiar* with energy efficiency programs or rebates from PPL Electric (difference is statistically significant, $p \leq 0.10$).

A significantly higher proportion of control group respondents (39%) than treatment group respondents (28%) reported they were *not at all familiar*. Moreover, when *very familiar* and *somewhat familiar* responses were combined to represent *familiar*, and *not too familiar* and *not at all familiar* responses were combined to represent *not familiar*, treatment group (54% familiar) and control group (40% familiar) still showed a significant difference (difference is statistically significant, $p \leq 0.05$).

When asked, more treatment group respondents than control group respondents could name an energy efficiency program offered by PPL Electric. A significantly higher proportion of treatment group respondents named two income-qualified programs (OnTrack and E-Power Wise) compared to control group respondents (difference is statistically significant, $p \leq 0.10$).

Satisfaction with Utility

The HERs had a positive impact on low-income customer satisfaction with PPL Electric. Survey respondents rated their satisfaction with PPL Electric's efforts to help them manage their monthly electricity usage. The results showed a significant difference between the treatment and control groups. On average, treatment group respondents gave a rating of 7.8 ($n_w=219$) and control group respondents gave a rating of 6.6 ($n=62$) (difference is statistically significant, $p \leq 0.05$). Treatment group respondents also gave a significantly higher

rating (8.9, $n_w=224$) than the control group (8.3, $n_w=63$) for their overall satisfaction with PPL Electric (difference is statistically significant, $p \leq 0.05$).

The low-income behavior program generated greater overall customer satisfaction with PPL Electric than the general residential behavior program. On average, low-income treatment group respondents gave a significantly higher rating (8.9) for overall satisfaction with PPL Electric than general residential treatment group respondents (8.1; $n=355$) (difference is statistically significant, $p \leq 0.05$).

Online Engagement

Low-income treatment and control group respondents did not significantly differ in reported visits to PPL Electric's website to look for ways to save money on their electric bill. As shown in Figure 7, 14% of treatment group respondents ($n_w=231$) and 13% of control group respondents ($n_w=69$) visited the utility website.

A significantly lower proportion of low-income treatment and control respondents reported visiting the utility website (14%; $n=300$) than general residential program survey respondents (32%; $n=536$) (difference is statistically significant, $p \leq 0.05$). Access to the Internet was a barrier for low-income customers; as Figure 7 shows, about 19% of low-income respondents did not have a computer or access to the Internet. The general residential behavior program's survey, which fielded one year prior to the low-income survey, did not offer the response option *Do not have a computer or Internet*. Cadmus added this response option to the low-income survey. Moreover, 55% of low-income respondents ($n_w=235$) agreed in general with the statement *My access to the Internet is very limited at home*. In comparison, 23% of general residential respondents ($n=534$) agreed with the Internet access statement.

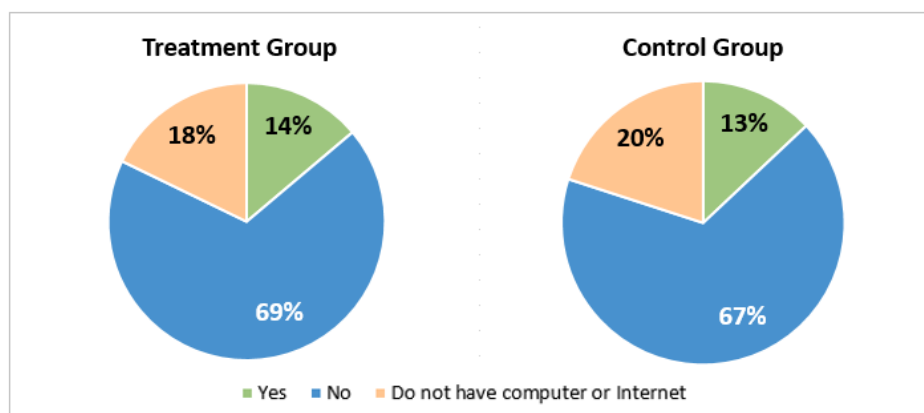


Figure 7. Low-income customer visits to PPL Electric website

Source: Survey question, "Have you ever visited the PPL Electric Utilities website to look for ways to save money on your electric bill?" (treatment group $n_w=231$, control group $n_w=69$)

Cost-Effectiveness

The low-income HER program was cost-effective during its second year of implementation, with a total resource cost (TRC) test result of 2.65 (June 2015 to May 2016). Total resource costs were lower and benefits were higher in the second-year than in the first year when the program launched (autumn 2014). Including the prior administrative costs for program set up during the launch period, the program TRC was 0.65. Over a longer term (and as seen in the second year), this program targeting income-qualified customers is expected to deliver cost-effective savings.

Key Findings and Conclusions

- 1. The savings ramp up was slower for the low-income behavior program than for the residential behavior program.** The slower ramp up of savings for the low-income program may have occurred for several reasons. The average low-income participants' pre-treatment consumption is low, which could result in fewer opportunities to take actions to save energy. They may already have been engaged with various energy-saving practices (behaviors and product adoption) to save money prior to receiving the HERs, and their additional actions are therefore a smaller magnitude and take longer to show up in the savings. Additionally, general residential HERs included low cost action steps to save energy, which could have led that population to achieve larger savings in less time.
- 2. The HERs appeared to have had some influence on engaging low-income customers in a targeted energy-saving behavior (i.e., turning down the heating thermostat temperature when leaving or sleeping).** This specific behavior change could be attributed to the HER's *Winter of 68* module, which promoted lowering the thermostat to 68 degrees during the winter.
- 3. HERs raised awareness of LIHEAP and drove customers to apply.** The HERs educated 40% of survey respondents about LIHEAP and led 94 to apply for this energy assistance, 11% of whom said they applied because of the HERs information. This positive outcome is attributable to the program.
- 4. The HER program boosted low-income customer satisfaction with PPL Electric and was more positively received by the low-income customers than general residential customers.** Notably, the low-income behavior program respondents provided a significantly higher rating for PPL Electric than did the general residential behavior program respondents. Moreover, low-income behavior program participants exhibited greater satisfaction with the HERs compared to the general residential behavior program participants. One plausible explanation is the low-income respondents' stronger belief in the accuracy of the neighbor comparison.
- 5. Fewer low-income customers may be visiting the PPL Electric website because they lack Internet access.** A significantly lower proportion of low-income respondents reported visiting the utility website (14%) than general residential program respondents (32%). Access to the Internet was a barrier for about 19% of low-income respondents, who did not have a computer or access to the Internet. Moreover, 55% of low-income respondents in general agreed with the statement *My access to the Internet is very limited at home*, compared to 23% of general residential HERs respondents.

Recommendations

- 1. Allow more time for a low-income behavior-based DSM program to reveal its value.** It may take longer for low-income behavior programs' savings to ramp up and for it to become cost-effective compared to other residential programs. The first year may not produce as much savings as future years, but utilities can still reap the customer satisfaction benefits.
- 2. Consider sending additional print HERs and/or developing print versions of some of the digital content to send to low-income customers.** While many utilities are moving to digital channels and digital content, many low-income customers have barriers to accessing this content. As a result, low-income customers may be less informed, may miss energy-saving opportunities, and may receive fewer encouragements to save. Consider alternative, non-digital ways of reaching out about ways to save, such as sending a seasonal newsletter that compiles digital content not found in the print HERs.

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