

# Behavioral Effects: How Big, How Long, From Whom, How Best?

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## ABSTRACT

Behavioral programs are increasingly popular, and are being considered by more and more utilities. They are an opportunity to achieve large potential savings, avoiding capital and installation barriers. However, the literature is sparse, and more information about savings, persistence, and customer responses to programs is needed if utility energy efficiency portfolios are to rely on such a program.

This statewide evaluation of a home energy report program, a common type of information-based residential behavioral program, is a full impact, persistence, and process study, and provides important evaluation value and context for the assessment (and improvement). The paper presents:

- Impact findings: Using control-group designs, the authors estimated net savings for two groups of electricity customers—high-use and average-use. The paper presents both absolute and proportional results and examines differences for customer groups.
- Persistence: A key concern associated with behavioral programs—and some believe an important perceived barrier to widespread portfolio adoption—is post-intervention persistence of the program savings. This study examined whether and when savings persist among high-use customers who temporarily (for six months) or permanently (for at least a year) stop receiving information about their energy use.
- Process evaluation: Finally, we present information on the process evaluation, including information on customer engagement with the reports, perceived usefulness of the reports, and barrier program features.

## Introduction

Connecticut Light and Power (CL&P) in Connecticut offers a Home Energy Reports (HER) to provide feedback to residential customers as part of their bills. The HER includes comparisons to 100 ‘neighbor’ homes chosen for their similar demographic and energy use characteristics, specific tips on how to save energy, and the participants energy use compared to the program designated neighbor group. The program is designed to be a low-cost social marketing program relying on feedback and comparison groups / “norms” to motivate behavior change. Behavioral programs that use home energy reports (HERs) have proven to be effective in reducing participants’ energy usage and in providing cost effective savings for numerous utilities (Mazur-Stommen and Farley, 2013). There is also evidence that the residential HERs elicit a degree of persistence of savings after participants stop receiving the reports (Allcott and Rogers 2012) further reducing the cost per kilowatt hour (kWh) of savings achieved by the program. Although the savings potential has been well documented (NMR et al., 2013), existing studies tend to have focused on high-use customers and have not established if these programs

can successfully reduce energy use across the entire residential population. The studies have also not fully explored the long-long persistence and reliability of such savings. This paper explores whether the CL&P HERs behavioral program is as effective among average energy use households as it is among high-use households and if there is a difference in how the high- and average-use households view their HER. The authors also explore the impact of different lengths of program participation on persistence of savings. This paper also looks at participants reactions to the HERs and how reactions differ among usage groups.

## **Program Design**

One critical characteristic of the HERs program is its reliance on an experimental design. The popular behavioral program implementer identified a study group of 48,000 CL&P residential customers across the state of Connecticut and then randomly assigned each of the study group households to either a treatment group that received HERs in the mail or to a control group that did not receive the HERs. The pilot program uses an “opt-out” design (less than one percent of recipients chose to opt-out of the program), where customers assigned to the treatment group automatically receive reports, but have the option to contact program representatives to opt-out of the HERs program if desired.

This paper evaluates the second year (Year 2) of this residential behavioral program in which the program varied the study design (NMR et al., 2013). While the first year of the pilot study included only high electricity use customers, the Year 2 study group included both high-use (i.e., about 1,600 kWh per month) and average-use (i.e., 700 kWh per month) households. The high-use households in Year 2 were a sub-set of participants from Year 1 of the program and are referred to as the “Extension” group throughout the paper. The average-use participants received their first report during Year 2 of the program and are referred to as the “Expansion” group throughout the paper. Both Expansion and Extension households received monthly reports from July of 2012 through August of 2013.

The paper also explores the persistence of savings among high-use households from Year 1 that stopped receiving reports at the end of the first year of the program. The authors refer to these households as the “Discontinued” households. The Discontinued households are further divided into Abbreviated intervention and Quarterly intervention households: the Abbreviated intervention households received reports for eight months of the Year 1 pilot program (approximately January 2011 to August 2011) while the Quarterly intervention households received a report once every three months for the entire first year of the Pilot (approximately January 2011 to December 2011).<sup>1</sup>

## **Methods**

The authors estimated energy savings and the persistence of savings using billing analysis. They prepared a dataset containing monthly billing data, program, rate code, and weather data and then analyzed the data in STATA, a widely used statistical analysis software package. The billing analysis relied on a statistical technique known as ordinary least squares

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<sup>1</sup> The implementer staggered the delivery of reports such that households received their first report sometime between January 2011 and March 2011, with most receiving their first report in late January or early February. These households then received their last report about one year later, again staggered between December 2011 and March 2012.

(OLS) robust regression, which is resistant to any imbalances in pre-program use between treatment and control groups and also to data point outliers; thus, OLS ensures that the method does not over-estimate or underestimate treatment effects. The authors applied this approach because it limits the impact of missing data (including inadequate post and pre-treatment electricity-use information as well as households lacking treatment/control assignments) were not evenly distributed between the treatment and control group households. This created an imbalance in the dataset, and robust OLS addresses such imbalances. The billing data for each household were compressed to a single pre-treatment and post-treatment average. The analyses used the estimating equation below:

$$\text{Estimated Average Electricity Savings} = \beta_0(Avg.Post) + \beta_1 X_1(Avg.Pre) + \beta_2 X_2(Treatment) + \beta_3 X_3(Electric Heat) + \beta_4 X_4(HDD) + \beta_5 X_5(CDD)$$

All results were multiplied by negative one (-1.0) for ease of interpretation; this step converts a measure of decreased use—a negative number—to a measure of savings—a positive number.

The authors used two methods to conduct the process evaluation for Year 2 of the program. We conducted qualitative telephone interviews with 304 participant residential households who received HERs monthly from late July or early August 2012 through March 2013. The survey included independent samples of 152 Extension households who had received reports in the Year 1 program as well as 152 Expansion households who were receiving HERs for the first time.

We also conducted three focus groups. The 21 attendees lived within a 15-mile radius of the facilities, were aware they were receiving HERs, and received an incentive of either \$85 or \$100.

The survey and focus group discussions focused on the following issues:

- Levels of readership and engagement with the HERs
- Usefulness of the HER information for their household
- Satisfaction with the program
- Barriers to engaging the program
- Ideas for changes in the program that could increase engagement and satisfaction

In this paper, we focus on findings from the survey and focus groups that address engagement with the HERs and changes in the reports that respondents felt could better meet their needs.

## **Impact Findings: Electricity Savings Attributable to the Program**

The billing analysis suggests that Year 2 treatment households (n=18,264) achieved electricity savings of about 1.82%; this translates into 0.64 kWh per day or 233 kWh per year for each household, or 4,254 MWh across the entire program (Table). We also tested for differences in savings between the high-use Extension (n=8,047) and average-use Expansion samples (n=10,242). One would expect the achieved numerical savings to differ for these two groups because their pre-program electricity use also differed, but the impact on the percentage of savings remained unknown.

The analyses revealed that the percentage of electricity savings differed significantly between high-use Extension households and average-use Expansion households, with Extension households saving about 2.31% and Expansion households about 1.17%. Note that the electricity savings achieved by the Extension group in Year 2 were comparable to those achieved by all Year 1 monthly report recipients—of which they are a subset—in the Year 1 study (i.e., 2.17%), suggesting that savings remain relatively constant over time in households with prolonged program exposure (NMR et. al., 2013). Due to a mixture of pre-program electricity use and differences in achieved savings, the Extension households saved an average of 433 kWh per year (3,487 MWh program savings), while the average Expansion household saved 96 kWh per year (977 MWh program savings). A Wald test concludes that the two models differ significantly.

Table 1. Estimated average electricity savings during year 2

<b>Sample Used</b>	<b>Total</b>	<b>Extension HH</b>	<b>Expansion HH</b>
Daily Electricity Savings (kWh)	0.64	1.19	0.26
Upper Bound 90% CI	0.74	1.45	0.37
Lower Bound 90% CI	0.53	0.93	0.16
Total kWh Electricity Savings/Household	232.89	433.38	95.58
Total MWh savings (program) <sup>a</sup>	4,253.50	3,487.41	976.54
Percent Savings	1.82%	2.31%	1.17%
Treatment Sample Size (No. of Households)	18,264	8,047	10,217
Control Sample Size	19,421	9,035	10,242
Explained Variance	88%	69%	56%

<sup>a</sup> The Extension and Expansion results come from separate models, so the total electricity savings results reported here cannot be duplicated through simple arithmetic.

We also explored the savings rates within high-use and average-use groups to determine whether the savings were concentrated among a sub-set of participants. The authors performed this analysis because the Year 1 study had suggested that savings were concentrated among the high-use users who had the greatest pre-program energy use—that is, the highest of the high users accounted for most of the program-induced energy savings (NMR et. al., 2013). In this Year 2 study, the evaluators examined use for those households with energy use that was within two standard deviations of the mean for the respective use group (i.e., high or average) versus those with use greater than two standard deviations from the group mean. The results demonstrate statistically significant savings between the sub-groups, indicating that savings were greater among the highest users within both the Extension and Expansion groups (Table 2 and Figure 1). Specifically, the typical Extension treatment group household saved 416 kWh over the course of the study period while the average outlying Extension treatment household saved 913 kWh during Year 2. The typical Expansion treatment household saved around 93 kWh over the course of Year 2 while the outlying Expansion treatment group did not save a statistically significant amount of electricity. These findings confirm the conclusions that HERs are generally most successful at inducing electricity savings among high-use households—with the highest users achieving the largest daily kWh savings.

Table 2. Estimated average electricity savings among typical and outlying households

Sample Used	Extension HH		Expansion HH	
	Typical Use	Outlying Use	Typical Use	Outlying Use
Daily Electricity Savings (kWh)	1.14	2.50	0.26	0.52
Upper Bound 90% CI	1.39	4.61	0.36	1.53
Lower Bound 90% CI	0.89	0.39	0.15	-0.50
Total kWh Electricity Savings Per Household	416.29	913.31	93.47	188.84
Percent Savings	2.34%	2.49%	1.16%	1.53%
Treatment Sample Size	7,637	406	9,952	265
Control Sample Size	8,950	440	9,948	294
Explained Variance	54%	50%	54%	10%

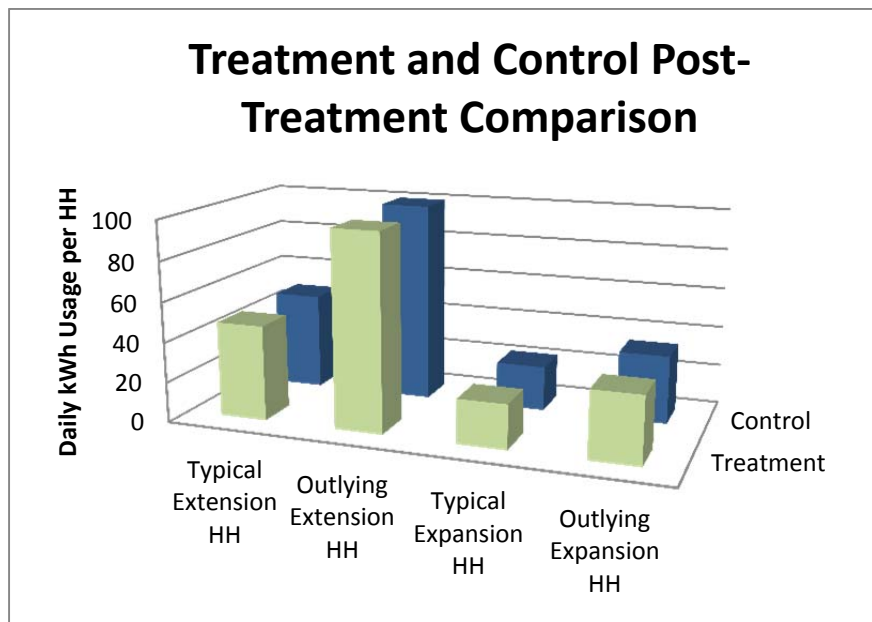


Figure 1. Comparison of daily energy usage between treatment and control households.

## Persistence of Savings

In addition to exploring electricity savings during the treatment period, the team also examined how long savings persist after treatment households stop receiving report. They explored savings persistence through two types of analyses:

1. Persistence of savings among the high-use Extension households during the hiatus between the last Year 1 and first Year 2 reports (April through July 2012).
2. Persistence of savings for all permanently discontinued Year 1 households. The authors specifically examined persistence of savings for the Abbreviated monthly (only received reports for eight months) and Quarterly (received reports every third month) treatment groups that did not receive reports after March of 2012.

The results of the first analysis indicate that the Extension sample continued to achieve savings comparable to their Year 1 savings during the hiatus period (1.97% during Year 1 and 2.17% during the hiatus). Monthly variations in savings, which ranged from 2.04% to 2.32%, reflect natural fluctuations in electricity use (Table 3).

Table 3. Estimated average electricity savings among the extension group during the hiatus between year 1 and year 2 of the program

	<b>Year 1</b>	<b>April thru July 2012</b>	<b>April 2012</b>	<b>May 2012</b>	<b>June 2012</b>	<b>July 2012</b>	<b>Year 2</b>
	<b>Received Reports</b>	<b>No Reports</b>	<b>No Reports</b>	<b>No Reports</b>	<b>No Reports</b>	<b>No Reports</b>	<b>Received Reports</b>
Extension Treatment Effect	0.97	0.99	0.91	0.89	0.96	1.21	1.19
Percent Savings	1.96%	2.17%	2.27%	2.32%	2.16%	2.04%	2.31%
Treatment Sample Size <sup>a</sup>	8,071	7,674	8,052	8,031	8,030	8,073	7,637
Control Sample Size <sup>a</sup>	8,160	9,404	8,000	8,217	8,973	8,872	8,950
Explained Variance	84%	71%	44%	57%	71%	77%	69%

<sup>a</sup> The sample size varies because the team did not always have billing data for each household for every month

The results of the second analysis point to continued electricity savings for the discontinued treatment sub-groups from Year 1. In particular, the discontinued Abbreviated and Quarterly2 treatment groups each continued to achieve statistically significant savings between

<sup>2</sup> There was also a monthly discontinued treatment group comprising those households not included in the Year 2 Extension group. The discontinued monthly group's (a subset of its original group) pre-treatment energy usage was

April 2012 and July 2013. Overall, the Abbreviated and Quarterly groups saved about 1.86% and 2.06% respectively over the time period (Table 4).

Table 4. Estimated average electricity savings among the discontinued group after report cessation (April 2012 through July 2013)

	<b>Year 1<sup>a</sup></b>	<b>Year 2</b>
Discontinued Abbreviated Treatment Effect	0.52 (1.06%)	0.75 (1.86%)
Discontinued Quarterly Treatment Effect	0.72 (1.45%)	0.83 (2.06%)
Sample Size	47,296	35,573
Explained Variance	80%	69%

Looking at the persistence of electricity savings for each month after the cessation of reports, the results suggest that Quarterly treatment households exhibited statistically significant savings 15 months after receiving their first report, although the savings appeared to be diminishing over time (Table 5). In contrast, households in the Abbreviated treatment group not only saw savings diminish, but they also tended to become non-significant over time.

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borderline (p=0.106) significantly different from the control group making the monthly groups inclusion in this analysis inappropriate.

Table 5. Estimated average electricity savings among the discontinued group by month during year 2

	Discontinued Abbreviated Treatment Effect	Discontinued Quarterly Treatment Effect	Sample Size	Explained Variance
April 2012	0.46* (1.16%)	0.88 (2.20%)	34,692	54%
May 2012	0.56 (1.47%)	0.85 (2.25%)	34,420	55%
June 2012	0.79 (1.78%)	0.98 (2.22%)	35,909	69%
July 2012	0.82 (1.38%)	0.85 (1.44%)	35,573	76%
August 2012	1.08 (1.77%)	0.89 (1.46%)	35,375	77%
September 2012	0.84 (1.64%)	0.75 (1.46%)	33,846	76%
October 2012	0.43 (1.10%)	0.57 (1.45%)	34,767	65%
November 2012	0.40 (0.98%)	0.66 (1.62%)	32,606	56%
December 2012	0.89 (1.70%)	0.86 (1.66%)	29,856	64%
January 2013	0.41* (0.69%)	1.05 (1.79%)	35,375	71%
February 2013	0.46* (0.76%)	1.22 (2.00%)	31,419	76%
March 2013	0.36* (0.65%)	1.15 (2.11%)	34,312	68%
April 2013	0.30* (0.66%)	0.88 (1.89%)	34,102	53%
May 2013	0.26* (0.72%)	0.31 (0.83%)	32,351	49%
June 2013	0.55 (1.22%)	0.60 (1.34%)	33,787	64%
July 2013	0.56* (0.90%)	0.52 (0.84%)	33,524	72%

\*Indicates effect is not statistically significant.

## Process Findings

Process finding are based on a telephone survey of 304 program participants and focus group data from 21 program participants.



## Customer Engagement with the HERs

The telephone survey results suggest that engagement with the program—awareness and readership of the HERs—is high. Over 90% of respondents in the high-use Extension and average-use Expansion treatment groups said that they were aware of receiving the HERs. In about 58% of these households, someone read “the whole report.” A very small proportion (less than 1%) did not read the report at all. These results are very similar to those from a Year 1 survey of a sample of high-use participating households.

Most respondents remained engaged with the program over time, but evidence suggests that long-term recipients of the HERs, such as the Extension sample, may be associated with slightly declining levels of, or less consistent, engagement with the program’s primary means of encouraging behavioral change. Almost three-quarters of survey respondents were just as likely to read the reports near the end of the program year (at the time of the survey) as when they first started receiving the reports. If readership changed, it was slightly more likely to increase over time rather than decrease, but only among average-use Expansion households not the high-use Extension households. A majority of households have read “all of the reports” and 85% have read most of the reports (at least “more than half”). Average-use Expansion households were more likely to have read all of the reports (69% compared with 60% of high-use households).

In spite of reported readership, respondents seldom recalled specific information from the HERs. Respondents could describe the main elements of the HERs, but they could not easily vocalize details about the content of the reports weeks or months after they had received a report. Almost 90% of households mentioned the neighbor comparison when asked what information they remembered from the HERs, and 20% named the energy-saving tips, each of which are prominent and standard features of every report. Asked to describe a specific energy-saving suggestion, survey respondents collectively mentioned a dozen different tips but the most common response was “none” (30%). This finding did not differ between Extension and Expansion households.

Focus group attendees had strong positive or negative reactions to the neighbor comparisons that were not always revealed by the shorter open-ended questions in the telephone survey. Attendees in each focus group indicated the HERs sparked a “competitive spirit,” motivating them to try to maintain a favorable status in comparison to their neighbors. In this respect, the HERs appear to be successful at motivating recipients to consider their household electricity consumption and to consider how to increase their energy-saving behavior. In the words of one participant *“I enjoyed getting it because I had a sense of competition with it. I felt like I want to do better because it's kind of, it's ranking you among your neighbors. So I kind of enjoyed the competitive feeling, because I am conscious of what I use, what energy I use. And so it felt like I was being rewarded in some way for my effort.”*

In contrast, the neighbor comparison discouraged other attendees, making them less inclined to read the reports or more apt to discredit the information. Two attendees indicated they had stopped paying attention to the HERs because they knew their rating would be “More than Average” and did not see how they could improve their standing among the neighbor comparison group. Other attendees likened the HERs to receiving a “bad report card.” For these households, the HER comparison with their “neighbors” appeared to produce a sense of frustration or futility, since they did not understand why their household was using more than others. This increased the chances of these households disengaging from the HER Program and paying less attention to the HERs.

Whether motivated or not by the neighbor comparison, focus group attendees felt the HERs program did not explain the comparison group clearly. Most focus group attendees indicated the comparison with neighbors was the primary focal point of the HERs for them. However, only two people recalled noticing the description of the neighbor comparison group, even though it appears on the HERs directly below the neighbor. Nearly all attendees reported they did not know who they were being compared to. Many assumed that the term “neighbors” referred to houses in the immediate vicinity not those that are “nearby” and “similar in size.” Similar to the survey respondents, this misunderstanding caused many attendees to comment on the differences between their households and those of their neighbors. As one participant noted:

*“I think there are such different circumstances that, you know, there are people that are home all day. I had my husband in hospice for a year, and I had a lot more electricity usage with machines and what not during that period. I just think there are large families, small families. I don’t know that it really means much when you are compared with everyone else (in your neighborhood).”*

As the comments shown above illustrate, treatment households may interpret the neighbor comparison group as including their immediate neighbors—that is, people they may know, can observe, or might speak to as they go about their daily lives at or near their homes. While the implementer define the neighbor group as “approximately 100 occupied, nearby homes that are similar in size to yours” and specify a comparable square footage parenthetically, the terms “neighbors” and “neighborhood” encourage a commonly understood and culturally-embedded idea that neighbors are the people around us, the homes we can see and easily walk to from our own home.

## **Usefulness of the HERs**

Survey questions that briefly described each of the main elements of the HERs and asked respondents to rate their usefulness revealed that the majority of respondents judged the reports to be useful. Almost one-fourth of respondents judged the reports to be “very useful,” and 47% rated the reports as “somewhat useful,” and the percentages were even higher in households in which someone read the entire report.<sup>3</sup> Although the differences are small, Expansion households found the information in the HERs more useful than Extension households.

Despite the overall high assessments of report usefulness, it is important to note that no single element of the HERs stood out in the memories of respondents even though the overall report was considered useful. When asked to select the most useful information, households reverted to what they remember most easily (i.e., the neighbor comparisons and energy-saving tips). This result is also very similar to the Year 1 survey when 44% of respondents named the neighbor comparison as “most useful” and 15% cited the energy-saving tips. In both surveys, “none” was the second most often mentioned response for what households found to be the most useful aspect of the report.

Qualitative data from the focus groups and from open-ended survey questions revealed additional information on the effectiveness of the HERs: Regularly receiving the HERs reminded households of the importance of energy conservation behaviors and shaped the framework in

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<sup>3</sup> The causal relationship here is not clear—households that read each report may, as a result, find them more useful. Alternatively, households that find the reports to be useful initially may then continue to take the time to read each report when they receive it.

which they made decisions. A response typical for many was *“I don’t think I do anything special because of this report, but I think it is a kick in the pants every month not to slip.”*

## **Information Needs that are not Met**

Reactions to the HERs as measured by quantitative survey questions are generally positive, but households also voiced frustration with the reports in focus group discussions and open-ended follow-up questions.

Participants wanted more specific information on how their household could reduce its energy use. The energy-saving tips, they felt, were too general and not customized to their situation. For example: *“I wish the recommendations were less generic. They are too broad.”* And *“Much more specific to my house or new or upcoming products that would help me reduce home energy use.”*

Participants’ desire for more useful diagnostic information extended to the energy comparisons where respondents sought greater transparency and standardization, such as comparisons by time, housing type, or household size. For example: *“It makes more sense to me to compare my own electric use from month to month, on my bill, and from year to year. That means more to me, because I can see more of my usage. I can’t control what my neighbors are doing.”*

## **Conclusions**

The main purpose of this paper was to determine whether the HERs program model achieved the same percentage of savings for the average-use residential electricity customer as it does for high-use customers. The program evaluation shows that the program design achieved statistically significant savings (1.82%) for both high-use and average-use customers, but high-use households achieved statistically higher percent savings (2.31%) than average-use households (1.17%). Differences in pre-program electricity use and the percent savings means that high-use households achieve 350% more electricity savings as measured in kWh than average-use households.

Why does the program produce greater impacts for high-use customers? The process evaluation points to a few possible explanations:

High-use households would tend to receive a greater percentage of reports telling them that their use is higher than their “neighbors;” this appears to appeal to their competitive spirit, motivating these households to take actions to reduce use. In contrast, average-use households will have a higher likelihood of receiving reports that say their use is comparable to or lower than their neighbors, lessening motivation to save electricity.

High-use households may not have taken as many energy-savings steps as average-use households prior to the program; in other words, average-use households may already have adopted many of the tips prior to receiving reports.

As outlined more in forthcoming reports from this evaluation, high-use households tend to be wealthier than average-use households, making it easier for high-use households to afford measures that produce deeper savings than average-use households.

High-use households simply have more to lose. Small changes made in a home with lots of electricity to save will likely yield larger energy savings than similar changes made in a home with less electricity to save.

The analyses also demonstrate that high-use treatment households from the Year 1 study group continued to save electricity long after they stopped receiving reports. Households demonstrated average savings of about 2% through July 2013, a period of 15 months for the Quarterly treatment groups and almost two years for the Abbreviated treatment group. Thus, the evidence suggests that treatment households internalized the behaviors adopted during the treatment period, resulting in long-term savings that go beyond just the program period.

The paper also yields interesting results about how households react to the report. Perhaps the most important is the contradictory reaction to the neighbor comparison: treatment households generally distrusted the comparison, but they also cited it as the most useful part of the report. This usefulness manifested in a very objective way—the program design induces statistically significant electricity savings. Treatment households may get annoyed with the implementer for what these households view as an inaccurate comparison, despite this annoying aspect of the report, the report yields substantial electricity savings for the Company, which in turn also reduces demand and grid congestion as well as lowering greenhouse gas emissions.

The findings also highlight a second important reaction to the reports; they served to keep energy savings “top of mind.” Thus, while treatment households may have griped that the tips are things that “everyone already knows,” the reports served as a little reminder to take those actions on a regular basis. The persistence savings, moreover, suggest that, with enough reminders, these actions become habits; when households see their electricity use creeping back up, they turn back to those behaviors that help to lower that use, even if it is by just a few kWh per month.

Research planned for 2014 will estimate the persistence savings rate for average-use households.

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