CAPE LIGHT COMPACT SMART HOME ENERGY MONITORING PILOT EVALUATION REPORT

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1. EXECUTIVE SUMMARY

This report serves as the process and impact evaluation of Cape Light Compact's (CLC) Smart Home Energy Monitoring Pilot (SHEMP). This evaluation falls under the Massachusetts Cross-Cutting Program Evaluation conducted by Opinion Dynamics with subcontractors Navigant Consulting and Evergreen Economics.

The Smart Home Energy Monitoring Pilot (SHEMP) is implemented by Cape Light Compact (CLC). CLC's SHEMP is an opt-in pilot that offers an integrated in-home monitoring and feedback system for customers on their household energy usage. Through this pilot, customers have access to near-real-time data on their electric energy use based on the theory that, in response to this information, they will reduce their consumption. Customers receive the information through a website where they can set goals and update their profile based on their home characteristics and any relevant household changes. SHEMP is made up of two primary cohorts: (1) "Legacy" households that are using the iCES platform, originally developed by Grounded Power; and (2) "Energize" households that are treated with the Energize platform developed by Tendril (who acquired Grounded Power).

1.1 KEY FINDINGS

What Are the Impacts of the Pilot?

Our research indicates that the two SHEMP cohorts (Legacy and Energize) generated very different pilot effects. Due to differences in treatment approaches and customers reached, we cannot directly attribute these differences to either the pilot model or the specific customers reached. However, our secondary research suggests that the pilot-specific changes may have had an impact on customers' behavioral responses.

- There are significant savings differences between the SHEMP Legacy and Energize customers. Based on our estimates:
    - Legacy customers' savings range from 7.8% to 8.8% average savings per household.
    - Energize customers' savings estimates are significantly lower, ranging from 1.49% to 1.99% average savings per household.
- Similar to differences observed in savings, we see dramatic differences between SHEMP Legacy and Energize cohorts' cross-program participation levels. Specifically:
    - Legacy customers demonstrated a sharp increase in cross-program participation during the Legacy participation period. Roughly three to six months after pilot participation began (the participation period started between June and September 2009 for different customers), we observed a sharp increase in other program participation. However, this trend leveled off after 12 to 18 months of treatment.
    - Energize customers' monthly cross-program participation dropped during the treatment period. These participation findings are consistent with the self-reported findings that customers do not appear to be increasing their measure-based actions during the pilot period.

Can Behavioral Pilots Generate Persistent Savings?

The CLC SHEMP effort demonstrated persistent energy savings from 2009 to 2012 for the Legacy pilot participants. The 2009 PA Consulting Group Report[1] showed a savings of 9.3% per household, indicating that the savings for this pilot have remained relatively stable with treatment, with a modest decrease from the 2009 estimates to our savings estimates of 7.8% to 8.8% per household.

What Is the Process Feedback from Energize Customers?

We conducted a post survey with Energize customers to obtain process feedback and examine customers' engagement with Energize offerings and their behavioral responses to the pilot. We found the following for Energize customers[2]:

- Nearly half of Energize customers (47%) continue to use both the device and website after 12 months, and 12% of original participants no longer engage the device. Across all participants who have received the device, just under half (47%) say that they still use both the device and the website, while slightly fewer (40%) say that they use the device only. Most participants who removed the device (12% of all participants) said that they use neither the device nor the website. Only one customer reported using the website and not the device.
    - Engagement with the in-home display tends to decrease over time. Nearly half (47%) of the customers report using the in-home display less frequently than when they first installed it, while only a few (8%) said that they engaged with the information more frequently.
    - Many customers are not accessing the SHEMP website, and those who do access it infrequently. About half (54%) of customers have accessed the website since enrolling in Energize. Over a third of customers (39%) who use the website access it at least every three months, and a quarter (24%) access it at least once per month.
- Energize participants need more specific, actionable educational material than what is currently provided on the in-home display (IHD) to take action. Less than half of customers (48%) said they had enough information to take action from the IHD alone. Slightly more than half (54%) of those who logged on to the pilot website said that they found enough information from the site to take energy-saving actions at home.
- Awareness of alternative CLC programs is generally higher once customers have participated in SHEMP. Half (50%) of participants in the pre-period are aware of alternative programs to Energize offered by CLC, compared with more than half (62%) of participants in the post-period. However, this does not appear to be translating to more pilot participation.
- CLC Energize participants reported making few changes to their household equipment and behaviors during the pilot period, but many had taken actions in the 12 months before enrolling. Pre-period actions were much greater for low-cost measures and for energy efficiency appliances as compared to self-reported actions in the post-period. Notably, the percentage of respondents who reported installing these measures during the pre-treatment period was

[1] Cape Light Compact, Residential Smart Energy Monitoring Pilot, Final Report (March 31, 2010) http://tomharrisonjr.com/wp-content/uploads/2010/08/CLCSmartEnergyMonitoringPilotFinalReport3-31-2010.pdf.

[2] Note that Legacy customers were not surveyed for this study.

already high (51.9% low-cost measures, 28.6% appliances). This indicates that many participants put new energy-efficient measures in place shortly before they installed the IHD, and may have had limited opportunities to do so in the post-period. Only one post-period action indicated an increase; that was the installation of on-demand tankless water heaters. These findings are consistent with our findings in the cross-pilot participation analysis, and align with the lower observed savings estimates (as compared to Legacy customers).

- Furthermore, respondents did not report major changes in behavior during the pilot period, with the exception of a significantly higher number reporting that they hang laundry to dry. This indicates that customers may be taking smaller conservation actions as a result of the pilot treatment, some of which may not have been directly measured in the survey.

1.2 CONSIDERATIONS FOR FUTURE RESEARCH

To date, little is known about the stability of savings from CLC behavioral models due to their lack of maturity as programs. For this reason, we suggest continued evaluations of each pilot model on an annual basis.

2. INTRODUCTION

This report provides the findings from the 2012 annual process evaluation of the CLC SHEMP Pilot.[3] Opinion Dynamics Corporation, with subcontractor Navigant Consulting and Evergreen Economics (henceforth the "Evaluation Team"), were contracted to conduct this evaluation through 2012. This represents the third formal report of the three-year evaluation under the Massachusetts Cross-Cutting Program Evaluation contract.

Behavioral programs and pilots implemented in Massachusetts fall into two primary implementation models: opt-out and opt-in.

- **Opt-out models** assign customers to treatment. Customers have the choice to opt-out of programs, but are not directly asked if they want to participate before receiving treatment. The OPOWER HER program is the most common behavioral program in this model.

- **Opt-in models** are where customers specifically choose to participate in the program. These programs include a wide range of efforts, from online portals to in-home displays.

Opt-in customers are, overall, more motivated to take action and generate high savings per customer than opt-out programs. However, because customers have to initiate participation, the reach of opt-in programs is much lower than that of opt-out. The CLC SHEMP pilot is an opt-in model pilot.

Table 1. CLC Pilots

Model	Program	PA	Cohort	Program Start Date	Last Program Cycle End Date	Duration of treatment	Fuel type	Evaluated participants[4]
Opt-in	Tendril	CLC	In-home display program	~June 2009	~May 2012	36 months	Electric	83
Opt-in	Tendril	CLC	In-home display program	~June 2011	~May 2012	12 months	Electric	277

~ Enrolled was done on a rolling basis and as such the starting date for enrolled is noted here

Below we describe the CLC SHEMP Pilot model detailed in this report.

To participate in the Smart Home Energy Monitoring Pilot (SHEMP), Energize customers must be year-round residents of Cape Cod or Martha's Vineyard, have lived in their home for a year or more, have high-speed (always on) Internet connectivity, a free Ethernet port on their router, a power outlet near their router, and a power outlet within six feet of the electricity meter. Participation criteria for Legacy customers are the same, except that the power outlet needs to be immediately adjacent to the meter rather than six feet away.

[3] Information about previous year's evaluation can be found in our 2010 evaluation: *Opinion Dynamics (2011). Massachusetts Cross-Cutting Behavioral Program Evaluation. Oakland, CA: Presented to the Massachusetts Energy Efficiency Advisory Council.*

[4] Note values presented here are for first-year participants where programs were implemented for more than one year.

Table 2. Comparison of Legacy and Energize-Treated Customers in SHEMP

Treatment Characteristic	Legacy	Energize
Qualifying	Looked for over 650 kilowatt hours (kWh) per month, representing average customer use.	Customers were not selected based on usage. Recruitment was open to all customers.
Recruitment	Ran a two-by-two advertisement in the Saturday paper. Information was also posted on the website, and had a Provincetown radio station to recruit.	A front-page story was put in the local paper, email blasts were sent to customers, newsletters were sent, and information was posted on the website. Information was also posted in local weekly papers where the story was picked up.
In-home display	No in-home displays were provided for the Legacy customers.	Customers have in-home displays that toggle between kWh and usage screens. The in-home display will accept push notifications.
Frequency of usage feedback	Customers receive usage feedback data at close to one-minute intervals that can be viewed online.	Customers receive 5-15 minute interval data displayed on the in-home display (IHD) as well as online.
Reporting	Customers can opt-in to weekly or daily email reporting from SHEMP.	Customers do not receive reports.
Web engagement	The Legacy pilot has an in-depth social networking function online where customers "share" images of their usage from the website and discuss learnings with other users.	Energize shares information and feedback related to usage and provides benchmarking against others with similar homes, with no social networking component.[5]
Implementation	Provided feedback, manuals, and monthly reports. The pilot prompted customers to log-in and check their usage. Customers logged-in frequently.	Many Energize customers are not aware of the online portal and engagement. During the installation, many customers were not provided detailed information even though it was made available by Cape Light Compact.

[5] The vendor considered making the social networking component available to Energize participants, but it was not incorporated during the study timeframe.

3. METHODOLOGY

In this section, we detail the evaluation activities conducted for the CLC SHEMP Pilot. Table 3 below provides a brief snapshot of the tasks conducted. We describe each method following the table.

Table 3. Data Collection and Analysis Efforts Conducted to Support This Report

Program	PA	Participant Database Review	Cross-Program Channeling Analysis	Impact Analysis
Smart Home Energy Monitoring Pilot	CLC	Yes – all cohorts	No, just participation lift review	Model 1 is regression analysis with pre-processing. Model 2 is bias-corrected matching analysis.

3.1.1 Literature Review

We conducted a literature review in September 2012 to provide CLC with a high-level view of the current landscape of enhanced feedback programs, specifically the varying energy impacts of different **tools and tactics** of in-home feedback.

- **Tactics.** Customer outreach tactics include how customers are selected to participate in the program (e.g., opt-in versus opt-out deployment), as well as customer targeting and segmentation.
- **Tools.** Customer outreach tools include the delivery mechanisms in which customers interact with the program, as well as the feedback content in which information is provided to achieve the greatest impact on customers' behavior. The mechanisms by which customers engage with the programs include frequency of information provided to customers (i.e., real-time feedback down to weekly updates) as well as mail, email, online portals, and in-home displays. The feedback methods where information is provided include personal savings plans, social engagement, competitions and comparisons, energy savings tips, and program channeling.

Detailed findings from 21 in-home display and enhanced feedback programs[6] conducted in the United States from 2004 to 2012 can be found in Appendix A. Note that this is not a comprehensive list of all programs that have existed[7]; these programs have been chosen to reflect the variety of implementation strategies, research methodologies, and resulting savings for the different types of feedback provided through these programs.

3.1.2 Process Analysis: Survey Research

The Evaluation Team conducted three behavioral surveys that are discussed throughout this report for the **Energize-only cohort**. The primary roles of the behavior change survey research were: (1) to

[6] "Enhanced feedback" refers to the broad umbrella of behavioral programs that provide customers with additional details about their usage beyond the information included in their monthly bills.

[7] Additional reviewed programs that are not described in-depth in the literature review are provided in the "Further Reading" section at the end of this document. Feedback studies have been conducted since the 1960s and span three continents, but were excluded in the interests of providing the most current, locally relevant program information.

determine what actions participants report taking as compared to the pre-period; (2) to determine the proportion of actions that are reported to be equipment-based versus conservation behavior-based; and (3) to assess specifically which behaviors are contributing to pilot savings.

We designed the survey to allow comparisons between participant and control group members or their pre-period, regarding reported actions and behaviors taken in the year following first exposure to the behavioral pilot. Key questions included:

- Energy efficiency and conservation behaviors, including:
    - High-cost actions (such as appliances or envelope measures)
    - Low-cost actions (such as installing CFLs or SmartStrips)
    - No-cost actions (such as unplugging appliances, turning off lights)
    - Equipment maintenance and upkeep (such as HVAC tune-ups)
    - Participation in rebate or other non-behavioral programs (including audits)
- Demographic and household characteristics
- Engagement with pilot reports (if participant)

The survey was designed to understand differences in energy efficiency and conservation behaviors among participants, compared with control group members, based on participant exposure to the pilots. Therefore, the survey screened for recall to ensure that we spoke with household members who (a) were exposed to their report (based on their recall of the report), and (b) could provide some feedback related to the report (to ensure completion of process-related questions).

For this survey, we first asked all respondents if they had certain equipment in their home and regularly performed certain behaviors. Next, we asked all respondents if they installed any equipment or changed any behaviors in the past year. Then we asked about many specific actions and behaviors. The figures below detail the survey's logic.

Figure 1. Behavioral Survey Logic – Measures

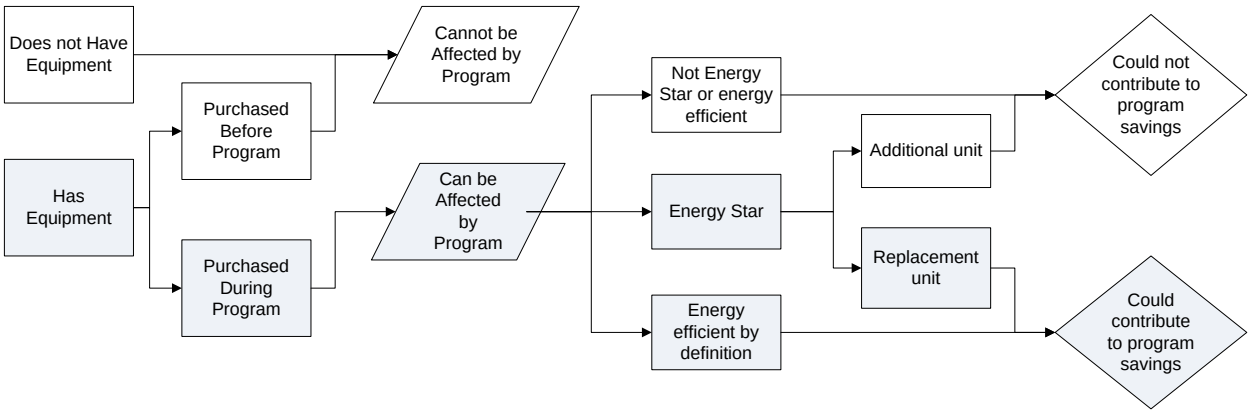
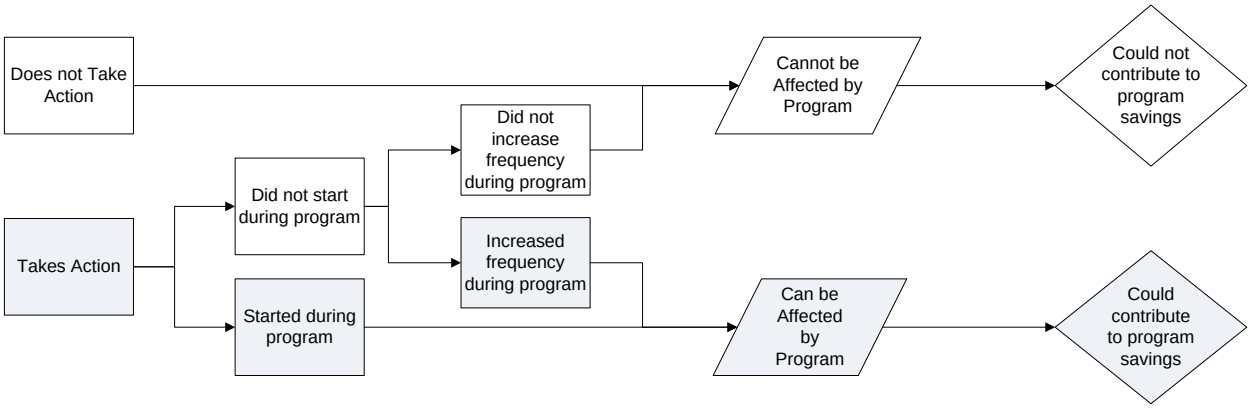


Figure 2. Behavioral Survey Logic – Behaviors



Pre-Post Interviews

We first interviewed customers in August through September 2011, prior to the pilot launch, and then again in November through December 2012, one year after treatment began. The initial, pre-treatment survey was conducted with SHEMP Energize customers scheduled to receive the Energize pilot. Customers were surveyed prior to receiving treatment and after treatment. Seventy-seven (77) total customers completed both survey efforts.

Because this analysis was on a panel of customers, quotas were not applied.

Post Survey with Comparison Group

In addition to conducting a pre-post analysis, Opinion Dynamics conducted 54 interviews with Energize respondents' matched comparison group households. These households were used to measure psychographic differences between the two groups to be used in an instrumental variable approach. Ultimately, the instrumental variable approach was not used for the impact evaluation.

3.1.3 Participation Analysis

To determine whether behavioral pilot treatment generates lift in other energy efficiency programs, we calculated whether more treatment than control group members initiated participation in other energy efficiency programs after the start of the behavioral pilot. We cross-referenced the databases of the behavioral pilot—both treatment and comparison groups—with the databases of other residential energy efficiency programs available to the customer base targeted by the behavioral pilots.

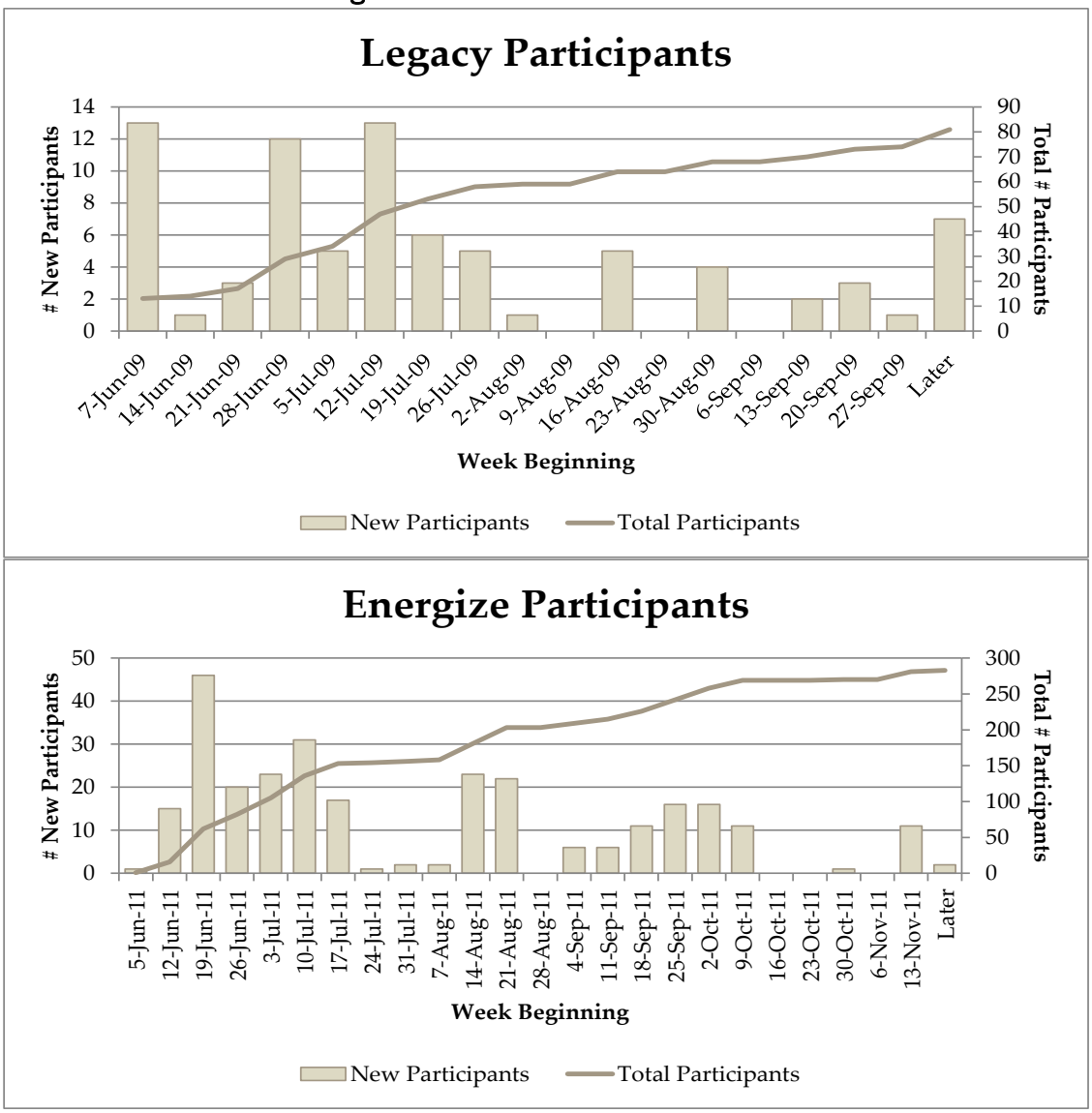
Through this database crossing, we determined (1) whether each pilot household participated in any program after the start of the behavioral pilot; and (2) the date of first participation in each non-behavioral energy efficiency program.

3.1.4 Impact Analysis

Customers Examined

SHEMP is an opt-in pilot involving two groups of customers: (1) Legacy households (N=83 in the analysis) that entered the pilot on the iCES platform during the period of June 9 through October 2, 2009[8] and remain on this platform; and (2) "Energize" households (N=277 in the analysis) that entered the pilot on the Energize platform during the period of June 7 through November 19, 2011.[9] Figure 3 displays the pilot enrollment for the Legacy and Energize participants over time.

Figure 3. Pilot Enrollment Over Time



Because the pilot is opt-in and most customers in each of the two participant groups (Legacy and Energize) enrolled in the pilot over a relatively short time span—most within four months—estimates of pilot savings rely on matched non-pilot comparison customers whose energy use provides a baseline against which the energy use of pilot participants is compared. In other words, the comparison group is treated as providing the "counterfactual" energy use of pilot households—the energy use of pilot

households were they not enrolled in the pilot.[10] The next section presents the models used in the analysis. The following section then discusses the selection of the matched comparison households used in the models.

Models Used in the Impact Analysis

Two models are used in the impact analysis, each estimated separately for Energize and Legacy customers. The first follows the approach of Stewart (2010), who essentially argues that matching a comparison group to the treatment group is a useful "pre-processing" step in a regression analysis to assure that the distributions of the covariates (i.e., the explanatory variables on which the output variable depends) for the treatment group are the same as those for the comparison group that provides the baseline measure of the output variable.[11] This minimizes the possibility of model specification bias. The regression model is applied only to the post-treatment period, and the matching focuses on those variables expected to have the greatest impact on the output variable.

As described in the next section, we matched participant and comparison customers on energy use during the pre-treatment period, and then estimated the following model:

Model 1

$$kWh_{kt} = \alpha_{0t} + \alpha_1 Treatment_{kt} + \alpha_2 PREkWh_{kt} + \sum_{j=1}^{J} \beta^j EE_{kt}^j + \varepsilon_{kt}$$

Where:

kWh_{kt} is the average daily electricity use by household *k* during month t

All Greek characters denote coefficients to be estimated, and in particular α_{0t} is a monthly fixed effect

$Treatment_{kt}$ is an indicator variable taking a value of 1 if customer *k* is a SHEMP participant, and 0 otherwise[12]

$PREkWh_{kt}$ is the average daily electricity use by household k during the most recent month before household *k* enrolled in SHEMP that is also the same calendar month as month *t*. For instance, if household *k* enrolled in August 2011, the value of $PREkWh_{kt}$ for June 2012 is June 2011.

EE_{kt}^j is an indicator variable for energy efficiency program *j*, taking a value of 1if customer *k* is in the program in period *t* and 0 otherwise. In the analysis we consider four EE programs (that is, *J*=4), denoted by the following variables in regression results reported in Appendix E:

[8] Seven Legacy households entered the program in 2010.
[9] Two Energize households entered the program after November 2011.
[10] Given that customers were not randomly assigned to treatment and control conditions, we cannot be certain that the matched comparison group exactly represents the counterfactual, although we believe that we come close to that using the method of matching described.
[11] Stuart, E.A. "Matching Methods for Causal Inference: A Review and a Look Forward." *Statistical Science,* 25(1), February 2010, 1-21.
[12] If program enrollment occurred during a bill cycle, the current bill cycle is not coded as the post-period, and the following bill cycle will be the first post-period observation.

LISF= Low Income Single Family program

MFR= Multi-Family Retrofit program

RHE= Residential Home Energy program

RP= Residential Products program

ε_{kt} is the error term

In this model α_1 indicates average daily savings generated by the program for participants over the course of the initiative.

The second model follows the approach summarized in Imbens and Woolridge (2008) and applied in Abadie and Imbens (2011).[13] In this model, the effect of the program in month *t* is the difference between the energy use of participant *k* and its estimated counterfactual (baseline) consumption. The estimated counterfactual consumption is the average consumption of its matched household amended to reflect differences between participants and their matches in the covariates ***X*** affecting energy use. Formally we have:

Model 2

$$Savings_{kt} = kWh_{kt} - \widehat{kWh^C_{kt}}$$

$$\widehat{kWh^C_{kt}} = kWh^M_{kt} + \hat{\beta}(\mathbf{X}_{kt} - \mathbf{X}^M_{kt}$$

Where:

kWh_{kt} = The average daily electricity use by household *k* during month t

$\widehat{kWh^C_{kt}}$ = The estimated counterfactual energy use by household *k* during month *t*

kWh^M_{kt} = The energy use by household *k*'s match during month *t*

$\mathbf{X}_{kt}$ = The values for household *k* in month *t* of the independent variables **X** affecting energy use

$\mathbf{X}^M_{kt}$ = The values of **X** in month *t* for household *k*'s match

$\hat{\beta}$ = The factors used to adjust household *k*'s energy use to reflect differences between household *k* and its match in the value of **X**

Following Abadie and Imbens (2011), the values of the adjustment factors $\hat{\beta}$ used in Model 2 are derived from a regression model applied to the post-program period, estimated using *only* the matched comparison households. In the current analysis the regression model used for adjustment purposes is identical to Model 1, except that the variable *Treatment* is excised, as the model is applied only to the matched comparison households. Formally:

[13] Imbens, G.W. and Woolridge, J.M. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature* 47 (2009), 5-86.
Abadie, A, and Imbens, G.W. "Bias-corrected matching estimators for average treatment effects." *Journal of Business & Economic Statistics* 29.1 (2011): 1-11.

$$kWh_{kt} = \alpha_{0t} + \alpha_2 PREkWh_{kt} + \sum_{j=1}^{4} \beta^j EE_{kt}^j + \varepsilon_{kt} \ ,$$

where the energy efficiency programs EE^j included in the analysis are the same four used in Model 1. The regression estimates used in Model 2 are $\hat{\gamma} = \left\{\hat{\alpha}_2, \hat{\beta}^1, \hat{\beta}^2, \hat{\beta}^3, \hat{\beta}^4\right\}$

Selecting Matched Comparison Households

In the analysis approach presented above, whether the estimate of savings is accurate—statistically speaking, efficient and unbiased—depends on selecting comparison households that accurately represent the counterfactual behavior of pilot participants. We take the perspective that the best matches for pilot household *k* are those households whose monthly energy consumption during a period before household *k*'s enrollment in the pilot most closely matches household *k*'s consumption during the same period. The underlying logic is that households with energy consumption closely matched over an extended period demonstrate that they respond the same to the many exogenous factors—weather in particular—that drive energy consumption. A more detailed description of the comparison household selection is provided in Appendix B.

4. PROCESS AND IMPACT FINDINGS

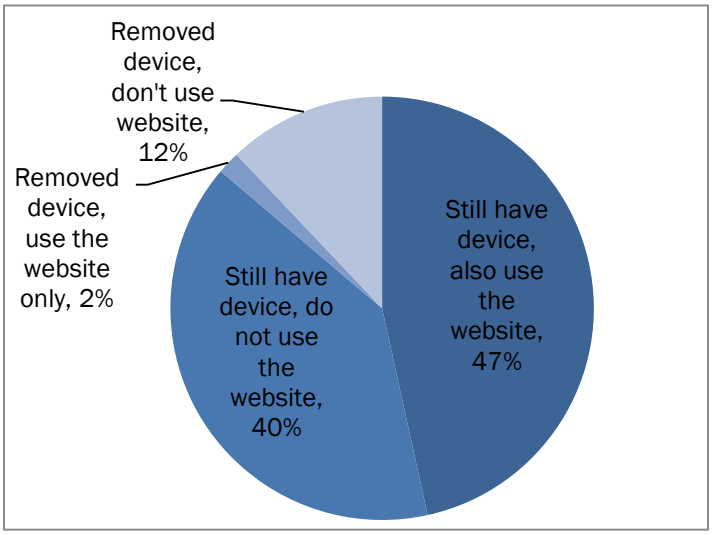
4.1 PROCESS FINDINGS

This chapter presents our process evaluation findings based on our survey of SHEMP Energize participants. This section is organized by the key areas of our findings: first, participants' level of engagement with the in-home display (IHD) and supporting website information and second, the in-home display and website's educational effects in the home. We add context to our survey findings with findings from our literature review to explore insights from other energy feedback programs where relevant.

4.1.1 Engagement with Device and Website

The first key area from our survey findings is tracking customers' ongoing engagement with the IHD information, both through the device itself and through the connected pilot website. Across all participants who have received the device, nearly half (47%) say that they still use both the device and the website, while slightly fewer (40%) say that they use the device only. Only one participant who removed the device said that they only use the website. Most participants who removed the device (12% of all participants) said that they use neither the device nor the website.[14] Figure 4 shows participant engagement with the information available through the pilot.

Figure 4. Participant Engagement with SHEMP Pilot Information Types (n=58)



Base: Participants who received an in-home display device. Note that participants who said they "never" use the website are classified as participants who do not use the website.

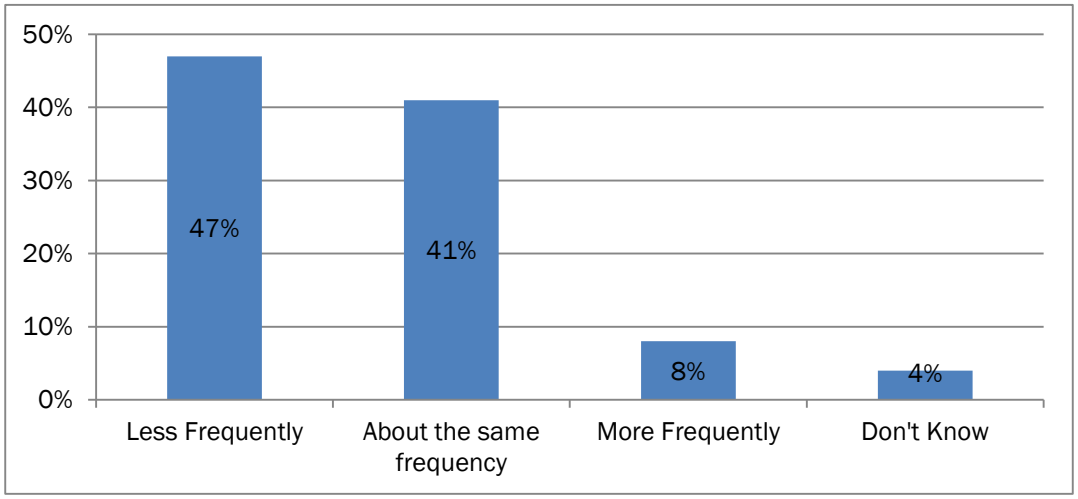
[14] Note that some participants said that they have used the website but that they "never" use it now. Customers who said they "never" use the website are classified as non-website users (e.g., if they use the device and "never" use the website, they are classified as "Still have device, do not use the website").

4.1.2 Engagement with the In-Home Display Device

Engagement with in the in-home display tends to decrease over time. We asked customers how often they use the in-home display now, compared to when they first received it. As seen in Figure 5 below, nearly half of the customers report using the in-home display less frequently. This indicates that while customers are interested in the technology in the short-term, they lose interest over time.

Our literature review of feedback programs (see Appendix A) suggests that energy information display programs frequently face decreased engagement over time as the information becomes less novel. To address this decrease, we found that programs that are proactive and regularly reach out to participants throughout the participation period are better able to maintain customer engagement.

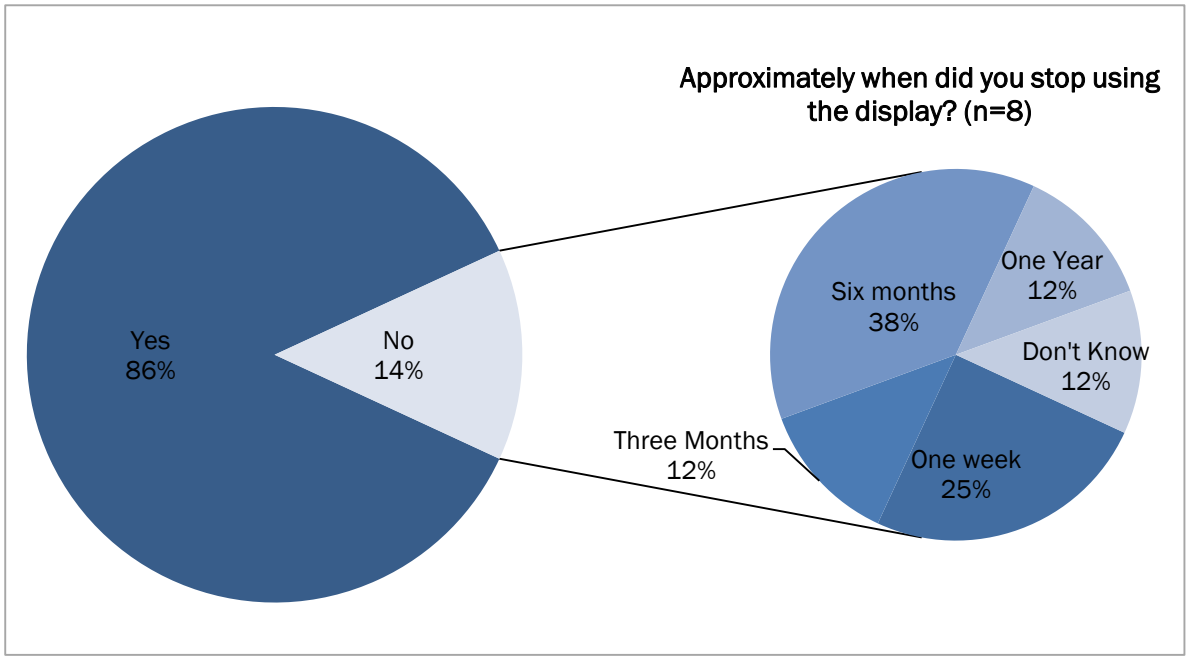
Figure 5. Engagement with In-Home Display After Installation (n=49)



Base: Respondents in Post Group with EID currently installed

While most customers currently have the in-home display still installed, about one in seven removed the device within one year. As shown in Figure 6 below, among those who removed the device, the majority (75%) stopped using the device within six months, and a quarter stopped within a week. In the context of Figure 5 above, customers may be removing the device because they no longer use it or have lost interest in the device. Future research should investigate reasons for uninstalling the device.

Figure 6. Percent of Customers with In-Home Display Installed (n=58)



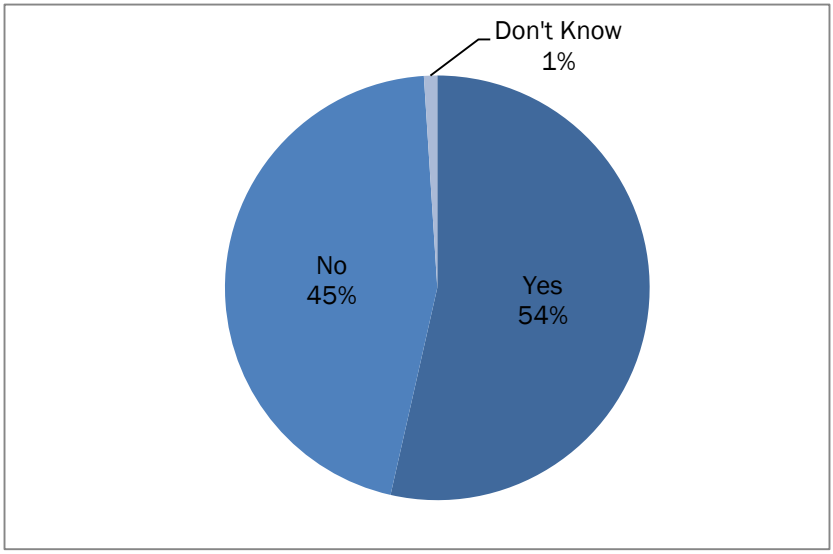
Base: Post Group

4.1.3 Engagement with the Website

Many customers do not use the Smart Home Energy Monitoring website, and those that do access the site use it once a month to once every few months. As seen in Figure 7, only about half (54%) of customers have accessed the website before. Furthermore, as shown in Figure 8, only about 12% of participants who use the website indicated that they use it once a week or more. Notably, most participants said they use the website either once a month (24%) or once every few months (39%), roughly as frequently as customers receive their energy bills. Some customers (10%) said that although they have accessed the site, they never use it now.

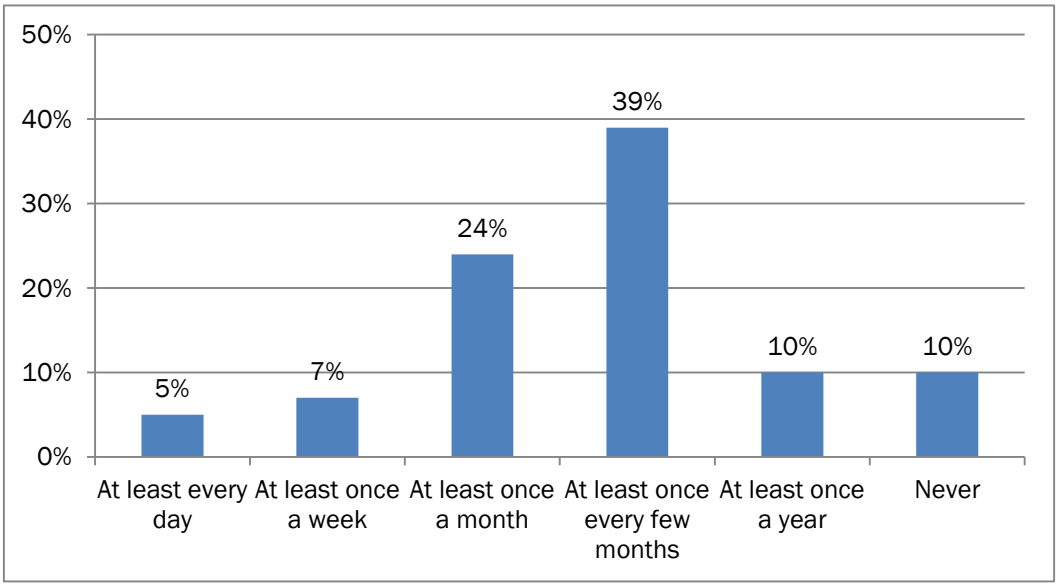
Our literature review of past feedback programs found that customers who engage with websites are more likely to produce higher energy savings. While the website is not attracting all participants, its presence and the information offered may help increase the per-participant savings from customers who use it. The literature review also found that additional social and reward elements with the website may help increase customer engagement and energy savings.

Figure 7. Percent of Customers Using the Smart Home Energy Monitoring Pilot Website to Monitor Energy Use (n=77)



Base: Post Group.

Figure 8. Frequency of Access to the Pilot Website (n=41)



Base: Respondents in Post Group who have used the pilot website.

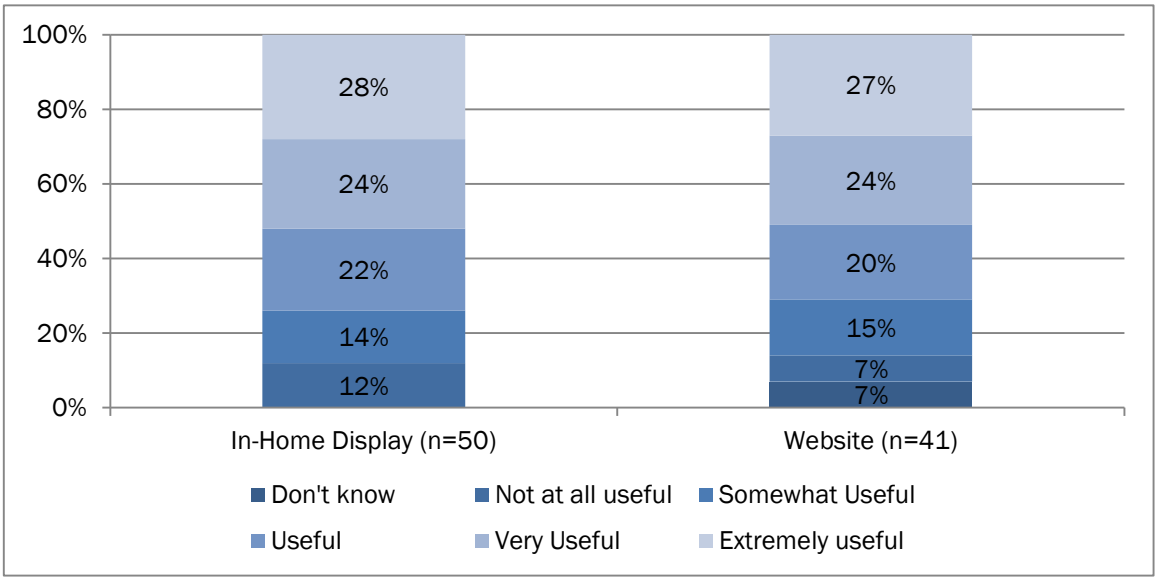
4.1.4 Information Usefulness and Education

The second key area from our survey explored how customers reacted to the information they received from the device and website, first by rating the usefulness of the information and then by describing the educational effects that the information had on their household.

4.1.5 Usefulness of Information

Most customers rate the website and IHD information equally in terms of their usefulness. While many participants felt it did not provide enough information to make changes, most customers (88%) found the in-home displays to be at least "somewhat useful." Furthermore, the vast majority of customers (86%) who accessed the pilot website found it to be at least "somewhat useful."

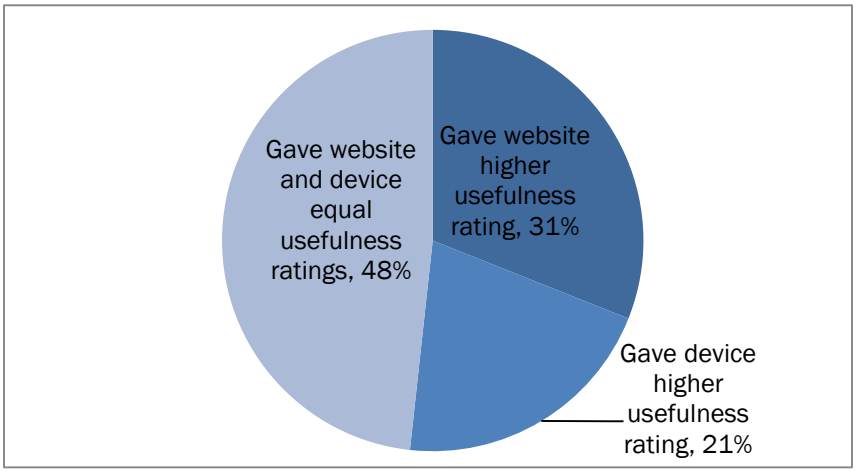
Figure 9. In-Home Display's Usefulness (n=50)



Base: (Left) Respondents in Post Group with EID currently installed; (Right) Respondents in Post Group who have used the pilot website

Of those who have used both the device and the website, there is not a clear preference. As shown in Figure 10, about half of participants who use both (48%) rated them equally in terms of usefulness, while some (31%) rated the website as more useful and others (21%) rated the device as more useful.

Figure 10. Participant Ratings: Website and Device Usefulness (n=29)*

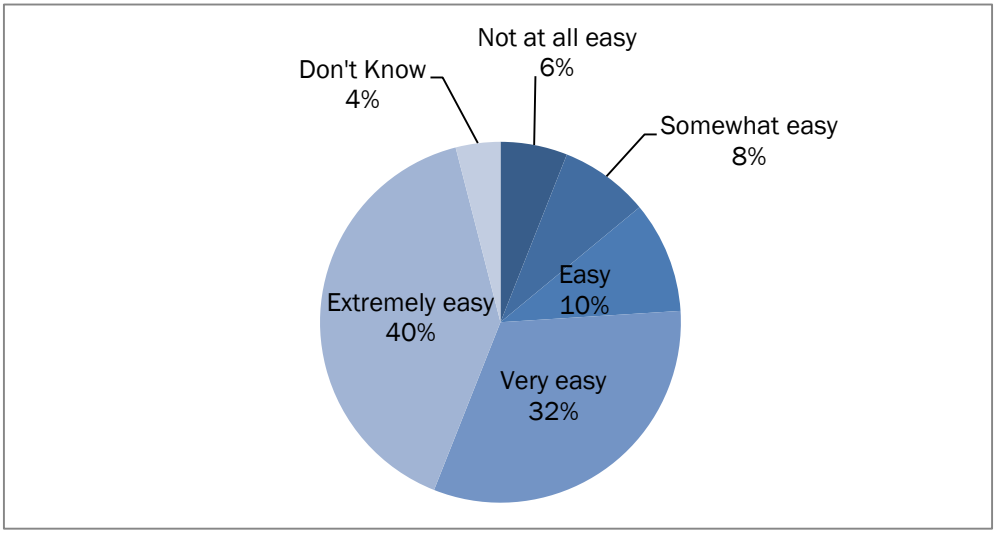


*Base: Participants who used the website and still have the device installed. Percents based on which element (website or device) received a higher rating on a one-to-five scale.

4.1.6 Educational Effects

Most customers feel they understand the information provided by the in-home display. As can be seen in Figure 11 below, the majority of participants (72%) found the information on the in-home display was "extremely easy" or "easy" to understand.

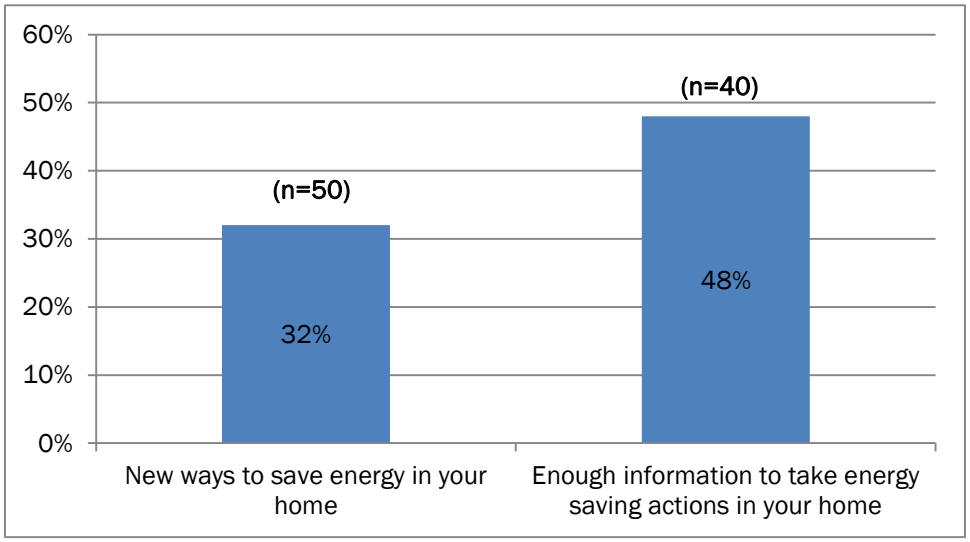
Figure 11. Participant Ratings: Device as Easy to Understand (n=50)



Base: Respondents in Post Group with EID currently installed

Although the information the device provided was rated as easy to understand, the majority of customers reported that the in-home display did not provide *enough* information to make changes at home. As shown in Figure 12 below, less than one-third of respondents reported that the in-home display provided them with new ways to save energy. Furthermore, more than half reported that they did not have enough information on how to make additional changes.

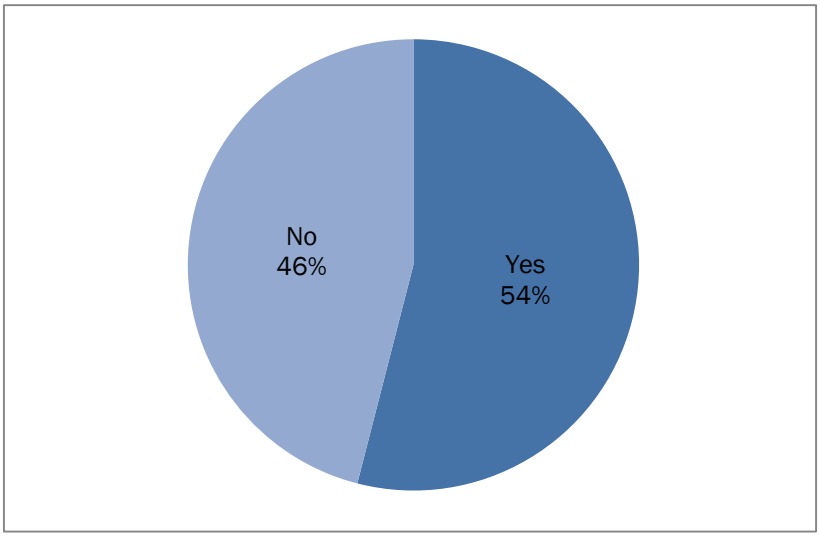
Figure 12. Participant Ratings: Did the In-Home Display Provide You With…?



Base: Respondents in Post Group with Energy Information Display (EID) currently installed

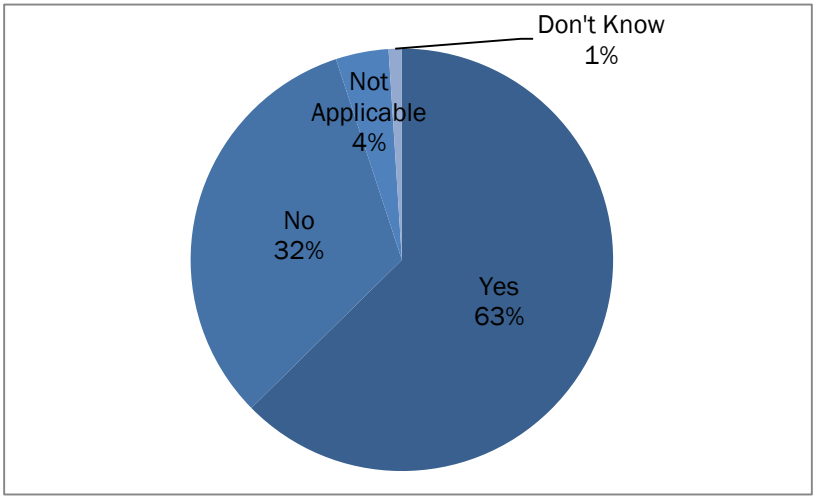
Slightly more participants (54%) who used the website said that the website gave them enough information to take action to save.

Figure 13. Participant Ratings: Website Provides Customers with Enough Information to Take Energy Saving Actions at Home (n=41)



After participating in the pilot, customers tend to share ideas about energy efficiency. As can be seen in Figure 14 below, since participating in the Smart Home Energy Monitoring Pilot, nearly two-thirds (63%) of participants shared their knowledge on how to save energy with other people in their household.

Figure 14. Percent of Participants Discussing or Sharing Ideas on How to Save Energy with Other People in Household since Pilot Participation (n=77)

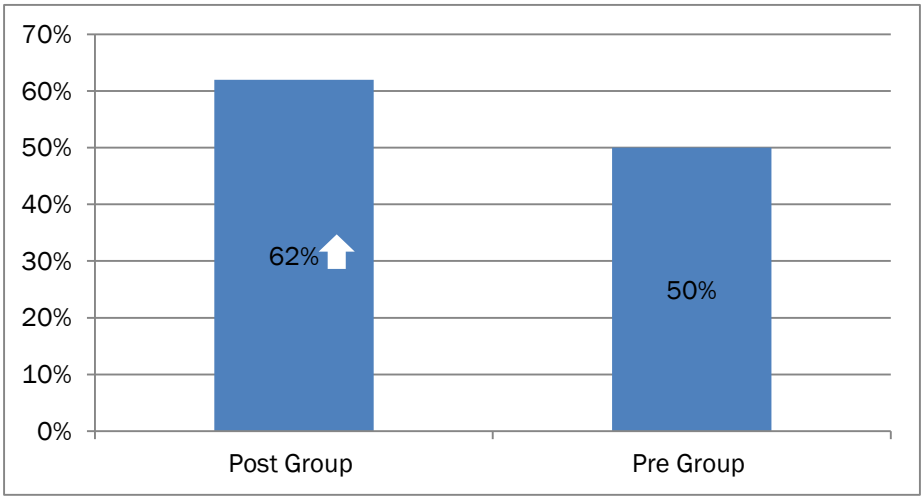


Base: Post Group

Customers who are learning new information are significantly more likely to share the information; however, customers are sharing information even if the information is not new to them but at lower rates. More than half (58%) of participants who did not get enough information to act from the pilot nonetheless talked with their families about ways to save. For those who did learn something, it was significantly higher (85%).

Participants show significantly higher awareness of CLC programs after participating in the SHEMP. As shown in Figure 15 below, about half (50%) of participants in the pre-group and nearly two-thirds (62%) of participants in the post-group are aware of alternative programs to the Smart Energy Monitoring offered by CLC, indicating a significant increase from pre-pilot participation.

Figure 15. Percent of Participants Aware of Alternative Energy Saving Programs (n=52)



Base: Pre- and Post-Group who recalled receiving device and took both surveys.
Arrow indicates a statistically significant difference at 90% confidence.

4.2 ACTIONS TAKEN

In this section, we present our results of the CLC SHEMP Energize customer responses in the pre- and post-period to questions on actions taken the past month. The differences demonstrated between the pre- and post-periods provide an indication of the actions taken as a result of the SHEMP Energize treatment. To add context to these findings, we also provide comparisons of the findings drawn from other previously fielded Program Administrator (PA) survey efforts, specifically National Grid and WMECo. It is important to note that the three PAs each implemented different behavioral programs: National Grid implemented OPOWER, WMECo implemented C3, and CLC implemented the Tendril IHD device. It is also worth noting that the WMECo and CLC surveys were fielded using a pre-post design, whereas the National Grid initiative compared customers against a control group. Here, we summarize the key findings presented in the tables in this section.

Notably, CLC participants showed a number of key differences in their survey responses as compared to other PAs:

- Significantly fewer CLC respondents reported taking action in the post-treatment period than in the pre-treatment period for low-cost measures and for energy efficiency appliances.
    - However, the percentage of respondents who installed these measures during the pre-treatment period was already high (51.9% low-cost measures, 28.6% appliances). This indicates that many participants put new energy efficient measures in place shortly before they installed the IHD and thus were unlikely to replace them with new versions during the one-year participation period.
    - These findings suggest that some pilot participants may be using the IHD information to monitor usage after efficient measures are installed and/or they may be actively seeking out ways to save energy, this pilot being one of the actions taken among many.
- Furthermore, respondents reported just one significant change in conservation behaviors after receiving treatment when compared to the pre-period. We found a significant reported increase in hanging laundry to dry during the pilot period.

Overall, these behavioral findings suggest that SHEMP Energize respondents were actively taking action prior to participating in SHEMP, and did not dramatically increase this behavior as a result of the pilot (as can be detected in the survey findings). However, the savings do suggest some action on the part of participants indicated in the observed increase in conservation action, but this is detected in only one action.

Table 4. Measure and Behavior Composites

(Percent of eligible customers installing at least one item in category)[a,b]

Measure group	OPOWER						Efficiency 2.0		Tendril IHD	
	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
	% Part.[c]	% Cntl.[c]	% Part.	% Cntl.	% Part.	% Cntl.	% Post-treatment	% Pre-treatment	% Post-treatment	% Pre-treatment
High-efficiency measures[a]										
Heating / cooling	11.9%	8.6%	8.6%	8.1%	10.2%	8.4%	10.3%	8.0%	14.3%	7.8%
Appliances	28.2	22.8	21.5	16.8	**24.8^**	19.8	17.0	14.1	16.9	**28.6^**
Consumer electronics	**22.8****	14.0	17.9	13.2	**20.4****	13.6	14.3	7.1	16.9	20.8
Light fixtures	9.3	9.2	**10.8^**	6.5	10.0	7.8	7.0	6.0	6.5	3.9
Building envelope	**18.0****	10.7	**13.9****	7.3	**16.0****	9.0	34.0	29.0	13.0	18.2
Low-cost measures	**49.6****	40.6	41.0	37.6	**45.3****	39.1	11.5	10.3	27.3	**51.9****
Behaviors[b]										
Hot water usage	41.2	35.1	39.8	37.6	40.5	36.3	47.0	42.0	33.8	35.1
Lighting	34.0	37.5	39.8	34.8	36.9	36.1	**59.0****	31.0	29.9	33.8
Consumer electronics	41.2	37.8	45.4	40.4	43.3	39.1	**59.0****	38.0	42.9	36.4
HVAC maintenance	22.1	26.3	24.4	29.6	23.2	**27.9^**	33.0	34.0	19.5	18.2
Space heating and cooling	27.2	28.7	34.7	31.6	30.9	30.1	**46.0****	30.0	19.5	23.4
Refrigerator maintenance	20.0	19.1	21.3	23.6	20.7	21.4	39.0	32.2	18.2	27.3
Home Energy Audit										
Home Energy Audit	3.7	4.9	8.2	7.3	5.9	6.1	9.2	4.6	14.3	18.2

[a] Measure composite metric: Purchased or installed at least one energy efficient item in measure group in past year (as % of eligible base). This metric does not imply positive net savings from these measures, as some could be additional units. High-efficiency measure groups are described in Table 6 and Table 7.

[b] Behaviors metric: Started or increased at least one of items in behavior group in past year (as % of eligible base). Behavior measure groups comprise the following measures:

- **Hot water usage:** Wash laundry in cold water, fully load washing machine or dishwasher, take short showers, reduce water heater temperature.
- **Lighting:** Turn off lights in unoccupied rooms, turn off outside lights by day, use task lighting or lighting timer.
- **Consumer Electronics:** Turn off computers, TVs, video game consoles, and power strips when not in use; put computers to sleep.
- **Space heating/cooling:** Lower window shades, use insulation or quilts, use portable window fan, set thermostat to recommended set points.
- **HVAC maintenance:** Maintain heating and cooling system, change furnace filter or boiler water, clean or replace air filters, clean areas around vents.
- **Refrigerator maintenance:** Make sure refrigerator seals are tight, clean refrigerator coils, check refrigerator temperature.

Note that hanging laundry to dry is not included in behavioral measure groups. See Table 9 for details.

[c] Part. are behavioral program participants who receive HER and Cntl. are control group members

** Significantly higher than other treatment group at 95% confidence level.

^ Significantly higher than other treatment group at 90% confidence level.

Table 5. Measure and Behavior Composite, Actions Taken as Percentage of Eligible Actions

Average count and percentage of eligible measures or behaviors taken

Measure group	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
	Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Measures										
Average n. of eligible measures	26.2	25.9	26.1	26.1	26.2	26.0	25.0	25.1	27.1	27.2
Average n. of measures taken	2.1	1.9	**1.9****	1.4	**2.0****	1.6	1.5	1.1	1.3	**2.0****
Average % of eligible measures taken	8.1%	7.2%	**7.3%****	5.3%	**7.7%****	6.3%	5.6%	4.3%	4.7%	7.2%
Behaviors										
Average n. of eligible behaviors	24.2	24.1	24.1	24.1	24.2	24.1	**23.3****	22.0	24.1	24.2
Average n. of behaviors started or increased	3.3	3.4	3.8	3.6	3.5	3.5	**5.2****	3.7	3.1	2.7
Average % of eligible behavior started or increased	13.6%	14.1%	15.4%	15.0%	14.5%	14.6%	22.3%	16.6%	12.9%	11.3%

Note: Eligible actions defined as the number of actions for which the person was in the "eligible base" for measures.
** Significantly higher than other treatment group at 95% confidence level.
^ Significantly higher than other treatment group at 90% confidence level.

Table 6. Changes in Measure Installations, High-Cost Measures

Percentage of eligible customers who purchased or installed high-efficiency measures in past year[a]

Measure	Eligible base	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
		Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Heating / Cooling											
Central AC (ES)[a]	Homeowners & have unit	3.3%	2.6%	6.7%	4.0%	5.0%	3.4%	3.7%	3.4%	6.9%	0.0%
Room or wall AC (ES)	Homeowners & have unit	12.3	9.8	8.4	7.0	10.3	8.5	9.3	9.3	12.9	10.3
Boiler (ES)	Homeowners & have unit	2.3	3.8	1.5	2.9	1.9	3.4	3.2	0	4.5	7.3
Furnace (ES)	Homeowners & have unit	1.9	3.0	2.8	2.9	2.3	2.9	3.8	2.5	3.5	1.7
On-demand or tankless water heater	Homeowners	**2.9^**	0.8	1.2	1.2	2.0	1.0	2.3	0	**5.2****	0.0
Appliances											
Clothes washing machine (ES or front-load)	Have unit	**14.9^**	10.0	12.9	10.8	**13.9^**	10.4	10.2	6.1	5.2	**19.5****
Dishwasher (ES)	Homeowners & have unit	9.5	10.6	8.0	5.2	8.8	7.8	11.1	7.0	4.1	**13.7****

Refrigerator (ES)	Homeowners & have unit	10.7	11.6	**8.6^**	4.4	9.7	8.0	5.9	6.9	9.2	7.8
Consumer electronics											
Television (ES)	Have unit	12.4	8.1	10.8	8.9	11.6	8.5	**13.4^**	6.2	7.9	13.0
Printer (ES)	Have unit	9.3	7.0	7.9	5.1	8.6	6.1	**8.3****	1.3	4.0	9.5
Computer (ES)	Have unit	9.6	5.8	7.0	7.0	8.3	6.4	3.5	1.3	7.8	6.5
Video game console (ES)	Have unit	3.3	3.0	8.5	3.3	5.7	3.1	0	0	0.0	5.3
Light fixtures											
Outdoor light fixtures (ES)	Have unit	**5.3^**	2.0	3.3	3.0	4.3	2.5	6.4	3.2	0.0	1.3
Indoor light fixtures (ES)	Have unit	**4.8^**	8.8	**9.4****	4.1	7.1	6.5	3.0	4.0	6.5	3.9
Building envelope											
Attic, ceiling, or wall insulation	Homeowners	**8.2****	3.7	**7.8****	2.8	**8.0****	3.3	6.9	5.7	9.1	11.7
Energy efficient or double paned windows	Homeowners	12.7	8.2	7.0	4.8	**9.8^**	6.5	4.6	8.0	6.5	9.1
Storm windows	Homeowners	1.6	1.6	2.9	1.2	2.3	1.4	1.1	0	0.0	2.6

[a] High-efficiency measures defined as an ENERGY STAR® version of a measure that was installed in the past year [denoted by (ES)], or the measure itself (if it is energy-efficient by definition).

** Significantly higher than other treatment group at 95% confidence level.

^ Significantly higher than other treatment group at 90% confidence level.

Table 7. Changes in Measure Installations, Low-Cost Measures

Percentage of eligible customers who purchased or installed high-efficiency measures in past year

Measure	Eligible base	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
		Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Low-Cost Measures											
Recycled a second refrigerator	Homeowners & have unit	16.5%	11.6%	11.1%	9.7%	13.8%	10.6%	**14.9%****	5.7%	5.2%	7.8%
Programmable thermostat	Homeowners	7.0	7.0	5.3	4.0	6.1	5.5	**6.9^**	1.1	2.6	3.9
Insulated outlets and/or light switches	Homeowners	4.9	3.7	**6.6^**	3.2	**5.7^**	3.5	2.3	2.3	0.0	**3.9^**
Motion sensors	Homeowners	3.7	4.1	3.7	1.6	3.7	2.9	2.3	3.4	0.0	1.3
Energy smart power strips	Everyone	8.0	7.6	4.8	6.4	6.4	7.0	6.0	5.0	9.1	11.7
Weather stripping/ caulking around windows/doors	Everyone	14.8	12.7	**15.9****	10.0	**15.4^**	11.4	4.0	9.0	5.2	**14.3^**

ENERGY STAR light bulbs or CFLs	Everyone	28.4	27.1	28.3	24.0	28.3	25.5	17.0	20.0	18.2	**29.9^**
Low-flow showerheads	Everyone	6.4	8.0	4.8	4.0	5.6	6.0	4.0	2.0	5.2	1.3
Faucet aerators	Everyone	4.4	2.8	2.8	1.6	3.6	2.2	2.0	4.0	0.0	1.3
Water heat wrap	Everyone	0.4	**2.8****	2.4	1.6	1.4	2.2	0	1.0	0.0	0.0
Lighting timers	Everyone	3.6	4.8	4.0	2.0	3.8	3.4	**3.0^**	0	2.6	5.2
Window shades, window insulation, window quilts	Everyone	6.8	8.8	7.6	5.6	7.2	7.2	7.0	3.0	1.3	3.9

** Significantly higher than other treatment group at 95% confidence level.
^ Significantly higher than other treatment group at 90% confidence level.

Table 8. Rebates for Energy-Efficient Measures

	National Grid (electric)		National Grid (gas)		National Grid (all fuel)		WMECo		CLC	
	Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Purchased any rebate-eligible item (as % of total n.)	**45.4%****	34.4%	**36.8%****	27.9%	**41.1%****	31.1%	39.0%	32.0%	37.7%	48.1%
Used rebate (as % of total n.)	13.5%	11.6%	**12.8%^**	8.0%	**13.2%^**	9.8%	6.0%	4.0%	15.9%	20.8%
Used rebate (as % of people with at least one eligible purchase)	29.8%	33.7%	34.8%	28.6%	32.0%	31.4%	15.4%	12.5%	41.4%	43.2%
Total n.	250	251	251	250	501	501	51	40	29	37

Note: Please refer to questions PE9a-PE9t in the Appendix D for the rebate-eligible items.
** Significantly higher than other treatment group at 95% confidence level.
^ Significantly higher than other treatment group at 90% confidence level.

Table 9. Changes in Daily Behaviors

Percentage of eligible customer who started or increased frequency of the energy-saving behavior in past year

Measure	Eligible base	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
		Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Hang laundry to dry	Has a dryer	6.5%	4.9%	8.6%	7.2%	7.5%	6.1%	5.3%	4.3%	**14.3%^**	5.3%
Wash laundry in cold water	Has a washing machine	18.1	16.1	18.5	17.6	18.3	16.8	24.5	20.0	14.3	16.9
Fully load the washing machine	Has a washing machine	16.1	16.9	**17.3^**	12.0	16.7	14.4	22.4	14.7	10.4	10.4
Fully load the dishwasher	Has a dishwasher	16.6	16.2	16.3	12.4	16.5	14.3	19.7	15.8	12.3	11.0
Turn off lights in unoccupied rooms	Everyone	29.2	25.5	32.3	26.4	**30.7^**	25.9	**50.0****	28.1	26.0	23.4
Use task lighting	Everyone	5.6	4.4	5.2	4.4	5.4	4.4	9.0	4.0	9.1	10.4
Use a lighting timer	Everyone	3.6	**7.2^**	7.6	5.6	5.6	6.4	5.0	2.0	5.2	5.2
Turn off outside lights by day	Has outside lights	13.5	17.8	18.3	15.9	15.9	16.9	**34.0****	19.8	8.0	14.3
Turn off computers when not in use	Has a computer	25.4	22.4	22.2	24.9	23.8	23.6	**40.0****	19.5	27.3	20.8
Put computers to sleep	Has a computer	**26.7^**	19.9	25.1	21.8	**25.9^**	20.9	28.2	23.4	22.1	16.9
Turn off TVs when not in use	Has TV	19.6	20.6	27.1	21.8	23.4	21.2	**41.2****	23.7	22.4	14.3
Turn off video game consoles when not in use	Has game console	22.3	26.7	24.5	26.1	23.3	26.4	45.7	41.7	38.5	21.1
Switch off power strips or unplug devices when not in use	Everyone	12.0	**18.3****	18.3	14.0	15.2	16.2	**29.0****	10.0	22.1	14.3
Lower window shades, insulation or quilts	Everyone	14.8	15.9	14.7	12.8	14.8	14.4	**30.0****	11.2	5.2	7.8
Take short showers	Everyone	16.8	15.9	19.5	18.0	18.2	17.0	**32.0****	17.7	13.0	7.8

** Significantly higher than other treatment group (either participant or control) at 95% confidence level.
^ Significantly higher than other treatment group (either participant or control) at 90% confidence level.

Table 10. Changes in Periodic Behaviors

Percentage of eligible customers who started or increased frequency of an energy-saving behavior in past year

Measure	Eligible base	National Grid (electric)		National Grid (gas)		National Grid (all fuels)		WMECo		CLC	
		Part.	Cntl.	Part.	Cntl.	Part.	Cntl.	Post	Pre	Post	Pre
Use a portable window fan	Everyone	9.2%	6.0%	9.6%	10.4%	9.4%	8.2%	11.0%	18.2%	3.9%	7.8%
Maintain your heating and cooling system	Everyone	14.5	16.7	13.2	**21.2****	13.8	**19.0****	16.0	19.8	13.0	11.7
Change the furnace filter	Has furnace	9.3	7.8	9.1	9.5	9.2	8.6	12.4	19.8	5.3	8.5
Clean the boiler water	Has boiler	4.5	4.3	8.0	9.4	6.3	6.9	2.7	**13.2^**	2.3	2.4
Reduce water heater temperature	Everyone	9.3	9.2	7.7	**12.8^**	8.5	11.0	7.0	13.7	11.7	7.8
Clean or replace air filters	Everyone	7.3	8.4	11.8	12.8	9.5	10.6	11.0	17.4	9.1	5.2
Clear the area around vents	Everyone	9.8	**15.1^**	11.1	15.6	10.4	**15.4****	20.0	23.1	7.8	6.5
Make sure refrigerator seals are tight	Everyone	9.8	12.7	13.1	16.0	11.5	14.4	26.0	22.2	7.8	11.7
Clean refrigerator coils	Everyone	7.0	9.6	8.7	12.0	7.8	10.8	16.0	12.4	10.4	6.5
Check the refrigerator temperature	Everyone	11.1	12.7	12.4	12.8	11.7	12.8	23.0	19.5	11.7	15.6
Set the thermostat to recommended set points	Has programmable thermostat	17.0	23.3	28.7	25.0	23.1	24.2	25.5	26.0	18.2	13.2

** Significantly higher than other treatment group (either participant or control) at 95% confidence level.
^ Significantly higher than other treatment group (either participant or control) at 90% confidence level.

4.3 PARTICIPATION IN OTHER CLC PROGRAMS

Our process evaluation also included an examination of participation in other CLC programs to examine potential channeling from SHEMP to other CLC programs. More details can be found in Appendix C. We found key differences between the two pilot groups (Legacy and Energize):

Energize Customers' overall participation in other programs dropped by 36.8% after participation. These participation findings are consistent with the self-reported findings, where we demonstrate that customers do not appear to be increasing their measure-based actions through programs. Key insights include:

- Most of the cross-program participation among Energize customers was in CLC's Residential Home Energy pilot.
- Although monthly program participation numbers were smaller, cumulative participation in the Residential Home Energy program steadily grew over the pilot participation period, while participation in other CLC programs remained relatively flat.

Legacy customers demonstrated a sharp increase in overall participation during the program participation period, with a 24.7% increase in cross-program participation. Roughly three to six months after pilot participation began (as the participation period started between June and September 2009 for different customers), we observed a sharp increase in cross-program participation. However, this trend leveled off after 12-18 months of treatment.

- Participation in the Residential Products and Services program sharply increased during the pilot period and then similarly began to level off about one year after the increase was observed.
- Participation in the Residential Home Energy program, however, shows a steady increase in overall participation over time.

4.4 IMPACT FINDINGS

4.4.1 Analysis Results

Regression results are presented in Appendix E. Savings estimates are reported in Table 11. Our savings estimates were calculated across two models for each pilot group, and are robust across model specifications, but average about 2% for the 12-month matches and 1.5% for the 24-month matches, though this difference is not statistically significant.[15] Savings estimates for Legacy customers are relatively robust to the model specification and the set of matches, averaging about 8.3%.

[15] Statements concerning statistical significance refer to Model 1. Estimation of standard errors for Model 2 is not a simple matter and so, given the similarity of results for the two models, we rely on Model 1 for statements about statistical significance and statistical confidence.

Based on our estimates, the savings generated for Legacy customers range from 7.8%-8.8%. Comparatively, Energize savings estimates are significantly lower, ranging from 1.49%-1.99% average savings per households.

Table 11. Estimate of Average Percent Savings During the Pilot Period

	Estimate of Average Percent Savings	Standard Error [a]	t-statistic
Legacy, standard matches, Model 1	7.80%	-0.76%	-10.28
Legacy, standard matches, Model 2	8.35%	-	-
Legacy, low-trend matches, Model 1	8.80%	0.72%	12.28
Legacy, low-trend matches, Model 2	8.21%	-	-
Energize, 24-month matches, Model 1	1.49%	0.63%	2.38
Energize, 24-month matches, Model 2	1.36%	-	-
Energize, 12-month matches, Model 1	1.93%	0.64%	3.00
Energize, 12-month matches, Model 2	1.99%	-	-

[a] Standard errors based on clustering of errors at the customer level. The analysis included 77 Legacy customers and 276 Energize customers. The analysis included three matches for each customer.

4.4.2 Discussion of Potential Reasons for Differences between Legacy and Energize Customers

The difference between savings by Legacy and Energize customers is significant, both statistically and practically. We identify three candidate explanations for this, none of which are mutually exclusive:

1. Legacy customers have been in the pilot longer and have "ramped-up" their savings from a lower initial level;
2. Legacy and Energize customers are receiving different treatments;
3. Legacy and Energize customers may be fundamentally different types of households.

Potential Effects of Different Treatments

The latter two explanations are the most likely drivers for the differences we see in savings between the two pilot groups. Unfortunately there is no systematic way to identify the relative roles of these explanations. The two groups are exposed to very different treatments.

To further unearth the potential drivers for these differences as they relate to the pilot tools and tactics, we conducted a literature review for CLC of other feedback technologies and approaches. Based on our review, we found that the following pilot attributes of the Legacy customers may play a role in driving these higher savings numbers. These factors include:

- Push-notifications and/or reports that the customer receives regardless of his or her level of engagement. In this way, even passive customers receive treatment.

- Real-time feedback (less that 15 minute). Programs that offer real-time feedback appear to have higher savings rates.

- Social engagement. Programs that have some form of social engagement, be it competition, rewards, comparisons, etc. appear to be more successful that those that do not engage other customers in their program model.

Potential differences in the target population

Further, we understand that Legacy and Energize customers were targeted differently and that Legacy customers were the earliest adopters of this technology in CLC's region. These differences could be a reason for the differences we see in the savings estimates. However, customers are not very different in terms of the few available observable characteristics. Legacy customers are somewhat higher energy users. In 2008, they averaged 27.9 kWh per day, whereas Energize customers averaged 23.4 kWh per day. The only demographic data available for *both* Legacy and Energize households are the year the participant's home was built, whether the customer has electric heat, and whether the customer is on the residential assistance rate.

4.4.3 Recommendations

Our overall findings suggest two key take-aways:

1. The treatment approach for Legacy customers may be more effective at generating pilot savings; and

2. The current Energize platform may not be providing sufficient feedback and educational material and content to keep participants engaged and taking more action than they were in the pre-period to generate savings comparable to the Legacy cohort.

Our research also suggests that Energize participants are receiving and generally understanding the information that they are presented from the IHD, but they are not always sure what actions to take based on the information they receive. In fact, only one-third (32%) of customers said that they felt they learned new ways to save energy in their home from the IHD information. Further, those who learned new ways to save were significantly more likely to share that information with others. Both our participant survey and our literature have found that information alone is not sufficient to promote action based on receiving energy information displays or visiting the related website. We have identified some ways that CLC can increase customer actions:

- **Add or increase proactive educational pushes for participants, and regularly reach out to them throughout the participation period.** Our survey found that participant engagement with the device often decreases over time, with nearly half (47%) reporting that they look at the device less often after one year of participation. Our literature review also found that in-home display devices are often insufficient for gaining significant per-person savings without PA "pushes" throughout the program period. These educational materials should be designed toward promoting energy-saving action, rather than awareness of usage alone. Information alone is not enough to prompt action. According to our literature review, some effective push tools that PAs have used include normative messaging such as neighbor comparisons and personal benchmarking, as well as ongoing personal feedback reports, online rewards, and customized, seasonally relevant savings tips. Many Legacy participants already receive these educational materials. CLC should consider expanding these reports to Energize customers.

    - **Focus on more sophisticated and deeper behavior change in educational materials.** A high number of respondents indicated that they had already installed high efficiency measures before they participated in the IHD pilot, with no detectable increase in their actions after participating in SHEMP Energize. Further, there were few significant differences in energy conservation behaviors during the pilot period.

- **Identify and differentiate pilot strategies based on engagement.** Participants are not uniform in the level of engagement with the device information. While many reported looking at the

device less often, many (41%) looked at it about as often and a few (8%) said they looked at it more often.

    - **Target less engaged participants with motivational appeals and pushes.** Less engaged participants may need more active reminders, pushes, or challenges to prompt action. SHEMP should consider ways to provide specific outreach to customers with lower levels of overall engagement.

- **Consider methods to better promote and integrate IHD information more with the program website.** Our literature review found that website engagement can help increase per-customer and overall savings, but our survey found that only about half of participants use the website (54%), and that only about one in five customers said that they used the website once a month or more (19%). Website content could be made more dynamic to offer information on predicted billing or tips based on current usage. Our literature review found that interactive components particularly help increase customer engagement in the website and take savings based on feedback.

To increase per-person savings, consider some targeting of high-usage customers. For the Legacy pilot, Cape Light Compact targeted high-usage customers (monthly usage over 650 kWh) for their participant pool. No such targeting was included in the Energize pilot. We found in our literature review that targeting customers, particularly high-usage customers, often produced higher per-customer savings, especially when partnered with ongoing engagement pushes from the PAs. Increased targeting of these customers may increase per-person savings within this group, and in turn increase overall savings.

A. CLC FEEDBACK PROGRAM LITERATURE REVIEW

This section details the findings from Opinion Dynamics' literature review of enhanced energy feedback programs and their respective tools (in-home displays, online portals, etc) and tactics (opt-in vs. opt out, targeting, messaging, etc.).

Key Findings and Recommendations

Our review of feedback programs demonstrates that the following tools and tactics can improve energy savings per household. The table below summarizes the tactics that we recommend for the design of opt-in feedback programs, similar to those currently implemented by CLC. We rank recommended tools and tactics by per-household program savings.

Table 12. Key Components for Successful Program Design

Component	Description	Program Savings Per Household
Real-time direct feedback	Energy usage feedback provided in intervals of one-minute or less	Up to 12%
Customer targeting	Program intervention targeted to specific customers (i.e. high usage customers and customers identified through segmentation)	Up to 12%
Bill estimates or to-date spending	Information provided to customers includes real-time cost or estimated bill information	Up to 12%
Multiple customer touchpoints	Customers engage with personal savings plans, social engagement, competitions, comparisons, tips, email notifications and messaging	Up to 9.3%
Online social engagement or rewards-based engagement	Social and reward-based elements, such as challenges, direct rewards, or benchmarks, provided to customers	Up to 9.3%
Personal savings plans	Customized upfront feedback includes online audits and benchmarking or goal setting	Up to 9.3%

Introduction and Methodology

We undertook this literature review in September 2012 to provide Cape Light Compact with a high-level view of the current landscape of enhanced feedback programs, specifically the varying energy impacts of different **tools and tactics** of in-home feedback.

- **Tactics.** Customer outreach tactics include how customers are selected to participate in the program (i.e., opt-in versus opt-out deployment), as well as customer targeting and segmentation.
- **Tools.** Customer outreach tools include the delivery mechanisms in which customers interact with the program as well as the feedback content in which information is provided to achieve the greatest impact on customers' behavior. The mechanisms in which customers engage with the programs include frequency of information provided to customers (i.e., real-time feedback to weekly updates) as well as mail, email, online portals, and in-home displays. The feedback methods in which information is provided include personal savings plans, social engagement, competitions and comparisons, energy savings tips, and program channeling.

This memo details findings from 21 in-home display (IHD) and enhanced feedback programs[16] conducted in the United States from 2004 to 2012. Note that this is not a comprehensive list of all programs that have existed,[17] nor even all programs that have been implemented since 2004; instead, these programs have been chosen to reflect the variety of implementation strategies, research methodologies, and resulting savings for the different types of feedback provided through these programs.

Types of Feedback Programs

We define feedback programs (like those currently implemented by Cape Light Compact) using a framework for feedback programs as used in the American Council for an Energy-Efficient Economy (ACEEE) white paper "Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities,"[18] published in 2010. This comprehensive meta-review looked at past feedback programs to identify the feedback program characteristics that were most likely to lead to energy savings. This framework has been used in multiple protocols to date, and as such we adopted it to remain consistent with industry trends.

In-home display and enhanced feedback programs provide customers with information about their energy usage more frequently than what already occurs through monthly utility bills. The term "feedback" itself is a catchall, with multiple types of programs that are included. There are two key types of enhanced feedback: direct feedback and indirect feedback. Our literature review includes 12 direct feedback programs, 9 indirect feedback programs, and one program that tested both direct and indirect feedback treatments.

In this report, we define **direct feedback** as programs that use specialized devices to provide customers with information about their energy use in real time or near real time (no more than 15-minute delay).

Indirect feedback refers to programs that provide customers with information about their energy use after the usage has occurred. Indirect feedback programs often include website integration, including Online Dashboards that detail billing usage over the course of the customer's billing period, and Online Audits that allow customers to identify the key energy-using equipment they have installed in their homes.

Detailed Findings

Program Tools and Tactics Overview

The types of feedback programs vary enormously and have changed significantly over time. We also examined the programs' specific tools and tactics, and looked across programs to see which tools and tactics relate to savings. Table 13 below presents the tools and tactics.

[16] "Enhanced feedback" refers to the broad umbrella of behavioral programs that provide customers with additional details about their usage beyond the information included in their monthly bills.

[17] Additional reviewed programs that are not described in depth in the literature review are provided in the "Further Reading" section at the end of this document. Feedback studies have been conducted since the 1960s and span three continents but were excluded in the interests of providing the most current, locally relevant program information.

[18] Ehrhardt-Martinez, Karen, Kat A. Donelly and John A. "Skip" Laitner. Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities. Washington: American Council for an Energy-Efficient Economy, 2010. 2012.

Table 13. Matrix of Tools and Tactics by Program (Ranked Highest to Lowest Savings)

Program	Mean Savings Per House-hold	Partici-pant Popul-ation Size	Total Savings (Annual)	Tactics								Tools									
				Opt-in	Real-Time Usage Updates (<1 min)	Near-Real-Time Usage Updates (15 min)	Daily to Weekly Usage Updates	Targets Specific Customers	Sample Sub-Groups	Change in Rate	Demand Response	Mail	Email/Text Message	Online Portal	In-Home Display	Cost (Predicted Bill or PTC)	Personal Savings Plan[a]	Social Engagement	Competition/Comparison	Tips	Program Channeling
High Savings																					
Salt River Projects M-Power Program (2005-2006)	12%	272	NC	X	X			X		X					X	X					
Cape Light Compact In-Home Display Pilot (ICES 2009-2012)	11.7%	80	NC	X	X			X			X		X	X		X	X	X	X	X	X
Hydro One PowerCost Monitor Pilot (2004-2005)	~8.5%[c]	500	NC	?	X				X						X	X					
Research Institute of Central Florida In-Home Display Pilot (2005-2007)	7.40%	17	22.2 MWh	X	X										X						
Illinois Citizens Utility Board Energy Saver Program (2010-2011)	~5.3%[c]	2,925	1890 MWh	[f]			X	X	X			X	X	X			X	X		X	X
Moderate Savings																					
Payson City Power Energy Efficiency Reports (2010-2011)	2.40%	5,000	726 MWh	[f]			X		X			X	X	X			X	X	X	X	
WMECo C3 Western Mass Saves! Program (2010-2011)	~2.5%[c]	24,617	1740 MWh[e]	[f]			X		X			X	X	X			X	X	X	X	X
Cape Light Compact Smart Home Energy Monitoring Pilot (2011-2012)[b]	2.30%	277	NC	X		X								X	X	X	X		X		X
Massachusetts PowerCost Monitor Pilot (2007)	1.90%	3,512	790 MWh	X	X										X	X					

Program	Mean Savings Per House-hold	Partici-pant Popul-ation Size	Total Savings (Annual)	Tactics								Tools									
				Opt-in	Real-Time Usage Updates (<1 min)	Near-Real-Time Usage Updates (15 min)	Daily to Weekly Usage Updates	Targets Specific Customers	Sample Sub-Groups	Change in Rate	Demand Response	Mail	Email/Text Message	Online Portal	In-Home Display	Cost (Predicted Bill or BTG)	Personal Savings Plan[a]	Social Engagement	Competition/Comparison	Tips	Program Channeling
Wisconsin Focus on Energy PowerCost Monitor Study (2008-2009)	1.50%	218	27.5 MWh	X	X										X	X				X	
Pennsylvania Power & Light Aclara Program (2008-2009)	~1.5%[c]	9,739	50.0 MWh	X			X		X	[g]			X	X		X	X			X	X
California Critical Peak Pricing Pilot (2005)	0.061 kW[d]	152	9.3 kW[d]	X			X	X			X		X	X							
SCE&G My Home Energy Report Program (2011-2012)	327 kWh	26,901	8800 MWh	[f]			X		X			X	X	X			X	X	X	X	X
BC Hydro Team Power Save Program (2008-Present)	208 kWh	25,000	5200 MWh	X			X	X					X	X			X	X		X	
SCE&G In-Home Display Pilot Phase 2 (2011-2012)	64.2 kWh	3,117	200 MWh	X		X							X	X	X	X				X	X
Low/No Savings																					
Stanford/Google In-Home Display Web App Pilot (2011)	0%	1,065	0 kWh		X									X	X	X					
Commonwealth Edison Customer Applications Program (2010-2011)	0%	7,825	0 kWh			X	X		X	X	X	X	X	X	X	X		X	X		
Arizona Public Service Aclara Program (2008-2009)	0%	36,905	0 kWh	X					X				X	X		X	X			X	
Energy Trust of Oregon PowerCost Monitor Pilot (2008)	0%	200	0 kWh	X	X					[g]					X	X					
Not Calculated																					

Program	Mean Savings Per House-hold	Partici-pant Popul-ation Size	Total Savings (Annual)	Tactics								Tools									
				Opt-in	Real-Time Usage Updates (<1 min)	Near-Real-Time Usage Updates (15 min)	Daily to Weekly Usage Updates	Targets Specific Customers	Sample Sub-Groups	Change in Rate	Demand Response	Mail	Email/Text Message	Online Portal	In-Home Display	Cost (Predicted Bill or PTC)	Personal Savings Plan[a]	Social Engagement	Competition/Comparison	Tips	Program Channeling
San Diego Gas & Electric Home Area Network Pilot (2011)	NC	552	NC	X		X		X	X		X		X	X	X		X	X	X		
South Carolina Electric & Gas In-Home Display Pilot Phase 1 (2010-2011)	NC	245	NC	X		X		X						X	X	X				X	X
BC Hydro Team Power Save Pilot (2007-2008)	NC	NC	NC	X			X						X	X			X	X		X	

NC= Not calculated

[a] This includes online audits and benchmarking/goal-setting).

[b] Phase 2 ("Energize") participants only. Phase 1 ("Legacy") design and participation are accounted for in the "Cape Light Compact In-Home Display Pilot (2009-2010)" entry.

[c] For these programs, a range of mean savings were provided (for example, for the Hydro One study the mean per-person savings were estimated at "7 to 10%"), or savings were provided only for mutually exclusive groups (e.g. savings for 3 levels of Aclara participation). The values in this table are the mean values of the ranges provided.

[d] Savings for demand response events only.

[e] Note that this excludes customers who received reports and opted in to the website (n=668) as kWh savings could not be precisely calculated for this subgroup.

f Participants receive home energy reports that are opt-out; they may also use the program online interface, which is opt-in.

[g] Utilities rolled out these programs in advance of an overall rate increase.

Tools and Tactics of High Energy Saving Programs

Below, we outline the best practices observed among those programs with the greatest energy savings per household.

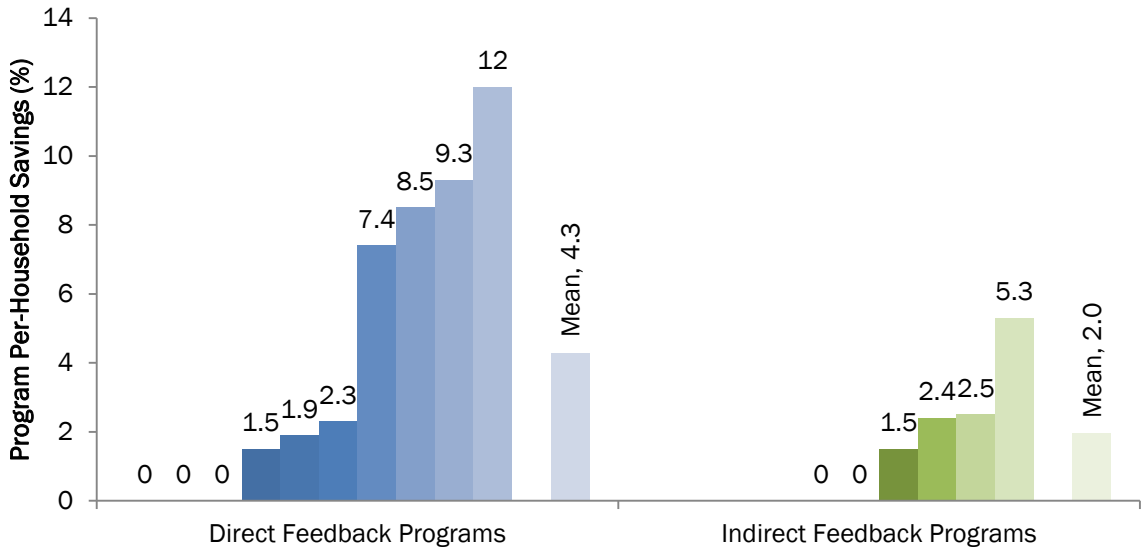
Tactics to Promote Customer Engagement

- **Most programs are opt-in or have opt-in elements.** For IHD programs, this is especially important as there are some customers who will never be interested in the device, and a general-population, opt-out approach is unlikely to be cost-effective or gain significant savings per household. Indirect feedback programs reach wider audiences with opt-out reports, but get higher per-household savings when they also offer opt-in elements.

Direct vs. Indirect Feedback

- **Direct and indirect feedback program models offer potential for high savings per household, but higher overall savings per household with real-time feedback.** This is consistent with earlier reviews of feedback programs. Figure 16 shows the comparison of direct and indirect feedback programs that estimated savings per household (as a percentage per household). Direct feedback programs, particularly those that show data in 1-minute intervals or less, prompted higher per household savings, with a mean of 4.3% savings, compared with a mean of 2.0% for indirect programs. However, as we discuss below, there are segments within these populations where savings were much higher than for the rest of the population.

Figure 16. Estimated Per-Household Savings by Feedback Type (n=15)*



*Note that this figure excludes programs that did not provide per-household average savings, including one direct feedback program and three indirect feedback programs that provided savings estimates in kWh or kW only. One program, which had both direct and indirect feedback elements, is counted under both categories.

This figure also excludes three programs where savings were not calculated.

Participant Targeting

- **Programs with the highest savings per household tend to target specific groups of customers for participation.** Programs without customer segmentation or targeting were more likely to have moderate to no savings per household overall.

- **Tactics of customer targeting used in past studies include high-usage customers and customers identified through segmentation** to be interested in saving energy but have not taken action.

- **Notably, all of the programs that produced zero savings per household had no customer targeting.** This includes a ComEd study, which comprised several customer outreach and engagement efforts (for selected treatment sub-groups), but did not explore customer segmentation or specifically identify customers who were most likely to save.

Table 14 lists programs that conducted targeted customer recruitment, along with their associated savings where available.[19]

Table 14. Types of Customer Targeting

Program Name	Targeting Description	Per-Household Savings
Salt River Project M-Power Program (Direct Feedback)	Targets customers who signed up for Salt River Project pre-paid billing plan (i.e., customers who would be likely to sign up for pre-paid billing such as customers in arrears on their SRP bills.	High (12%)
Cape Light Compact Tendril In-Home Display Pilot (Direct)	Geographic targeting of high-usage households (650 kWh/month or more).	High (9.3%)
BC Hydro Team Power Smart (Indirect)	Targets customers who are identified as "stumbling proponents": customers who have positive attitudes toward saving energy but take few actions to save. This group is estimated to be about 20% of the population.	Moderate (208 kWh per-household)
SDG&E Tendril In-Home Display Pilot (Direct)	Targeted high-usage households (700 kWh/mo or more). The programmable communicating thermostat (PCT) and IHD pilots targeted low-income customers specifically.	Not calculated (as of Sept. 2012)

- **Some past programs have also identified the highest savers through a subdivided treatment group.** These studies include general population treatment groups but identify subgroups that may have higher savings than the rest of the treatment group. Stratifications in past studies have included energy usage (high, medium, low) or equipment fuel (electric or gas). These programs have identified different savings levels based on these subgroups, as shown in Table 15. These customers, while not specifically targeted during these studies, may also serve as target groups for recruitment.

[19] Three pilots are marked as "Targets Specific Customers" in Table 13 but are not included in this table; two of these pilots targeted within each utility's existing customer panels, while one targeted customers within a certain rate type. Thus, the programs target specific customers within their customer base, but as customer panels they cannot be considered a "target group" within the general population.

Table 15. Treatment Group Subdivision Savings[20]

Program Name	Sample Subdivision Description	Overall Per-Household Savings	Sub-Group Per-Household Savings
Commonwealth Edison Customer Applications Program (2010-2011)	Subgroup within IHD/Critical peak pricing treatment group (about 10%), not otherwise defined.	None (0%)	High (20% during demand response events and 14% during other peak times)
Hydro One PowerCost Monitor Pilot (2004-2005)	Space heating fuel type (non-electric).	High per-person (8.5%) and aggregate (6.5%)	High (aggregate 8.2%)
Arizona Public Service Aclara Program (2008-2009)	Pre-program usage (top one-third of energy users).	None (0%)	High (6.3%)
Wisconsin Focus on Energy PowerCost Monitor Study (2008-2009)	Pre-program usage (top three-fourths of energy users).	Moderate (1.5%)	Moderate (3.4%)

Rate Changes and Demand Response Integration

- **Rate changes and demand response integration may not be key to program success.** Few programs integrated changes in billing rate or demand response elements into their program designs. Past reviews of feedback technology have noted that too much focus on demand response can also be detrimental in programs with overall savings goals, as customers tend to shift demand to other times of day rather than reduce their usage overall.[21]

Tools to Promote Customer Engagement

Delivery Mechanisms

- **The highest per household savings tend to be achieved through programs that provide multiple, ongoing touchpoints with customers (especially through website engagement), rather than through feedback alone.**

- **Programs with participants who opted-in to more intensive participation, typically a subset of all report recipients, often had significantly higher savings than customers who received reports only.** This is especially noticeable for indirect feedback programs, where customers may receive monthly reports or opt-in to the program website.

- **High-saving programs often include social and reward-based elements, such as challenges, direct rewards, or benchmarks.** Programs that leverage motivational tactics to keep customers engaged with the *platform* achieve greater per-household savings.

- **Most programs that generate high per-household savings include some online, interactive component.** As these programs rely on modern, increasingly sophisticated technology, online dashboards and interfaces are necessary to customer engagement.

[20] This excludes programs that subdivide the sample by level of treatment received (i.e., by level of engagement); we discuss these programs in the next section.
[21] Ehrhardt-Martinez et al.

- **As customers become more accustomed to instant information, program administrators need to compensate by providing more "push" to customers.**

    - Most studies with higher savings among "engaged" customers include program administrator "pushes" to increase engagement, such as email notifications or reminders printed on bills. Among newer programs, Program Administrator (PA) pushes are especially prevalent when producing higher savings.
    - However, we have found that these PA pushes are not enough on their own. The highest savings programs include both PA pushes and target customers who are the most interested in the information.

- **In-home displays are often included in the high-energy savings groups; however, this is not a determinant of savings.** While in-home displays are often a component of high-saving programs, they are also prevalent in low to moderate saving programs.

Note: Three of the five studies that found the highest savings were conducted more than five years ago (in 2004 and 2005). These programs offer participants instant information and little else, but still resulted in significant per-household savings. One key technology change that has occurred since these studies is the introduction of the iPhone and other smart phones, resulting in a technology culture where instant information is now a given rather than a novelty. The two high-savings programs that have been introduced in the last three years (since 2009) include significantly more participant engagement efforts from the program administrators.

Feedback Content

- **Direct feedback programs that provide to-date or estimated energy costs save more.** Nearly all of the higher saving (and direct feedback) programs include either real-time cost or estimated bill information; however, only a few of the lower-saving, indirect feedback programs mentioned that they provided this information.

    Note that indirect feedback programs instead are more likely to include personal savings plans (such as online audits or benchmarking) as part of their tools for engagement, which appear to be less successful in prompting action.

- **Customized information is an important component for prompting action.** Most programs with highly engaged savers included opportunities for users to develop customized analysis and savings plans based on their home's equipment.

Table 16. Savings Variations and Engagement Tools

Program Type	Customer Actions		Program Administrator "Pushes"				Overall Savings Per Household	Per Household Savings Among Highly Engaged
	Personal Savings Plans [a]	Social Engagement [b]	Email, text message, or mail	Competitions/ Comparisons to others	Tips	Program Channeling		
Cape Light Compact In-Home Display Pilot (2009-2010)	X	X	X	X	X	X	9.3%	NC, but highest savers checked information more often
Illinois Citizens Utility Board Energy Saver Program (2010-2011)	X	X	X		X	X	5%-5.6%	6.01% (website users)
WMECo C3 Western Mass Saves! Program (2010-2011)	X	X	X	X	X	X	2%-3%	5.5%-5.7% (website users)
Massachusetts PowerCost Monitor Pilot (2007)							1.9%	2.9% (those who said they used the device)
Wisconsin Focus on Energy PowerCost Monitor Study (2008-2009)					X		1.5%	5.4% (those who said device was useful)
Pennsylvania Power & Light Aclara Program (2008-2009)	X		X		X	X	Estimated 1%-2%	2.9% (Greatest level of engagement with audit (Level 3 participants)
BC Hydro Team Power Save Program (2008-Present)	X	X	X		X		208 kWh	NC, but "strong correlation" between engagement with information and overall savings
Arizona Public Service Aclara Program (2008-2009)	X		X		X		0%	High savings among high-usage, most engaged participants (Level 3 participants reduced 357 to 1461 kWh annually)

[a] Includes online audits and personal benchmarking/goal setting.

[b] Includes social networking and events.

Conclusions

The literature review indicates that incorporating the following tools and tactics into enhanced feedback program design may increase per household energy savings:

- **Provide real-time direct feedback**. Our review indicates that providing energy usage feedback in intervals of one-minute or less tend to have higher per-household energy savings than less frequent feedback.
- **Target customers**. Program interventions that target specific customers tend to have higher per-household energy savings. In cases where general population customers are recruited, high per-household savings generally derive from a sub-group of the target customers.
- **Provide bill estimates or to-date spending**.
- **Engage customers through multiple touchpoints.** A review of the literature indicates that how you interact with the customer is important, and high-savings programs tend to combine many aspects. Notably, the specific delivery mechanism does not appear to directly impact the overall savings of a given program. However, those programs with multiple touchpoints generated the greatest overall savings. Programs should consider engaging customers by:
  - **Offer personal savings plans**. Customized upfront feedback that includes goal setting, benchmarking, and online audits tend to result in higher per-household savings
  - **Provide customers with social engagement and competition through online interfaces.** This is particularly the case for programs with online interfaces. Websites are important, but awareness of the website can be an issue for some programs, especially for those with IHDs that are separate from the online dashboard.

Additional Details for the Literature review

Key Terms

- **Enhanced feedback:** A type of energy conservation behavioral program that provides customers with additional details about their usage beyond the information in their monthly bills. This includes both direct and indirect feedback. The intention of these programs is for customers to react to this information by taking immediate action to reduce energy use.

- **Direct feedback**: Programs that provide customers with information about their energy use in real-time or near-real-time (no more than 15-minute delay). Customers are able to react immediately to the information. Direct feedback programs nearly always require a home to have a smart meter and for the resident to install a separate device and connect it to that meter. These devices currently include the following:

  In-Home Display (IHD): A specially installed device that provides the resident with their current usage information. IHDs will always display current usage, but may display additional information such as historical usage and associated cost for current usage. These devices can also be called an *Energy Information Display (EID)*.

  Home Area Network (HAN): These devices have the same information display capabilities as an IHD, but are also connected to equipment throughout the house (such as the thermostat) to allow the resident to directly control their equipment in reaction to the device information. Home area networks usually require the installation of additional accessories to an IHD.

- **Indirect feedback:** Programs that provide customers with information about their energy use after the usage has occurred. This can range from up to one day after the usage has occurred to one month, when the customer receives their regular bill. Indirect feedback programs provide customers with additional analysis of their bills or allow customers to engage with their billing information with a greater amount of detail. However, they rarely require that customers purchase or install any new equipment. Indirect feedback programs include the following:

  Online dashboards: Customers may access an online interface linked to their bill that provides them with detailed billing usage over the course of their billing period. Rather than being real-time, the information is usually updated a few days after the usage has occurred. This may include customer progress toward energy savings goals set by the customer at the beginning of their program participation; it may also include normative comparisons to neighbors' usage, or to the customer's usage during previous billing cycles. The energy report programs included in this literature review offer further analysis via online dashboards, where participating customers may review and analyze their energy usage on a daily basis.[22]

  Online audits: An online dashboard where the customer identifies the key energy using equipment they have installed in their home. In utility programs, this is generally linked directly to the customers' billing information so that they may see how each home equipment type has contributed to their past energy usage over the past year or month.

[22] This report, therefore, excludes OPOWER programs, which provide customers with energy reports, but only on a monthly basis and with no online dashboard component.

Detailed Program Descriptions

Although energy feedback studies go back decades,[23] they have grown rapidly in the last few years, and the technology associated with these programs has been rapidly evolving. Utilities have begun adding feedback programs to their portfolios in only the last few years. Many earlier studies

These programs are generally intended to promote energy saving behaviors. As more utilities have brought behavioral programs into their portfolios, these programs are meant to guide customers to the most efficient actions by showing them the details of when and where they use the most energy in their homes.

However, just as energy saving behaviors themselves vary widely, programs vary significantly in implementation, research methods, and savings results. In the following sections, we describe the key programs reviewed by direct and indirect feedback programs.

[23] See Ehrhardt-Martinez et al.

Direct Feedback Programs Reviewed

Table 17. Summary of Reviewed Direct Feedback Programs (Highest to Lowest Energy Savings)

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
High Savings							
Landis+ Gyr ecoMeter	Phoenix, AZ area (Salt River Project)	October 2005-October 2006 (1 year)	IHD was a component of the SRP pre-paid utility billing program. Customers signed up for a prepaid bill program and received the device as part of their participation. An estimated 30,000 customers participated during the study period.	Estimated annual per-household kWh reduction of 12% compared with customers on the standard (not pre-paid) rate	Opt-in program. Targeted general population of customers; participants need an AMI meter, which can be installed during program participation. Note that this program included a larger number of lower-income participants compared with other programs, as many participants signed up for the M-Power program due to being in arrears on the SRP bills.	Information Displays	Updated information on real-time basis (every 3 seconds); limits set on monthly usage through prepaid billing; cumulative usage information
iCES platform	Cape Cod, Massachu-setts (Cape Light Compact)	Spring 2009-February 2010 (9 mos.)	IHD pilot where 91 recruited households signed up to receive a device that at no cost that connects to both their meter and their home computer. Information is displayed in real time on a computer "dashboard." The device was installed only by a professional.	Estimated daily per-household kWh reduction of 9.3% compared with control group who participated in no other CLC programs. Evaluation also found that customers with high savings interacted with the website more frequently than customers with low/no savings	Opt-in based on recruitment of qualifying households. Targeted customers with greater than 650 kWh/month usage in Cape Cod and Martha's Vineyard.	Online Interface	Monitor household usage on a near real-time basis (every 15 minutes) and sends information (via a router) to a connected dashboard device. Dashboard provides detailed usage info, including: Savings information (kWh, dollars, and CO2), Monthly usage and totals, energy savings tips, households energy use distribution, normative comparisons, and alerts to DR events (though none were called during the study period)

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
The Energy Detective (TED)	Florida (Research Institute of Central FL)	Sept. 2005-Aug. 2007 (2 years)	Pilot program. Provided IHD devices to 17 homes at no cost. These devices provided real-time feedback on energy use to encourage savings.	Estimated 2-year per-household kWh reduction of 7.4% compared with control group (ranged from -9.5% to 17.5%), and weather adjusted kWh/day savings of -2.9 to 19.5 kWh. However median savings was much lower, closer to 2%, due to small sample size. The study notes that customers with the highest consumption also had the largest savings.	Opt-in. Did not target specific participants.	Information Displays	Instantaneous usage (updates every few seconds); historical usage; cumulative cost per hour; times of peak daily and monthly demand. No additional messaging other than device display.
PowerCost Monitor	Ontario, Canada (Hydro One)	Summer 2004-Sept. 2005 (1.5 years)	Pilot program. 500 customers signed up to receive the PCM feedback device from Hydro One.	Estimated 1.5-year aggregate kWh reduction of 6.5%, with average savings per person between 7% and 10%. Savings also varied by types of measures in home: customers with non-electric space heating saved aggregate 8.2% kWh, versus 1.2% for those with electric space heat. Among those with non-electric space heat, those with electric water heaters saved 16.7%, while those with non-electric water heat saved 5.1%	Possible customer panel; General population, stratified in to 6 groups based on annual kWh usage, designed to be representative of all major regions in Hydro One territory; may have been drawn from customer panel	Information Displays	Instant usage (updates approximately every 30 seconds); total cost per hour; predicted bill; historical usage (up to one month); predicted usage. No additional messaging other than device display.
Moderate Savings							

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
Tendril	Cape Cod, Massachu-setts (Cape Light Compact)	June-Nov. 2011 (5 mos.)	Second pilot for CLC customers. Customers received a Tendril IHD device that displayed usage at up to 15-minute intervals	Estimated daily per-household kWh of 2.3% compared with the control group	General population	Information Displays	Real-time information through device (kWh) provided every 15 minutes; historical usage; cumulative cost; "push" notification from CLC notifying of events; website provides benchmarking and normative comparisons with other homes
PowerCost Monitor	Massachu-setts (NGRID, NSTAR, WMECo)	May 2007-Nov. 2007 (6 mos.)	Program tested PCM marketing and rollout methods. Customers could receive PCM device either for free from a home energy audit or by purchasing directly at one of three different price points ($9.99, $49.99, or $29.99). NGRID had 377 total participants, WMECo had 32, and NSTAR had 3,103.	Estimated daily per-household kWh reduction of 1.9% compared with the control group; savings estimated to be 2.9% among those with a working device	Opt-in. Pilot program, screened for customers with compatible meters. Targeted customers slightly differently in each utility territory. NSTAR recruited general public, who paid for device, WMECo targeted home energy audit participants, and National Grid targeted both.	Information Displays	Instant usage (updates approximately every 30 seconds; total cost per hour; predicted bill; historical usage (up to one month); predicted usage
PowerCost Monitor	Madison, WI (Energy Center of WI)	Spring 2008-Summer 2009 (1 year)	300 customers signed up to receive an in-home energy information display device. These customers were randomly assigned to treatment and control groups. Treatment customers (218) received device with tip sheet, control customers (95) did not receive anything.	Estimated daily per-household kWh reduction of 1.5% compared with control group, likely within range of -1.4 to 4.3%. The study found 3.4% per-person savings among customers with functional devices, and 3.8% savings among those who check device frequently	Opt-in. Random selection of customers who expressed interest in in-home feedback display	Information Displays; Enhanced Billing Information	Instant usage (updates approximately every 30 seconds); total cost per hour; predicted bill; historical usage (up to one month); predicted usage; three non-specialized tip sheets from administrators on ways to save and available programs.

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
EnergyHub	South Carolina (South Carolina Electric & Gas)	October 2011-July 2012 (1 year)	Phase 2 of 2. Residential customer program rollout, with a total of 3,117 participants. Customers called SCE&G to receive feedback device. Customers can also register for EnergyHub website to get more detailed and visualized usage information, or SCE&G website to get savings tips and information on relevant programs. EnergyHub also sells separate add-ons to help directly manage usage in response to device information, but they are not provided through the program.	Absolute annual savings of 64 kWh and 0.01 kW savings per-person, based on deemed savings*	Opt-in. General population.	Information Displays; Online Interface	Real-time information through device (kWh) provided every 15 minutes; historical usage; cumulative cost; "push" notification from SCE&G notifying of events; related SCE&G website providing tips and programs; EnergyHub website that provides more detailed usage information and analysis
Low/No Savings							
PowerCost Monitor	Oregon (ETO)	January-August 2008 (9 mos.)	Customers signed up to receive a feedback device. They could either purchase the device from ETO's website at $29.99 (the normal retail price was $150), or get it for free during a home energy audit. 200 total customers participated.	Study found no statistically significant difference between treatment and control groups, and savings between 1.6 and 2.6 kWh per day; also found lower savings at 3, 6, and 9-mo. research periods	Opt-in. General population of customers, half offered through ETO website at a discounted price and half offered through home energy audits - all opt-in customers who express interest in saving energy	Information Displays	Instant usage (updates approximately every 30 seconds); total cost per hour; predicted bill; historical usage (up to one month); predicted usage
The Energy Detective (TED)	Mountain View, CA (Stanford & Google)	March 2010-October 2010 (8 mos.)	Test of Google web application using data from The Energy Detective (instead of the TED website). Google employees tested both the device and web interface. 1,065 total employees participated.	Average savings of 5.7% across all participants compared with control groups; however, savings decreased after the first four weeks of use and was at 0%	Opt-in. Targeted a Google employees, originally within California office, then across U.S., stratified by U.S. region	Online Interface; Information Displays	In addition to TED real-time data display (updates every few seconds), Google web interface provided graphs of real-time and historical consumption, bill projections, daily kWh, tips, and email reminders.

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
				compared with control group by the end of the three-month participation period.			
eWeb (Online Dash-board, EID/HAN)	Chicago, IL (ComEd)	June 2011-May 2011 (1 year)	The program was designed to test both dynamic pricing and feedback technologies. Customers were put into one of 25 different study groups (23 treatment, 2 control) that tested multiple combinations of components in feedback programs: dynamic pricing (multiple kinds of rates), educational materials, indirect feedback, and direct feedback. These different treatment groups received different combinations of these materials (such as direct feedback alone, direct feedback with dynamic pricing, direct feedback with educational materials, etc.)	No (0%) overall average per-household kWh savings found; however, this is only among a subgroup of participants in dynamic pricing + EID (about 10%) that participated in DR events and saved more than 20% CPP and 14% peak-time rebate pricing; some EID customers also saved during peak times even if they were not on a special DR rate	Opt-out. Random selection of from general population of homes with AMI smart meters in two areas, outside and inside Chicago	Information Displays & Online Interface	Materials and motivational tactics varied by group. Some received additional educational materials, some received OPOWER normative comparisons, some received notifications of usage and/or DR events, some received EID devices -- and some received none of these. Some customers were signed up for different load-based rates such as critical peak pricing or time-of-use, while others were not put on any special rate plan.
Savings Not Calculated							
Tendril	San Diego, CA (San Diego Gas & Electric)	June-October 2011 (5 mos.)	The program had three components: the Residential Automated Controls Technology (RACT), the Low-Income In-Home Display (IHD), and the Low-income programmable communicating thermostat (PCT) pilots. All 3 were demand response feedback programs. The program provided the technologies for these programs for free,	Not calculated at this time.	Opt-in. Targeted 100 high-usage (700 kWh/mo or more) single-family home-owners with central AC and not enrolled in other DR or renewable programs. The PCT and IHD pilots targeted low-income customers specifically.	Information Displays; Online Interface	Real-time information through device (kWh) provided every 15 minutes; Notifications through the device before DR events; link to a special "energy management" website; ability to track both real-time and historic usage; Biggest Energy Saver (BES) competition which shared and ranked participants'

Device Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
			but did not offer any additional incentives. The program had 207 total RACT participants, 279 IHD participants and 66 PCT participants.				savings from the previous year
AzTech	South Carolina (South Carolina Electric & Gas)	Nov. 2010-Oct. 2011 (1 year)	Phase 1 of 2. Residential pilot. 245 participating customers received the AzTech EID device for free from SCE&G. Device provides usage info every 15 minutes. Customers could also go to SCE&G website to learn about ways to save.	Not calculated	Opt-in. Members of SCE&G "Voice of the Customer" panel.	Information Displays; Online Interface	Real-time information through device (kWh) provided every 15 minutes; historical usage; cumulative cost; estimated bill.

Indirect Feedback Programs Reviewed

Table 18. Summary of Reviewed Indirect Feedback Programs (Highest to Lowest Energy Savings)

Program Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
High Savings							
Efficiency 2.0 (Online Dash-board)	Chicago area, IL (Illinois Citizens Utility Board, ComEd and People's Gas territory)	June 2010-2011 (1 year)	Randomly selected customers receive reports with their monthly bill that compared usage to previous bills and to neighbors' usage; the report also provides access to website for detailed feedback and to sign up for savings goals. 11,682 customers opted in to website information.	Estimated daily per-household kWh reduction of 5%-5.6% compared with control group. Furthermore, savings were 6.01% for participants who signed up on the website, compared with 1.47%-1.63% savings for participants who received the mailer only.	Reports are opt-out, but website is opt-in. General population, randomly selected for treatment and control groups. Going forward the program is planning matching process to identify non-participants most similar to participating customers.	Online Interface; Enhanced Billing Information	Historical usage; usage comparison to neighbors; goal-setting and tracking; customized savings tips; online audits (from ResNet); rewards points for savings, redeemable for discounts; contests and challenges
Moderate Savings							
Aclara (Online Audit)	Eastern Pennsylva-nia (Penn-sylvania Power & Light)	2008-2009 (1 year)	Online home energy dashboard with online audit and savings recommendations. Customers can sign up at one of three levels of commitment: Level 1 is a survey of basic home information (including heating and cooling equipment), Level 2 includes an appliance inventory, and level 3 includes comprehensive home details and customized, changing tips. 9,739 total customers participated in 2008.	Estimated daily per-household kWh reduction in Level 1 was 1.2% (ranging from 0.3% to 2.2%); in Level 2, daily reduction was 1.1% (ranging ranging 0.6% to 1.6%). For Level 3, estimated daily per-household kWh reduction was 2.9% (ranging from 1.6% to 4.3%).	Opt-in. General population of PPL customers.	Online Interface	Online audit at 3 levels of detail; graphics showing historical usage tracking; pie charts identifying end uses that use the most energy; tips for ways to save based on audit responses; bill-to-date online information. The report notes that PPL also raised their rates significantly (usually around 30%, but up to 35%) in January 2010, and began notifying customers of the upcoming change in mid-2007.

Program Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
Efficiency 2.0 (Online Dash-board)	Western Massachu-setts (WMECo)	Nov. 2010-June 2011 (9 mos.)	Pilot program. Customers were randomly selected to receive reports with their monthly bill that compared their usage to neighbors and previous bills; customers could then sign up for more detailed usage analysis and to set savings goals on WMECo website. 25,000 customers received reports, while 7,200 opted in to the online interface.	The evaluation did not calculate overall savings, but found that report-only participants had 0.4% per-household kWh savings. Online participants had 5.5% savings for online-only participants, and 5.7% savings for participants both go reports and opted onto the website.	Reports are opt-out, but website is opt-in. General population, randomly selected for treatment and control groups for reports. Quasi-experimental design for the online component due to its opt-in design.	Enhanced Billing Information; Online Interface	Report provides monthly and annual neighbor comparisons; website provides list of tips, historical usage, neighbor comparisons, goal-setting and tracking, customer rewards (can redeem for discounts), community/social engagement
Enerlyte (Online Dash-board)	Payson City, UT (Payson City Power)	October 2010-October 2011 (1 year)	Customers received a customized utility bill with "energy efficiency report" with feedback on energy usage and neighbor comparison; customers could then sign up for more detailed usage analysis and to set savings goals. Can also set goals working with customer service reps at utility center. 5,000 customers received reports.	2.4% savings per participant compared with control group; 726,000 total kWh savings; however, writers note that the data was not weather normalized	Opt-out. General population, but information collected allows segmentation and targeted messaging.	Enhanced Billing Information; Online Interface	Historical usage comparisons; neighbor comparisons; online audit; efficiency tips; goal-setting and competitions; peak alerts; action plans; mobile app added to provide peak alerts
Efficiency 2.0 (Online Dash-board)	South Carolina (South Carolina Electric & Gas)	April 2011-March 2012 (1 year)	Customers signed up to set energy savings goal and received monthly report showing progress toward that goal, how their usage compared to neighbors, and relevant behavioral tips and related SCE&G programs. 26,901 customers signed up for the program in 2011.	Overall savings of 327 kWh per-person and demand savings of 0.12 kW per-person; however, based on program deemed savings due to study timing. Most participants interviewed met their savings goals, but their goals were modest.	Opt-in. General population	Online Interface; Enhanced Billing Information	Monthly benchmarking report (mail or online dashboard) that shows progress toward overall savings goal; Like Home Comparisons of monthly usage; relevant savings tip

Program Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
				Billing analysis planned for 2012.			
BC Hydro (Online Dash-board)	British Columbia (BC Hydro)	"Early 2007"-2008 (1 year)	Pilot program. Customers signed up for an energy savings goal on BC Hydro "Team Power Smart" website. Customers could set one of several levels of goals: 5%, 10% or 20%. Customers who met their goal received cash rebates equal to cost of energy saved (e.g. a 5% reduction led to rebate equal to a rebate payment equal to cost of energy saved). The program was rolled out to all customers in October 2007 and is currently still in place in BC Hydro territory.	Precise savings not calculated, but program administrators found that about half of customers saved energy, though only 20% met their savings goals. Customers with 5% savings goals were most likely to meet it (41% met), while customers with 20% savings goals were least likely to meet it (7% met). Control group could sign up for goal but did not receive any incentives for meeting it - they had about 14% reach goal, 32% save and 55% increase	Opt-in. Pilot program, targeted general population customers that were employees of BC Hydro's "largest customer." However, noted that future programs in the same vein would target "stumbling proponents," customers who had positive attitudes toward saving energy but taking few actions, estimated to be about 20% of customer population	Online Interface; Email Communication	Online tool to track and compare historical usage, set goals and track progress toward goal, and get tips to reduce consumption. BC Hydro also sent electronic reminder newsletters to encourage customers to visit the site regularly.

Program Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
BC Hydro (Online Dash-board))	British Columbia (BC Hydro)	2008-2010 (2 years)	Full program rollout of pilot described above. Customers sign up on BC Hydro page to set energy savings goal on "Team Power Smart" website to set a total one-year kWh savings goal of 10% only. (Note this goal-setting changed from the pilot.) Customers who meet the goal receive cash rebates equal to the cost of the energy saved. Total participants estimated at 300,000, and 75,000-80,000 in the 2009-2010 period.	Estimated annual per-household kWh reduction by 2010 was 208 kWh per person. Estimated annual per-household savings percentages ranged from 0-16%. Participants who did not meet 10% goal had average savings of 4-5%. Program administrators estimate that 75% of customers had measurable energy savings; however, only 20% of participants met the savings goal of 10%.	Opt-in. General population, but conducted segmentation to find target group and focuses mostly on them. Lately has been expanding away from this group.	Online Interface; Email Communication	Online tool to track and compare historical usage, set goals and track progress toward goal, and get tips to reduce consumption. BC Hydro also sent electronic reminder newsletters to encourage customers to visit the site regularly. Also conducts events and in-person outreach, including a loyalty program to keep customers engaged over time.
Ambient Energy Orb (Online Dash-board)	CA Statewide (SCE, PG&E, SD&GE)	Summer 2005 (3 mos.)	Part of a rate program where customers were charged higher rates during peak demand period. Customers were linked to a website (or received mailed reports) that provided detailed bill analysis on their overall usage. Customers also received an "Energy Orb," a globe-shaped light that displayed different colors during peak demand periods to notify the customer when to save.	Estimated per-household savings of 0.061 kW per peak period (2pm-7pm) per day; this was consistent with every daily peak hours and did not change on specific DR days; percentages were not specified but found greater savings in treatment group than control group. Note that total savings were not calculated.	Opt-in. Recruitment within customers already on critical peak pricing rate	Online Interface; Information Displays	Increased rates during peak demand periods; detailed analysis of past usage; bill analysis that shows detailed usage during peak period (2pm-7pm); email "push" notifications to encourage customers to use the website; changing color of the "Energy Orb" during peak demand periods
Low/No Savings							

Program Type	Location	Timing	Program Description	Energy Savings	Customer Targeting	Feedback Tools	Motivational Tactics
Aclara (Online Audit)	Arizona (Arizona Public Service)	2009-2010 (1 year)	Nearly identical to PPL program, Aclara is an online home energy dashboard with online audit and savings recommendations accessed via the customer's online bill. Customers can sign up at one of three levels of commitment: Level 1 is a survey of basic home information (including heating and cooling equipment), Level 2 includes an appliance inventory, and level 3 includes comprehensive home details and customized, changing tips.	No (0%) overall average per-household kWh savings found; however, for customers in highest tier of energy usage (top one-third in terms of annual usage), usage was reduced 6.3%. Within the highest-level users, Level 1 participants reduced 275 to 450 kWh annually; Level 2 participants reduced 361 to 727 kWh annually; and Level 3 participants reduced 357 to 1461 kWh annually	Opt-in. General population targeted, but also tested for differences by usage tier (lowest third, middle third, highest third).	Online Interface	Online audit at 3 levels of detail; graphics showing historical usage tracking; pie charts identifying end uses that use the most energy; tips for ways to save based on audit responses; bill-to-date online information.

Evaluation Best Practices

We also examined some of the best practices in evaluation of feedback programs. We found that evaluations have been increasingly using billing analysis with a control group. The need for billing analysis is not surprising, as there are no set measures or behaviors, and therefore no truly predictable savings, associated with these programs. However, billing analysis is time-consuming and, therefore, expensive. Only one utility (South Carolina Electric & Gas) has developed deemed savings for its feedback programs, but even they are planning to verify these deemed savings through billing analysis in fall 2012.

Some savings analyses include a true control group, comprising random assignment of interested participants into control and treatment groups. Some billing analyses use comparison groups of later participants, so that the level participant interest in behavioral programs is represented in both the treatment and comparison groups, particularly for opt-in programs. Older billing analyses (including the SRP and Florida studies) used the general population as the basis for comparison.

One area that has not been studied thoroughly at this point is persistence of behaviors for these programs. Most programs use one year of billing data as the basis for comparison; however, as many of these programs are relatively new, the question of persistence has not yet been definitively answered.

Table 19 provides an overview of the methodologies used in measuring savings. One key issue of comparison between indirect and direct feedback programs is sample size: Indirect feedback programs tend to have much larger sample sizes (often reaching out to the whole population) than direct feedback programs.

Table 19. Evaluation Research Designs by Program (Organized by Type and Year)

Report	Sample Size	Duration	Calculations	More than 1 Year?
Experimental Design				
ComEd Energy Report Pilot (Indirect & Direct)	8,500 total customers (675 in control groups, 7825 among various treatment groups)	June 2011-May 2011	ANOVA of mean energy usage; regression analysis of event load days, used control group	N
Energy Center of WI PowerCost Monitor Study (Direct)	218 treatment, 95 control	Spring 2008-Summer 2009	Billing analysis with control group	N
ETO PowerCost Monitor Pilot (Direct)	200 treatment, 691 control participants	January-August 2008	1-year Billing analysis with control group planned, but interim data available from 9 mos. of billing data	N
Hydro One PowerCost Monitor Pilot (Direct)	500 treatment, 52 control	Summer 2004-September 2005	Billing analysis with control group	Y (18 mos.)
WMECo Efficiency 2.0 Program (Indirect)	25,000 customers received mailed reports, 25,000 in control group. 7,200 opt-in participants using online interface (among the 25,000 contacted)	November 2010-June 2011	Billing analysis with control group	N

Payson City Power Enerlyte Pilot (Indirect)	est. 5,000 treatment group, 500 control group	October 2010-October 2011	Billing analysis with control group	N
Illinois Citizens Utility Board Efficiency 2.0 Program (Indirect)	2,925 treatment group, 3,382 control group (for website engagement); 14,855 treatment group, 60,065 control group (for reports)	June 2010-2011	Billing analysis with control group	N
Quasi-Experimental Design				
South Carolina Electric & Gas EnergyHub In-Home Display Program (Phase 2) (Direct)	3,117 total participants; comparison group not yet defined	October 2011-July 2012	Billing analysis with comparison group (to be conducted fall 2012)	N
South Carolina Electric & Gas My Home Energy Report (Indirect)	26,901 total participants; comparison group not yet defined	April 2011-March 2012	Billing analysis with comparison group (to be conducted fall 2012)	N
Cape Light Compact In-Home Display Pilot (Direct)	91 parts, 96 interested non-parts, 100 random non-parts	Spring 2009-February 2010	Billing analysis; quasi-experimental design	N
Arizona Public Service Aclara Program (Indirect)	36,905 in participant group; 8,870 in comparison group	2009-2010	Billing analysis; quasi-experimental design (2009 participants' usage compared with usage of 2010 participants during 2009 (i.e., before participating in program))	N
BC Hydro Team Power Save Program (Indirect)	300,000 total participants, 75-80,000 estimated in 2009-2010 period	2008-2010	Billing analysis with non-participant group (not described)	N
Pennsylvania Power & Light Aclara Program (Indirect)	9,739 total treatment group; 6,659 comparison group	2008-2009	Billing analysis, quasi-experimental design (2009 participants were comparison group for 2008 participants during 2008).	N
Massachusetts PowerCost Monitor Pilot (Direct)	377 NGRID participants, 32 WMECo participants, 3103 NSTAR participants	May 2007-November 2007	Billing analysis with comparison group	N
California Critical Peak Pricing Pilot (Indirect)	152 participants, 118 control	Summer 2005	Difference of differences analysis of hourly load impacts; experimental design with control group	N
Stanford & Google In-Home Display and Web Application Study (Direct)	1065 total households	March 2010-October 2010	Difference of differences analysis of information recorded by device (no billing data); control group for first three months was	N

			treatment group for final five months	
Salt River Project M-Power In-Home Display Program (Direct)	estimated 30,000 participants during study period	October 2005-October 2006	Billing analysis by SRP; used comparison group of general customers on standard rate	N
Research Institute of Central FL In-Home Display Pilot (Direct)	17 participants, 2million general population utility customers (from customer database of Florida Power & Light)	Sept. 2005-Aug. 2007	Billing analysis with comparison group (used total general population of Florida Power & Light Customers, did not include random assignment)	Y (2 years)
No Savings Studied				
San Diego Gas & Electric Tendril In-Home Display Pilot (Direct)	99 TECH participants, 108 in IHD participants in RACT (non-low-income) group; 66 PCT participants and 279 IHD participants in low-income group	Installation conducted June to August 2011, DR events called from Aug. to October 2011	Savings not calculated at this time	N
South Carolina Electric & Gas AzTech In-Home Display Program (Phase 1) (Direct)	245 pilot participants; control group not used	November 2010-October 2011	Savings not calculated	N
BC Hydro Team Power Save Pilot (Indirect)	Sample sizes not described	"Early 2007"-2008; full program rolled out in 2008	Goals (not savings) tracked; Quasi-experimental design ("control" group did not get incentives but still got information)	N

Works Cited and Reviewed

Carroll, Ed, Eric Hatton and Mark Brown. "Residential Energy Use Behavior Change Pilot." Final. 2009. 2012.

"Detailed Findings from SHEMP Interim Impacts Evaluation." Memo to Cape Light Compact. Waltham: Opinion Dynamics Corporation and Navigant Consulting, 28 September 2012. 14. 2012.

"Energy Information Display Findings." Opinion Dynamics Corporation, 15 April 2011. 2012.

Faruqui, Ahmad, Sanem Sergici and Ahmed Sharif. "The Impact of Informational Feedback on Energy Consumption - Survey of the Experimental Evidence." The Brattle Group, Inc., 2009.

Foster, Ben and Susan Mazur-Stommen. Results from Recent Real-Time Feedback Studies Report Number B122. Washington: American Council for an Energy-Efficient Economy, 2012. 2012.

Harding, Mathew and Patrick McNamara. "Rewarding Energy Engagement - Evaluation of Electricity Impacts from CUB Energy Saver, a Residential Efficiency Pilot Program in the ComED Service Territory." Stanford University, n.d. 26. 2012.

Horst, G. Commonwealth Edison Company Customer Applications Program - Objectives, Research Design, and Implementation Details. Palo Alto: Electric Power Research Institute, 2011. 2012.

—. The Effect on Electricity Consumption of the Commonwealth Edison Customer Applications Program: Phase 2 Final Analysis. Palo Alto: Electric Power Research Institute, 2011. 2012.

Kihm, Steven, Karen Koski, and Andy Mendyk. “Focus on Energy – PowerCost Monitor Study.” Final Report. Madison: Energy Center of Wisconsin, April 2010. 2012.

Massachusetts Three Year Cross-Cutting Behavioral Program Evaluation Integrated Report: Prepared for Massachusetts Energy Efficiency Advisory Council & Behavioral Research Team. Final. Waltham: Opinion Dynamics, 2012. 2012.

Mountain, Dean. "Summary on the Impact of Real-Time Feedback on Residential Electricity Consumption: The Hydro One Pilot." Ontario: Hydro One, March 2006. 4. 2012.

Neenan, B. Paying Upfront: A Review of Salt Revier Project's M-Power Prepaid Program. Palo Alto: Electric Power Research Institute, 2010. 2012.

Nexus Energy Software, Opinion Dynamics Corporation, and EPRI Solutions. "California Bill Analysis Pilot - A Research Project Conducted as Part of the California Statewide Pricing Pilot (R) 02.06.001." Final report. 2006. 2012.

PA Consulting Group. Cape Light Compact - Residential Smart Energy Monitoring Pilot. Final. Madison: PA Knowledge Limited 2010, 2010. 2012.

Parker, Danny S., David Hoak and Jamie Cummings. "Pilot Evaluation of Energy Savings from Residential Energy Demand Feedback Devices." Contract Report. 2008. 2012.

PowerCost Monitor Pilot Program Evaluation Prepared for: National Grid, NSTAR Electric, Western Massachusetts Electric Company. Final. Waltham: Opinion Dynamics, 2008. 2012.

Research Into Action. "Home Area Network Pilots Process Evaluation Prepared for SDGE, A Sempra Energy Utility." Final. 2012. 2012.

"Residential Home Energy Report." SCEG PY1 MHER Commission Report. Opinion Dynamics Corporation, 15 April 2012.

"Results of Aclara Energy Analysis for APS." Memo to Aclara. Oakland: Opinion Dynamics Corporation, 30 December 2010. 12. 2012.

"Results of Aclara Energy Analysis for PPL." Memo to Aclara. Oakland: Opinion Dynamics Corporation, 3 August 2010. 11. 2012.

Siems, Antje. "Evaluation of the Massachusetts PowerCost Monitor™ Pilot Program." Waltham: Opinion Dynamics Corporation, n.d. 2012.

Sipe, Brien and Sarah Castor. "The Net Impact of Home Energy Feedback Devices." 2009 Energy Program Evaluation Conference. Portland: IEPEC, 2009. 11. 2012.

South Carolina Electric and Gas Residential Energy Information Display Program Evaluation Prepared for SCE&G. Draft. Waltham: Opinion Dynamics, 2012. 2012.

Further Reading

"Skip" Laitner, John A. "The Economy-Wide Impact of Feedback-Induced Behaviors that Drive Residential electricity Savings." American Council for an Energy-Efficient Economy, n.d.

Ehrhardt-Martinez, Karen, Kat A. Donelly and John A. "Skip" Laitner. Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities. Washington: American Council for an Energy-Efficient Economy, 2010. 2012.

Elburg, Henk van. "Smart Metering and Consumer Feedback: What Works and What Doesn't." 2008 ACEEE Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy, 2008. 12. 2012.

Harris, Jan, Jane Hummer and Patrricia Thompson. "Behavior Change Interventions What Works, What doesn't and Why." 2010 ACEEE Summer Study on Energy Efficiency in Buildings (2010): 7-128 to 7-140. 2012.

Medyk, Andrew, Steve Kihm and Scott Pigg. "A Reflection of Ourselves...How Households Interact with In-Home Feedback." 2010 ACEEE Summer Study on energy Efficiency in Buildings (2010): 7-197 to 7-206. 2012.

Neenan, B. Residential Electricity Use Feedback: A Research Synthesis and Economic Framework. Final Report. Palo Alto: Electric Power Research Institute, 2009. 2012.

Shick, Skip and Summer Goodwin. Residential Behavior Based Energy Efficiency Program Profiles. Portland: Bonneville Power Administration, 2011. 2012.

Yun, Tae-Jung, et al. "Domestic Energy Displays: An Empirical Investigation." 2010 ACEEE Summer Study on Energy Efficiency in Buildings (2010): 7-348 to 7-360. 2012.

B. CLC SHEMP Comparison Group Selection

Selecting Matched Comparison Households

In the analysis approach presented in the methodology section, whether the estimate of savings is accurate—statistically speaking, efficient and unbiased—depends on selecting comparison households that accurately represent the counterfactual behavior of program participants. We take the perspective that the best matches for program household *k* are those households whose monthly energy consumption during a period before household *k*'s enrollment in the program most closely matches household *k*'s consumption during the same period. The underlying logic is that households with energy consumption closely matched over an extended period demonstrate that they respond the same to the many exogenous factors—weather in particular—that drive energy consumption.

From a statistical perspective, an argument to include other observable variables in the match must follow from the logic that these other variables are correlated with any separation in the match during the post-enrollment period that is not due to the effect of the program nor to other variables included in the analysis, and that the values of these other observable variables are different on average for the program and comparison households. With this in mind, we also account for electric heat in the development of the matches.

The matching method used to develop the comparison group for Energize households is the following two-stage process. For each program participant, energy consumption in the *M* months before program enrollment was compared to *all* CLC residential customers with billing data over the same *M* months—roughly 162,000 customers. The basis of comparison is the difference in monthly energy use between a participant and its match, DPM_t. Denoting by SSD the sum of squared DPM_t over the matching period, the ten CLC non-pilot residential customers with the lowest SSD were chosen as "finalists" for the participant (first stage). From the ten finalists, three customers were chosen to be included in the analysis (second stage). Typically, these three were the matches with the lowest SSD *and* the same heat type. If there were not at least three finalists with the same heat type, the three matches included in the analysis were chosen sequentially as follows: (a) all finalists with the same heat type; (b) the remaining finalist(s) with the lowest SSD.

Matches for Energize customers were for both 12 months and 24 months before the start of the pilot (in other words, we conducted the analysis for Energize customers using two sets of matches). The energy use by Energize households and their matches during the matching period is presented in Figure 17 and Figure 18.

Matches for Legacy households followed the same basic process as used for Energize households, except that the matches were for only 12 months due to the available data, and two approaches for the second stage of the matching were used. The first approach followed the process described above—matches were based on minimizing SSD subject to having the same heat type (standard matches). In the second approach, matches were based on minimizing the linear trend of D_{PM} during the matching period, subject to having the same heat type (low trend matches). In the next section, we provide the rationale for this second approach. The energy use for Legacy households and their matches during the matching period is presented in Figure 19.

Figure 17. Comparison of the Average Monthly Consumption of Energize Households and Their 12-Month Matches in the 12 Months Before Pilot Enrollment

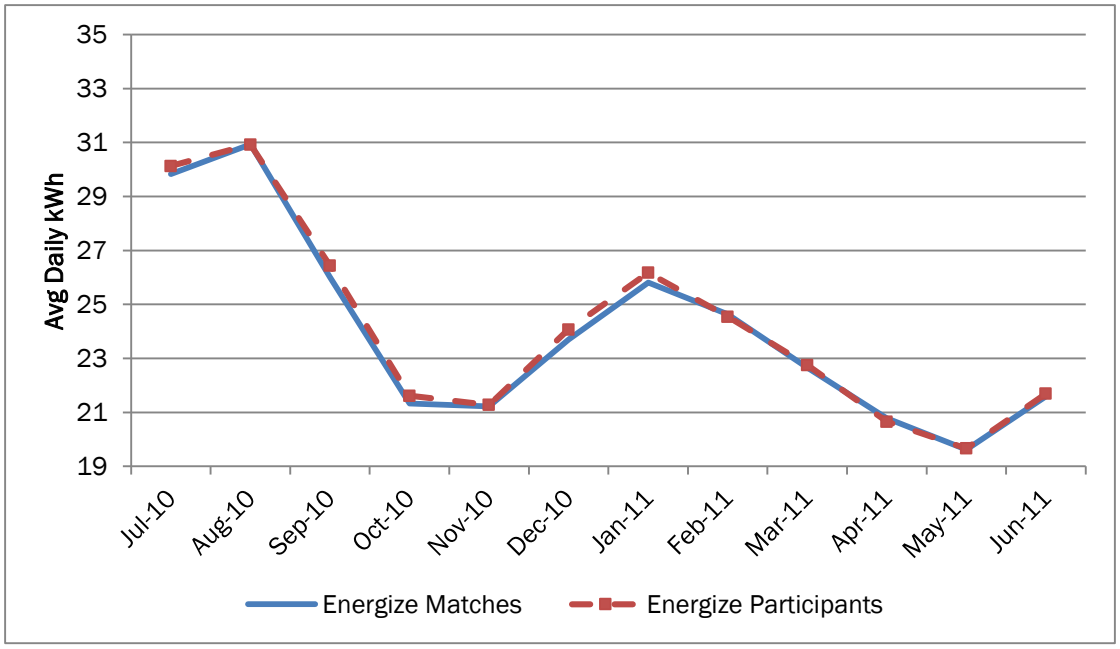


Figure 18. Comparison of the Average Monthly Consumption of Energize Households and Their 24-Month Matches in the 24 Months Before Pilot Enrollment

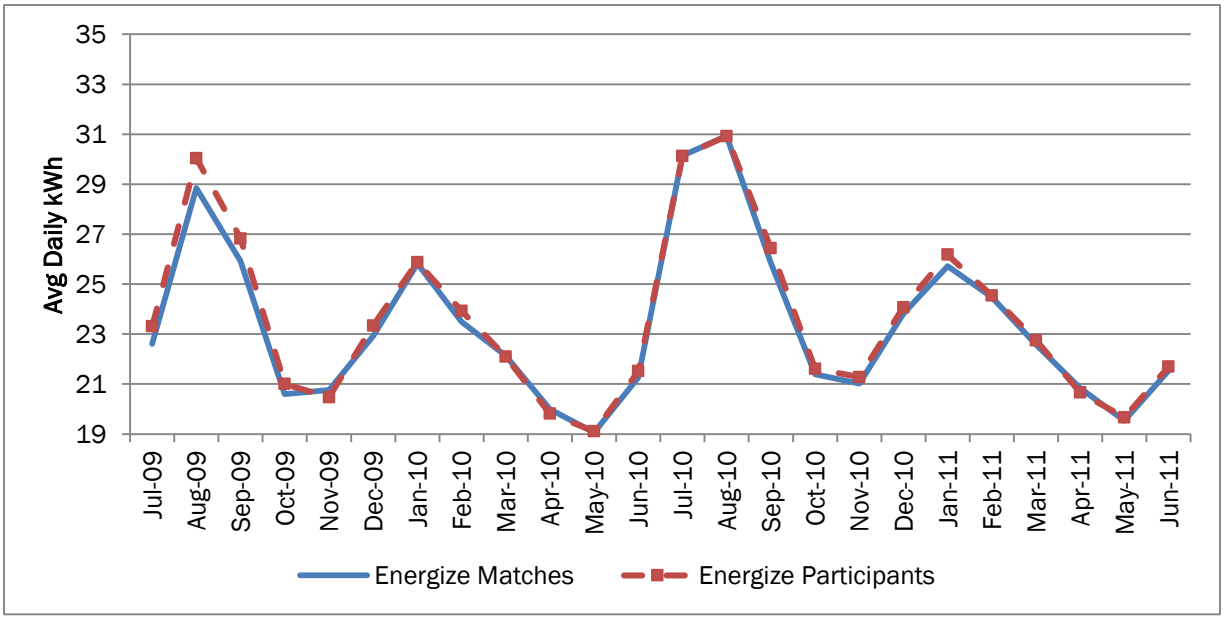


Figure 19. Comparison of the Average Monthly Consumption of Legacy Households and Their Standard Matches in the 12 Months Before Pilot Enrollment

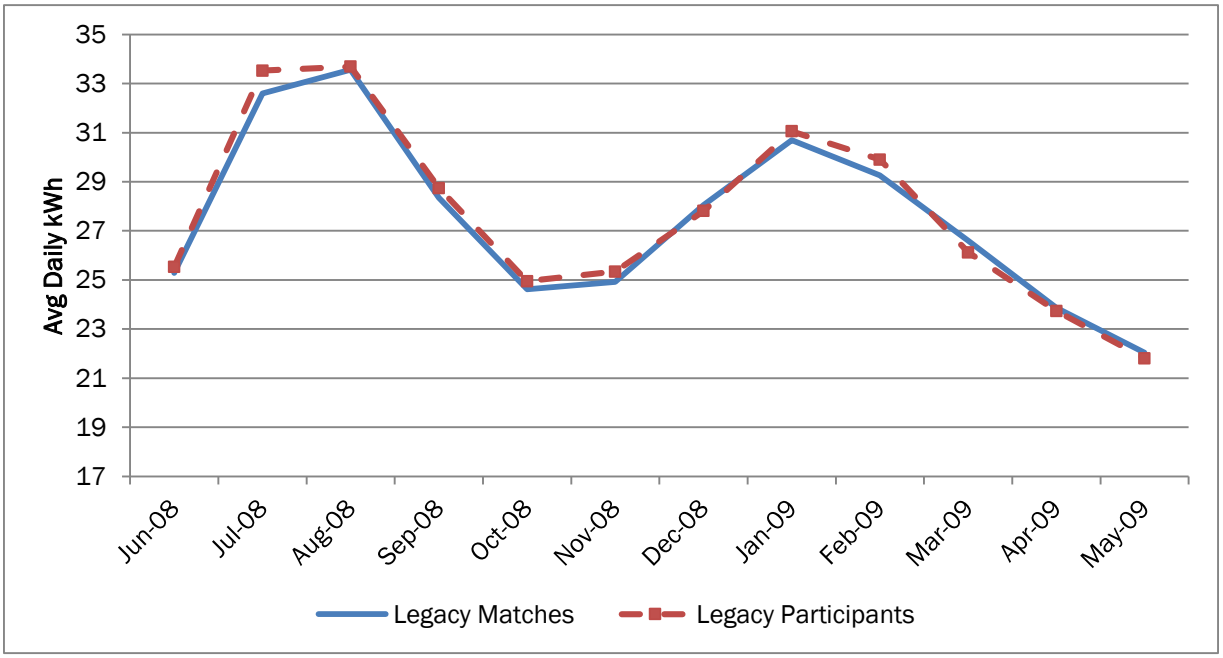
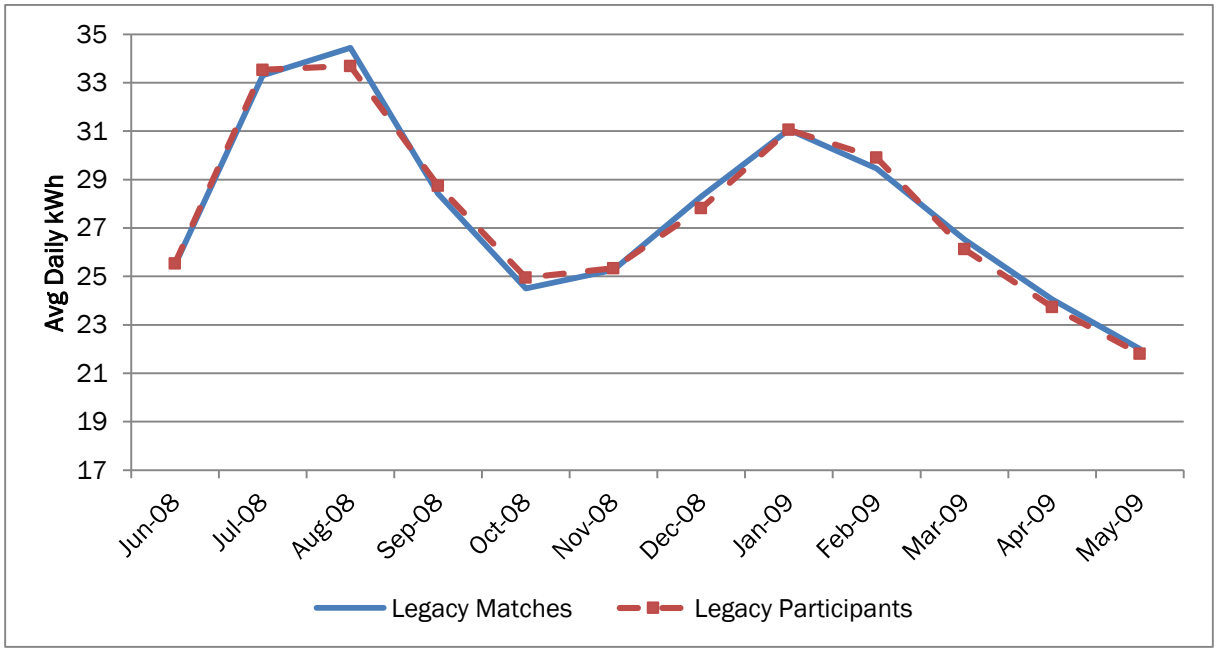


Figure 20. Comparison of the Average Monthly Consumption of Legacy Households and Their Low-Trend Matches in the 12 Months Before Pilot Enrollment



The Issue of Selection Bias in the Estimate of Pilot Savings

The analysis described above attempts to estimate the average pilot effect on pilot participants. The function of the matched comparison households is to provide an estimate of the counterfactual (baseline) energy use by participants—the energy use by participants if they were not in the pilot. As noted previously, matching estimators are designed to eliminate model specification bias, by assuring that the distribution of covariates X conditioning the counterfactual estimate is the same as that under treatment. With respect to energy use, by far the most important conditioning variable is pre-pilot energy use in the same billing period of the previous year. This variable, along with monthly fixed effects, accounts for about 95% of the variation in energy use over a 1-year period. The implication is that given a model that matches on pre-pilot energy use, with regression correction as advocated by Imbens and Woolridge (2008) and used in Model 2, we are highly likely to generate an excellent counterfactual for participants.

Accepting that the analysis approach addresses model specification bias, we turn to the question of selection bias. In the current context, selection bias is the result that the counterfactual derived from the matches overstates/understates the energy use by participants during the program year (in the absence of the program) due to unobservable differences between the two groups. It implies, in other words, that even though the participants and their matches behave very similarly for 12-24 months, it remains plausible that in the absence of the pilot their energy use would not be the same on average over the next 12 months because unobservable factors cause systematic differences between the two groups.

For behavioral programs, it is difficult to develop a convincing argument for selection bias given good matches based on pre-program billing history. The most likely standard narrative concerning unobserved differences between participants and comparison households does not support the argument for selection bias. This story is that the participants are more likely than the typical household to behave like "energy hawks"—always on the lookout for ways to save energy—and that this behavioral characteristic is what drove them into the program. Given good matches over a long horizon, though, this argument is unpersuasive because the matches are observationally equivalent; they act as if they have a similar behavioral propensity.

More generally, matches based on the energy use history account for selection bias due to "stable" differences between participants and the general non-participant population with respect to energy use. Suppose an underlying set of unobservable variables **Z** reflect a household's behavioral propensity to save energy, and these variables are correlated with participation in the program. One can reasonably expect that close matching on the energy use history will, on average, generate the same distribution of **Z** among the matched households as among the participant households. As observed by Stuart (2010),

> "This assumption [nonconfoundedness] is often more reasonable than it may sound at first since matching on or controlling for the observed covariates also matches on or controls for the unobserved covariates, in so much as they are correlated with those that are observed" (pg. 3).[24]

In other words, the *behavioral* narrative for selection bias is necessarily reflected in a parallel *statistical* narrative. The statistical argument has to be that in the regression model there are unobservable

[24] Stuart, E.A. "Matching Methods for Causal Inference: A Review and a Look Forward". *Statistical Science,* 25(1), February 2010, 1-21. In the current context, the assumption of "nonconfoundedness" implies the assumption of no selection bias.

variables affecting energy use at time t that are correlated with the participation decision. Note, though, that unless these same variables do not affect energy use in the pre-program year, their effect is largely absorbed by the pre consumption variable *PREkWh*, thereby eliminating the associated selection bias.

The claim that longer matching horizons do a better job of driving selection bias from the analysis implies the assumption of greater stability of **Z**. There is no right/wrong answer to the question of the correct matching horizon, though to account for seasonal effects it is clear that the minimum match horizon should be 12 months. It is worth mentioning that matching on demographic variables implies that **Z** is invariant over time—perfect stability—and relatively highly correlated with the matched demographic variables.

A pseudo-test for selection bias

It is not possible to statistically test for selection bias, but Imbens and Woolridge (2010) present a test that is suggestive. In the current context, the logic of the test is that in the absence of selection bias the difference between participants and matches in average energy use (D_{PM}) should be no different just before the start of the program than during the preceding months, and no different in the months preceding the matching period than during the matching period. In other words, we should observe no statistically discernible trend in D_{PM}. If we do detect a trend then we suspect selection bias. Note the consistency of the logic of this test with the energy hawk narrative.

In the current context, a simple implementation of the test is to determine whether, given matching based on months $t=1,...M$ before the start of the matching period, D_{PM} in months t=1,2 is drawn from the same distribution as D_{PM} in months t=3,..M, and D_{PM} in months t=M+1, M+2..., is drawn from the same distribution as D_{PM} in months t=1,...M.

Figure 21 presents D_{PM} for Energize customers and their 24-month matches over the period February 2008 to September 2012. The period on which matches are based is roughly June 2009 to May 2011 ("roughly" because different participants entered the pilot in different months over the 3-month period June 2011-September 2011, and the 24-month matching period reflects this). The figure makes clear two features related to the potential for selection bias:

- During the pre-pilot period the difference in energy use between participants and their matches is very small on average, and there is no trend in the difference;
- There is a sharp drop in the difference at the start of the pilot.

Applying the pseudo-test for selection bias indicates no evidence of selection bias.

Figure 21. Difference between Participants and Matches in Average kWh/Day (D_{PM}), Energize Customers, 24-Month Matches (Participants-Matches)

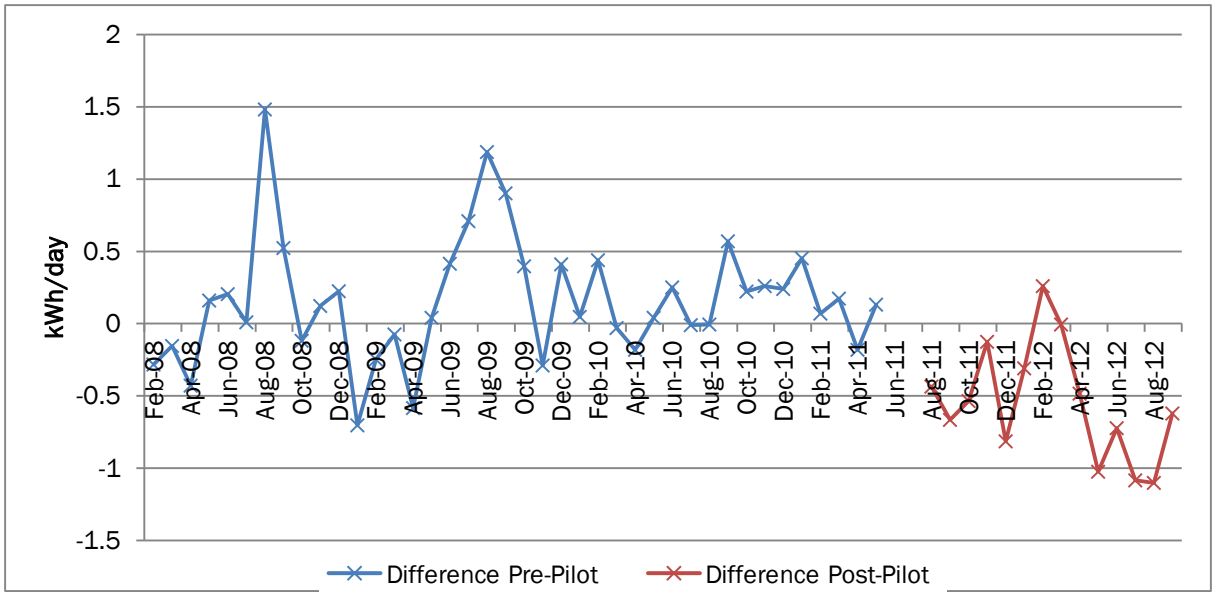


Figure 22 presents D_{PM} for Energize customers and their 12-month matches over the same period. The matching period is roughly June 2010 to May 2011. Once again there is a sharp drop in D_{PM} at the start of the pilot, which is highly suggestive of program effect, but in this case there is a slight trend in the data, and in fact statistical testing indicates that for many months prior to the start of the matching period D_{PM} is not drawn from the same distribution as that implied by the observations of D_{PM} during the matching period. For this reason, in the modeling of pilot impacts, we favor the results obtained with the 24-month matches.

Figure 22. Difference between Participants and Matches in Average kWh/Day (D_{PM}), Energize Customers, 12-Month Matches (Participants-Matches)

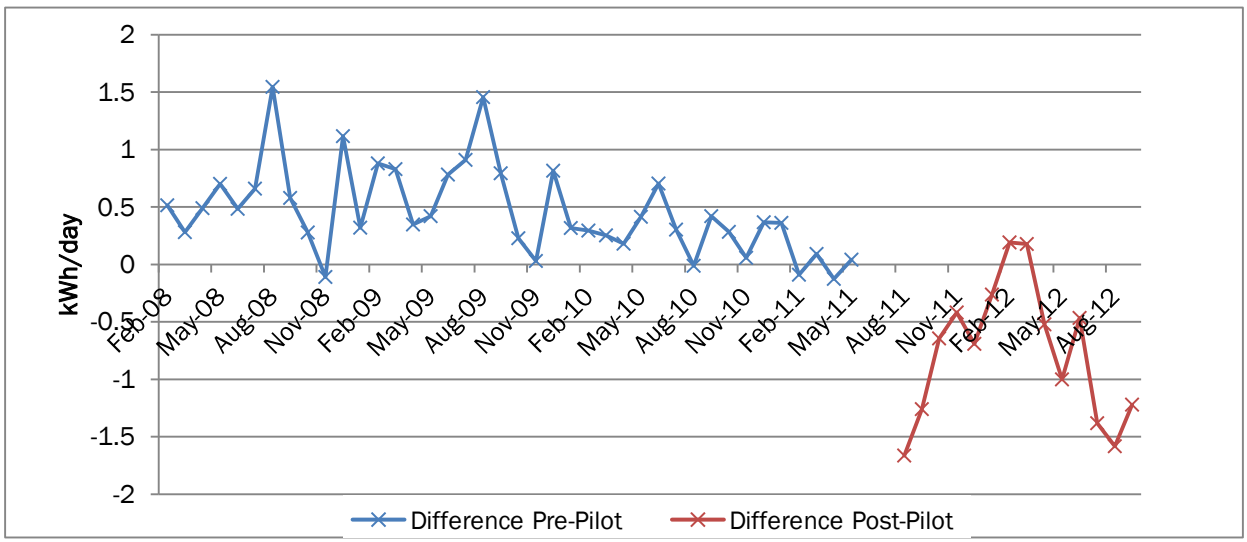


Figure 23 presents D_{PM} for Legacy customers and their 12-month standard matches. Statistical testing does not reject the conclusion that D_{PM} in the last month of the pre-pilot period is drawn from the same distribution as that for the 11 months prior, but there does appear to be a trend in D_{PM} in the pre-pilot

period, and the observation of D_{PM} in the month before the start of the pilot is more than one standard deviation from the average.[25] Consequently, we drew a second set of matches as described in the previous section, in which the second stage gave preference to matches for which the D_{PM} has the lowest trend over the matching period. Figure 24 presents the graph of D_{PM} for these low-trend matches. The trend is substantially reduced and the observation of D_{PM} in the month before the start of the pilot is now well within one standard deviation of the mean D_{PM} of the previous 11 months.

Figure 23. Difference between Participants and Matches in Average kWh/Day (D_{PM}), Legacy Customers, Standard Matches (Participants-Matches)

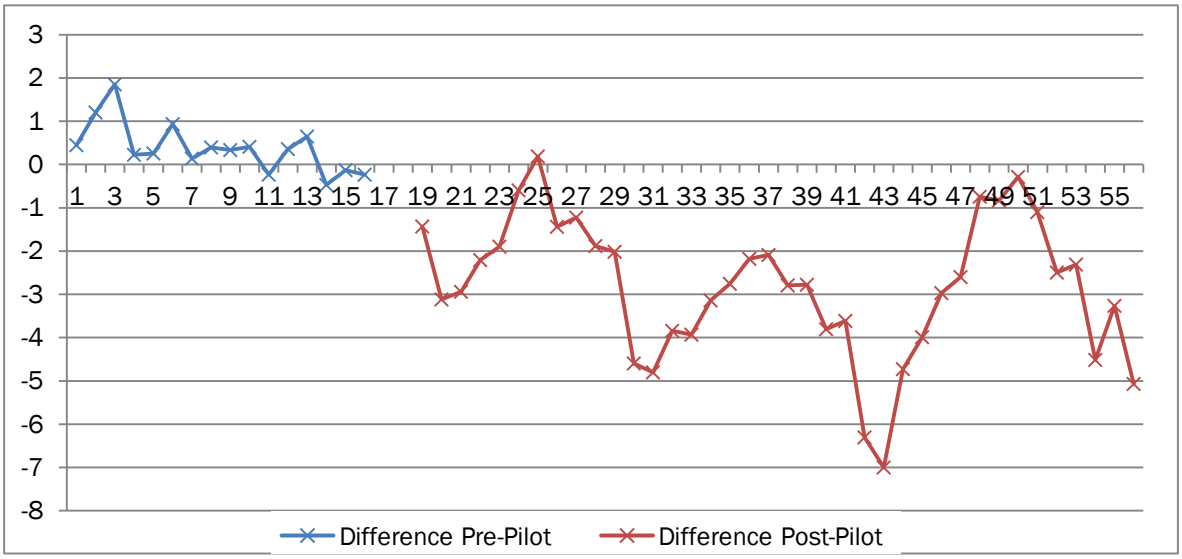
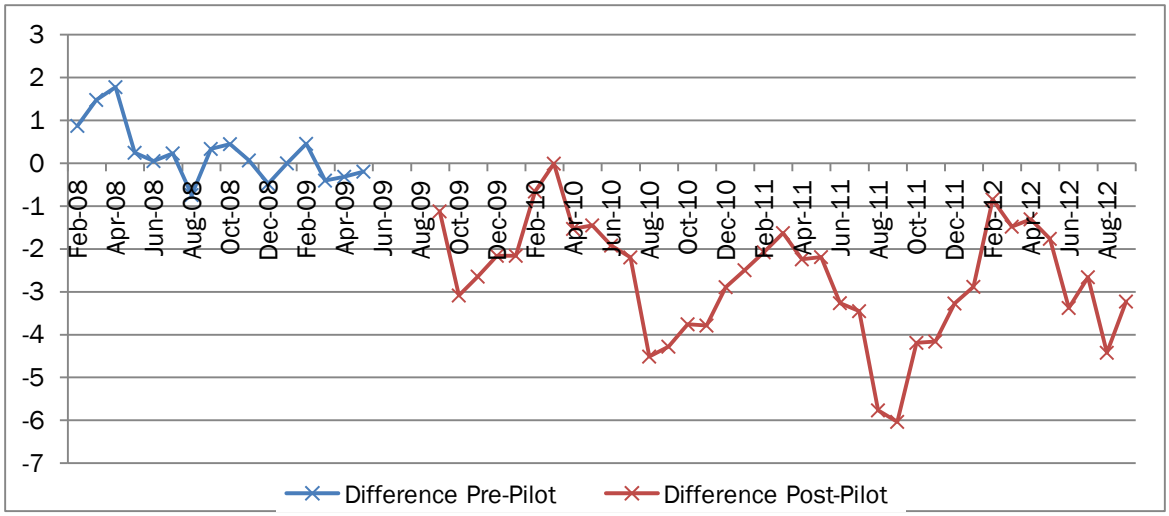


Figure 24. Difference between Participants and Matches in Average kWh/Day (D_{PM}), Legacy Customers, Low-Trend Matches (Participants-Matches)



[25] We did not have data to test whether D_{PM} *before* the start of the matching period is drawn from the same distribution as that in effect during the matching period.

Correcting for selection bias

The available evidence strongly supports the argument that the analysis does not suffer from selection bias. Still, it is worth considering taking steps to correct for selection bias, because whether selection bias exists is not knowable. The standard correction for selection bias involves two-stage instrumental variables (IV) analysis. This approach requires identifying variables correlated with the participation decision but assumed to be *not* correlated with the error term of the regression model of monthly energy use used to estimate program savings (in this case, the regression model of Model 1). IV analysis necessarily involves a loss of efficiency in the estimate of program savings because the participation decision is replaced by a prediction of the participation decision. Moreover, in small samples such as used in this analysis, weak instruments—instrumental variables not highly correlated with the participation decision—can generate biased estimates of savings. IV analysis can be, in other words, a cure worse than the disease.

Healthy skepticism about IV analysis aside, the evaluation team's survey of Energize participants and matched comparison households included a number of questions believed to hold promise as good IV variables, in the sense that one could make a reasonable case that responses would not be correlated with the error term of the regression model while being reasonably correlated with the participation decision. A total of 54 pairs of surveys for Energize households and matched comparison households were completed. The matched comparison households were drawn from the list of ten candidate 12-month matches (see section 0, "Selecting matched comparison households"). Only three of the survey questions generated responses that were sufficiently correlated with the participation decision to warrant consideration as IV variables (absolute value of the correlation in parentheses):

- P1b: "I always try new technologies before other people do" (0.282);
- P1c: "I trust my utility" (0.161);
- P1h: "I am more likely to change my actions if people I respect have already taken action" (0.104).

Regressing these variables along with the covariates in Model 2 that vary across customers (in particular, *PREkWh* and the *EE* variables) on the participation decision—the first stage of IV estimation, generated a Wald statistic of 5.30. This is a very low value indicating that instrumental variable analysis is highly problematic. The second stage of the IV analysis generated an estimate of program savings that was the wrong sign, wildly disproportionate (net savings over *negative* 10%), and not statistically significant. In view of the result from the first stage of the IV analysis, and the analysis presented above indicating that selection bias is not an issue this result is not considered in the discussion of analysis results.

Summary on the issue of selection bias

In summary, selection bias is not deemed to be a significant issue in the statistical analysis of savings by participants. If it were, the standard statistical recourse to address it—instrumental variables regression—would be very unlikely to generate clearly more accurate estimates of program savings.

C. CLC SHEMP Participation Analysis

Table 20. Legacy and Energize Participation in Other CLC Programs

	Legacy Participants (n=77)							Energize Participants (n=277)						
	Legacy (Pre)		Legacy (Post)		Legacy Difference			Energize (Pre)		Energize (Post)		Energize Difference		
Participation Type	n	%	n	%	n diff (Post - Pre)	% diff (Post - Pre)	p-value	n	%	n	%	n diff (Post - Pre)	% diff (Post - Pre)	p-value
Participation in at Least One Program	24	31.17%	43	55.84%	19	24.68%	0.00	169	61.01%	67	24.19%	-102	-36.82%	0.00
Participation in Low-Income Single Family	0	0.00%	2	2.60%	2	2.60%	0.16	4	1.44%	2	0.72%	-2	-0.72%	0.32
Participation in Residential Home Energy	15	19.48%	29	37.66%	14	18.18%	0.01	135	48.74%	45	16.25%	-90	-32.49%	0.00
Participation in Residential Products & Services	12	15.58%	29	37.66%	17	22.08%	0.00	74	26.71%	27	9.75%	-47	-16.97%	0.00
Participation in Multi-Family Retrofit	0	0.00%	0	0.00%	0	0.00%	.	0	0.00%	1	0.36%	1	0.36%	0.32

Figure 25. Cape Light Compact Overall Pilot Participation – Energize Customers

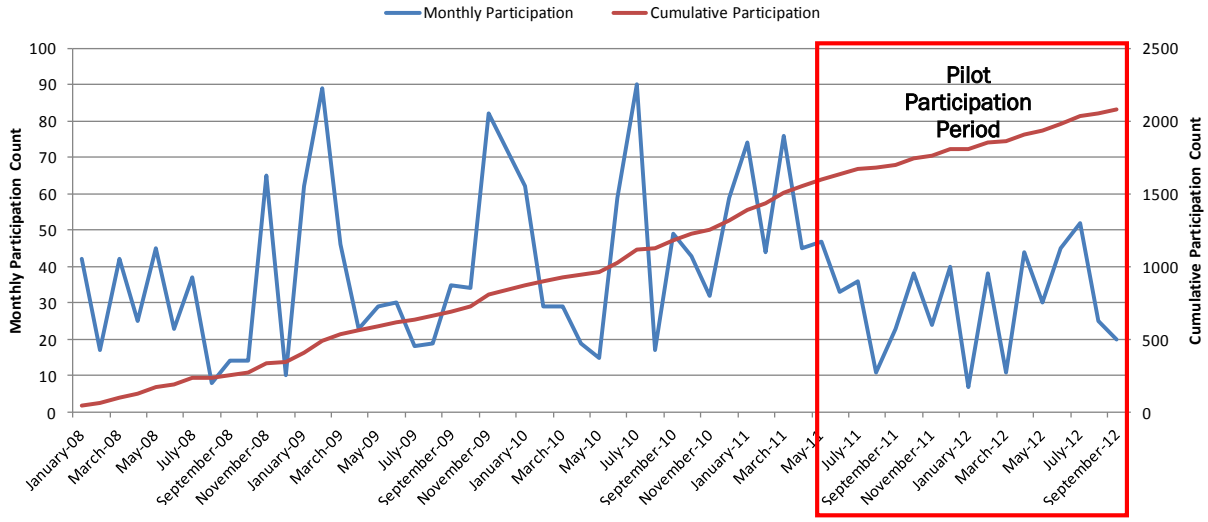


Figure 26. Cape Light Compact Monthly Pilot Participation – Energize Customers

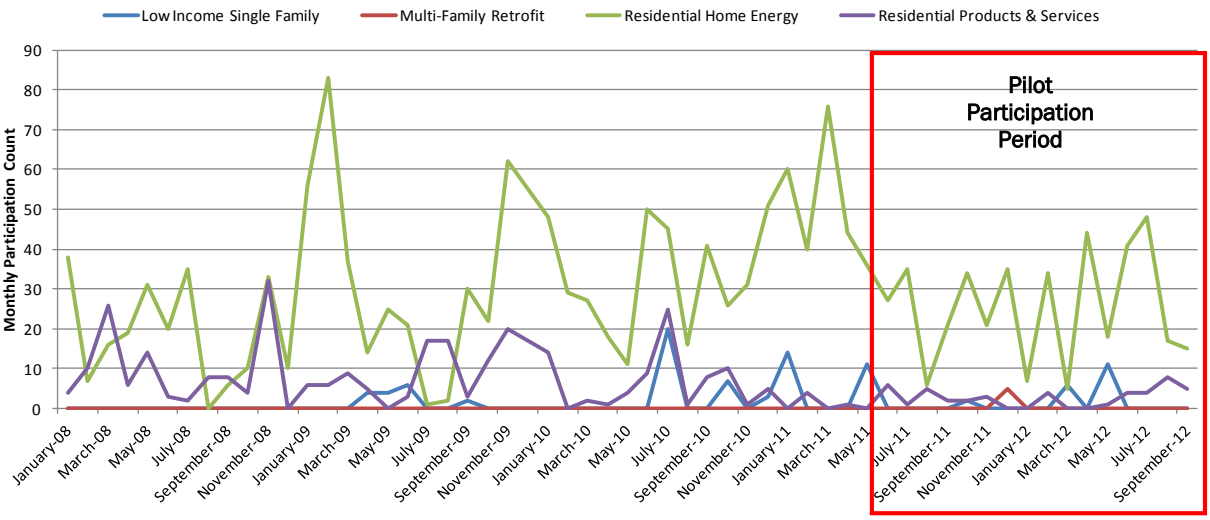


Figure 27.Cape Light Compact Cumulative Pilot Participation – Energize Customers

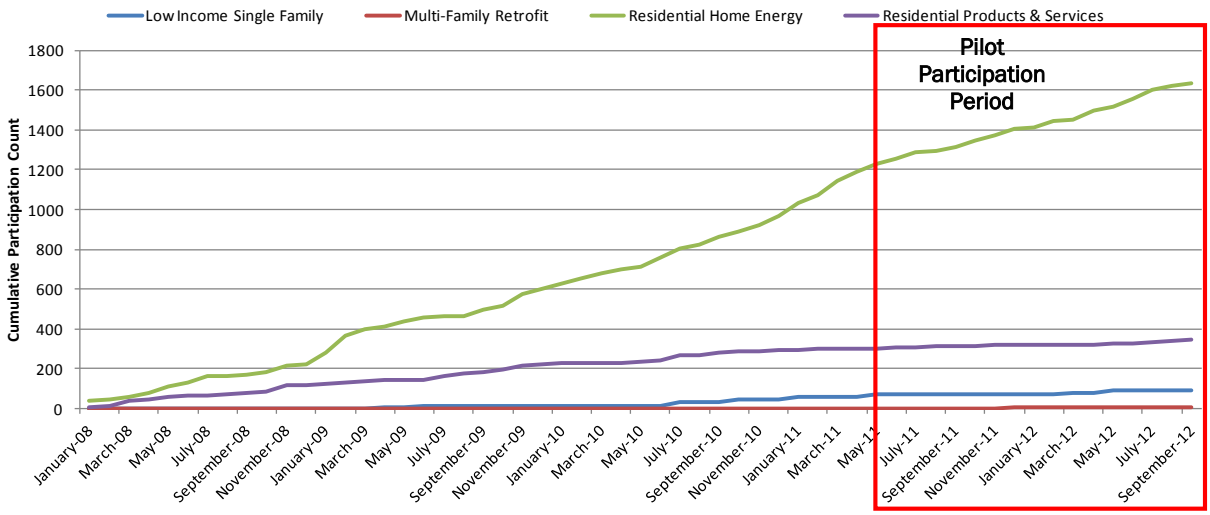


Figure 28. Cape Light Compact Overall Pilot Participation – Legacy Customers

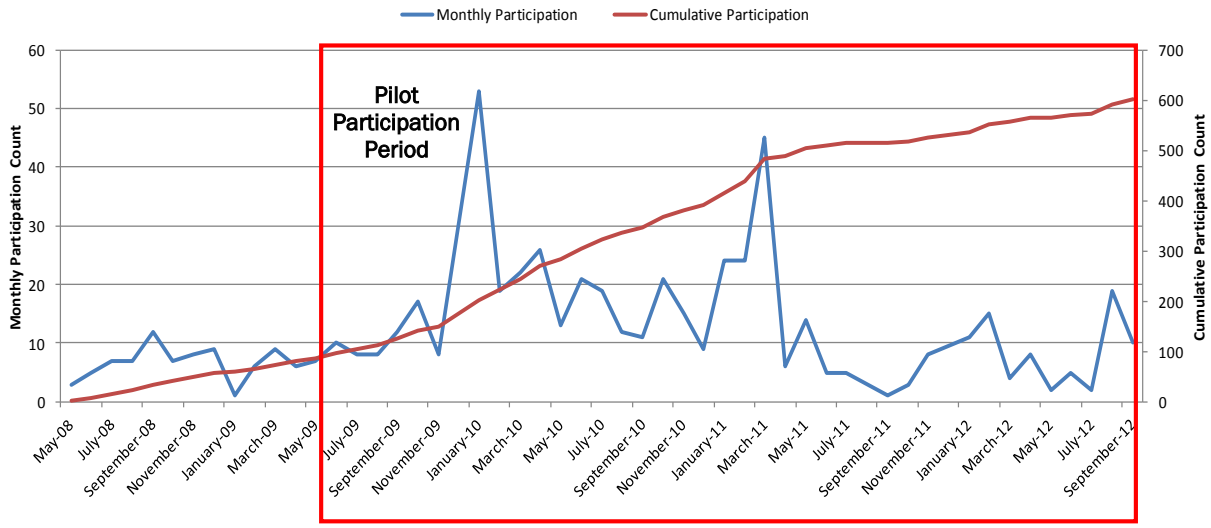


Figure 29. Cape Light Compact Monthly Pilot Participation – Legacy Customers

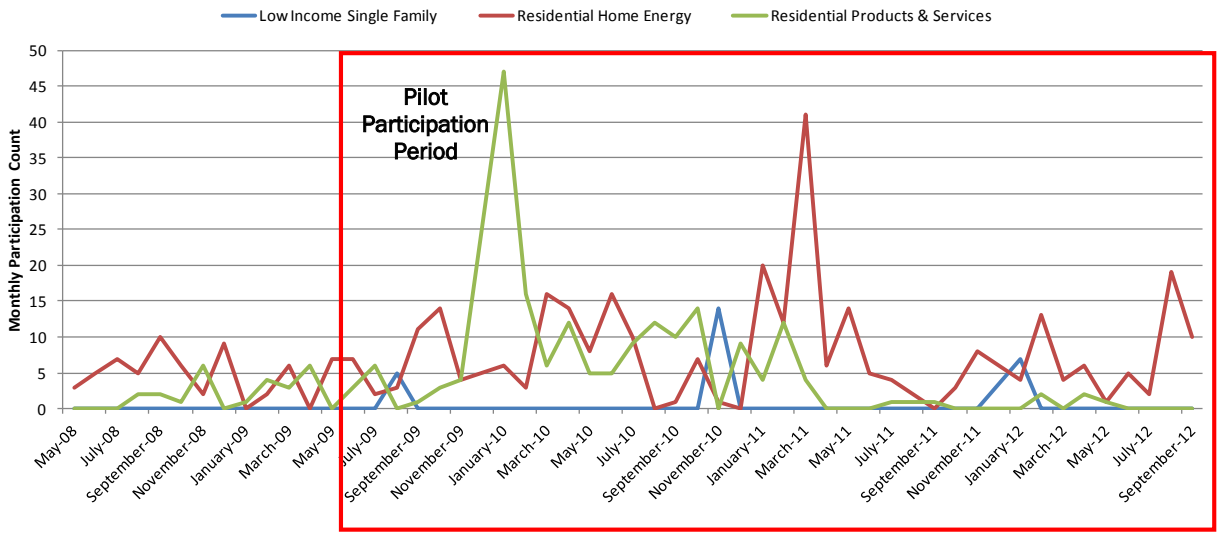
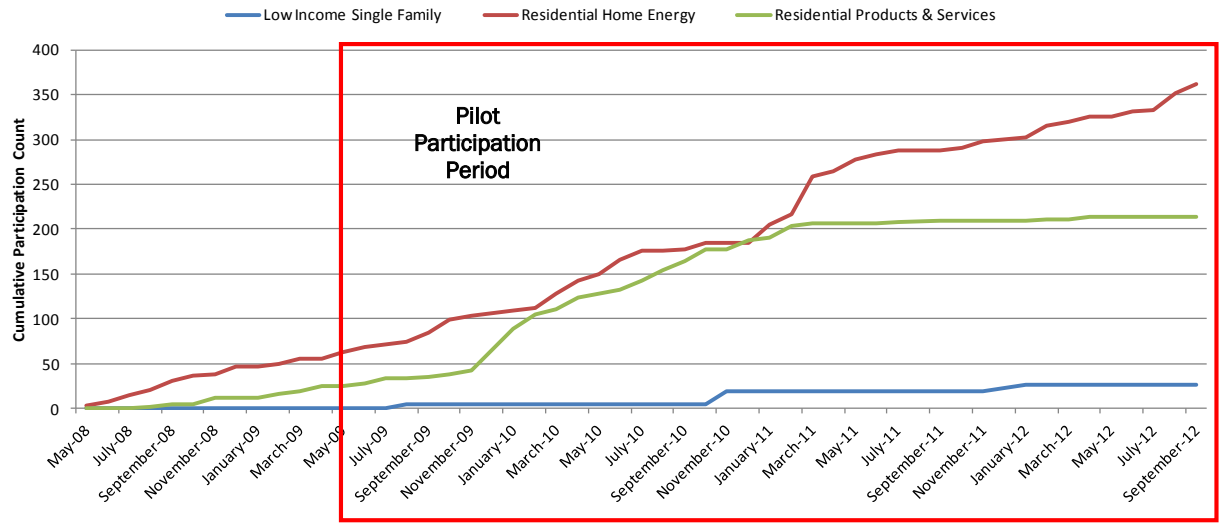


Figure 30. Cape Light Compact Cumulative Pilot Participation – Legacy Customers



D. CLC PRE-POST SURVEY WITH COMPARISON GROUP

The goal of this questionnaire is to collect two pieces of information: (1) post data on CLC SHEMP participants' behaviors and responses to the pilot, and (2) responses to attitudinal and demographic questions among the participant and comparison group to use in the final impact analysis. The table below summarizes the questions to be received by each surveyed group.

Survey Question Category	Participant Group	Comparison Group
Demographics	Yes, to be used in the final impact evaluation in support of a mills ratio or adjustment factor in impact models.	
Psychographics, Media preferences, Satisfaction and Engagement with CLC	Yes, to be used in the final impact evaluation in support of a mills ratio or adjustment factor in impact models.	
Actions Taken	Yes, to be compared with pre-data.	No, pre-period data will be used as the comparison point to estimate changes in behavior among the participants.
Political Ideology	Yes, to be used in the final impact evaluation in support of a mills ratio or adjustment factor in impact models.	

Phone Recruiter

[IF PART=1]

Hello, my name is _____ with Opinion Dynamics Corporation calling on behalf of Cape Light Compact. We are conducting a follow-up study to understand your home energy use to help improve Cape Light Compact programs. You were selected to participate in this survey because you completed a similar survey for Cape Light Compact's Smart Home Energy Monitoring Pilot last year. The survey will ask you questions regarding energy saving actions and practices your household may have taken since participating in the pilot. Your responses will be kept confidential and your name will not be revealed to anyone.

[IF PART=2]

Hello, my name is _____ with Opinion Dynamics Corporation calling on behalf of Cape Light Compact. We are conducting a study to help improve Cape Light Compact programs. Your responses will be kept confidential and your name will not be revealed to anyone.

(**Who is Cape Light Compact?** Cape Light Compact is an inter-municipal organization made up of all 21 towns of Barnstable and Dukes counties. They administer regional energy efficiency programs and negotiate lower electricity rates for all electric ratepayers on Cape Cod and Martha's Vineyard.)

C1. Are you currently talking to me on a regular landline phone or a cell phone?

1. Regular landline phone
2. Cell phone
98. (Don't Know)
99. (Refused)

C2. Are you currently in a place where you can talk safely and answer my questions?

1. Yes
2. (No, schedule a callback)
3. (No, do not call back)
8. (Don't know, schedule a callback)
9. (Refused, schedule a callback)

Screener[ASK IF PART=1]

S1. Please confirm that the following is still your primary residence: [READ IN <street_addr> <unit> <city>]

1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[THANK AND TERMINATE IF S1=2,98,99]

Demographics

[INCLUDE D5-D6 IN DAILY DISPO REPORT]

D5. Over the past year, has there been a change in the number of people who live in your household on a full time basis?

1. Yes, an increase in occupancy
2. Yes, a decrease in occupancy
3. No change
98. (Don't Know)
99. (Refuse)

D6. Has your household income changed in the past year?

1. Yes, it has increased
2. Yes, it has decreased
3. No change
98. (Don't Know)
99. (Refuse)

[SKIP TO NA1 IF D6 = 3, 98, 99]

DE6. Please stop me when I get to the range of your household's total annual income before taxes:

1. Less than $25,000
2. $25,000 - $34,999
3. $35,000 - $49,999
4. $50,000 - $74,999
5. $75,000 - $99,999
6. $100,000 - $149,000
7. $150,000 - $199,999
8. $200,000 or more
98. (Don't know)
99. (Refused)

Participant-only Post-Program Questions

Awareness of Energy Consumption [ASK IF PART=1]

NA1. How do you think your household's current energy use compares to your energy use last year? Is it…

1. Much higher
2. Slightly higher
3. About the same
4. Slightly lower
5. Much lower
98. (Don't know)
99. (Refused)

[ASK IF NA1=1,2,4,5]

QNA1a. Why do you think your household's current energy usage is <QNA1> than it was last year? [OPEN RESPONSE]

NA2. How do you think your household's current energy use compares to similar homes in your neighborhood? Is it…

1. Much higher
2. Slightly higher
3. About the same
4. Slightly lower
5. Much lower
98. (Don't know)
99. (Refused)

[ASK IF NA2=1,2,4,5]

QNA2a. Why do you think your household's current energy usage is <QNA2> than similar homes in your neighborhood? [OPEN RESPONSE]

NA5. If you had an opportunity to advise your friends or neighbors on how to save energy in their homes, what would be your top 3 recommendations?

1. [OPEN RESPONSE]
2. [OPEN RESPONSE]
3. [OPEN RESPONSE]
98. (Don't know)
99. (Refused)

NA3. Are you aware of any programs besides Smart Energy Monitoring that [INSERT PA NAME, Cape Light Compact in this case] offers to help you save energy in your home?

1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF NA3=1]

NA4. To the best of your knowledge, what energy efficiency programs does [INSERT PA NAME] offer? [OPEN END, 98="I don't remember any program names"] [MULTIPLE RESPONSE up to 3 programs]

Energy Efficient Equipment [ASK IF PART=1]

I am going to list equipment or appliances that might be in your home.

PE1. Does your home have a… [ROTATE; MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. Central air conditioning unit			
b. Room or window/wall air conditioning unit			
c. Clothes washing machine			
d. Clothes dryer			
e. Dishwasher			
f. Television			
g. Printer			
h. Computer			
i. Video game console			
j. Outdoor light fixtures			
k. Indoor light fixtures			
l. Boiler			
m. Furnace			
n. Refrigerator			
o. Pool			
p. Attic, ceiling or wall insulation			
q. Programmable thermostat			
r. On-demand or tankless water heater			
s. Energy efficient or double-paned windows			
t. Energy smart power strips (IF NEEDED: These are power strips or surge protectors that can automatically turn off peripherals for electronics when the main device – like a TV or computer - is not in use. For example, it could turn off the printer when your computer is asleep).			

[ASK IF PE1c=1]

PE2. Is your washing machine front-load or top-load?
1. Front load
2. Top load
98. (Don't Know)
99. (Refused)

[ASK IF PE1o=1]

PE3. Do you have a pool pump?
1. (Yes)
2. (No)

[ASK if any PE1a-t=1]

PE3a. Did you purchase or install any of the equipment or appliances we just discussed in the last year?
1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PE3a=1]

PE4. Did your household purchase or install [INSERT EACH PE1=1 and PE4=1; FOR PE1o=1, ASK ABOUT POOL PUMPS, NOT POOLS, IF PE3=1] in the past year? [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH PE1a-t=1, FOR PE1o=1, ASK ABOUT POOL PUMPS, NOT POOLS, IF PE3=1]			
b.			

PE5a. Does your household currently have a second refrigerator?
1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PE5a<>1]

PE5b. Did your household have a second refrigerator at any point in the last year?
1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PE5b<>2]

PE5. Has your household recycled a second refrigerator within the last year?
1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PE1a=1]

PE6. How many years old is your central air conditioning unit?
1. [OPEN RESPONSE NUMERIC]
98. (Don't Know)

[ASK FOR ALL PE4a-h=1, PE4L-n=1, PE4q-r=1]

PE7. Was the [INSERT EACH PE4a-h=1, PE4L-n=1, PE4a-r=1] you installed in the last year an additional unit or replacement for an older model? [1=Additional, 2=Replacement, 98=(Don't Know), 99=(Refused)]

	Additional Unit or System (1)	Replaced an older model (2)	Don't Know (98)
a. [IF PE1a=1 & PE4a=1] Central air conditioning unit			
b. [IF PE1b=1 & PE4b=1] Room or wall air conditioning unit			
c. [IF PE1c=1 & PE4c=1] Clothes washing machine			
d. [IF PE1d=1 & PE4d=1] Clothes dryer			
e. [IF PE1e=1 & PE4e=1] Dishwasher			
f. [IF PE1f=1 & PE4f=1] Television			
g. [IF PE1g=1 & PE4g=1] Printer(s)			
h. [IF PE1h=1 & PE4h=1] Computer(s)			
l. [IF PE1l=1 & PE4l=1] Boiler			
m. [IF PE1m=1 & PE4m=1] Furnace			
n. [IF PE1n=1 & PE4n=1] Refrigerator			
q. [IF PE1q=1 & PE4q=1] Programmable thermostat			
r. [IF PE1r=1 & PE4r=1] On-demand or tankless hot water heater			

[ASK IF PE4a-n=1 except PE4d=1](Excludes items that are energy efficiency by definition)

PE8. To the best of your knowledge, is/are the [INSERT EACH PE4a-n=1, DO NOT INCLUDE PE4d] you purchased in the last year ENERGY STAR qualified? [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH PE4a-n=1, except PE4d=1]			
b.			

Financial assistance for measures installed in past year[ASK IF PART=1]

[ASK IF PE3a=1]

[ASK FOR EACH PE4=1 EXCEPT where (PE1d=1 OR PE1i=1)] (REBATE-ELIGIBLE ITEMS)

PE9. Did you receive a rebate and/or tax incentive for the…? [INSERT EACH PE4=1 EXCEPT where (PE4d=1 OR PE4i=1)] [1=Rebate, 2=Tax Incentive, 3=(Other special pricing mentioned), 4=(None of these / no special pricing), 98=(Don't know), 99=(Refused)]

	Rebate (1)	Tax Incentive (2)	Other special pricing (3)	None of these (4)	Don't Know (98)
a. [INSERT EACH PE4=1 EXCEPT where (PE4d=1 OR PE4i=1)]					
b.					

Other energy saving measures[ASK IF PART=1]

PA1. Does your home have…? [Rotate; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. Weather stripping or caulking around windows and/or doors			
b. Energy Star light bulbs or compact fluorescent lights, also known as CFLs*			
c. Low-flow shower heads			
d. Faucet aerators			
e. Water heater wrap			
f. Insulated outlets and/or light switches			
g. Fluorescent lights that are not compact (e.g. fluorescent bulbs that are longer and thinner than CFL)			
h. Motion sensors (e.g., for lighting)			
i. Lighting timer(s)			
j. Task lighting			
k. Storm windows			
l. Insulated window shades, window insulation or window quilts			

**These bulbs usually do not look like regular incandescent bulbs. The most common type of compact fluorescent bulb is made with a glass tube bent into a spiral, resembling a soft-serve ice cream, and fits in a regular light bulb socket.*

PA2. Did you purchase or install any of the items we just discussed in the last year?

1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PA2=1]

PA2a-l. Did your household purchase or install [INSERT EACH PA1=1] in the past year? [1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH PA1=1]			
b.			

PA3. Have you ever had a home energy assessment or audit, where someone from Mass Saves, Cape Light Compact or another organization came to your house and assessed your home's energy use?

1. (Yes)
3. (No)
98. (Don't Know)
99. (Refused)

[ASK IF PA3=1]

PA3a. Was this home energy assessment conducted within the past year, or more than 1 year ago?

1. Within the past year
2. More than 1 year ago
98. (Don't Know)

99. (Refused)

[ASK IF PA2a-l=1 AND PA3a=1]

PA4. Did your household receive the [INSERT EACH PA2a-l=1] within the past year as part of a home energy assessment? [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH PA2a-l=1]			
b.			

[ASK IF PA2a-l=1]

PA5. Did you receive [INSERT EACH PA2a-l=1] for free?. [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)	*INT* PA6. If Yes: Specify source of free item
a. [INSERT EACH PA2a-l=1]				[OPEN END]
b.				

[ASK IF ANY PA5=1]

PA6. How or where did you receive the free [INSERT EACH PA5=1]? [OPEN RESPONSE]

Behavioral Actions Taken [ASK IF PART=1]

BA1. Do you regularly… [INSERT EACH BA1a-o] [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. Hang laundry to dry			
b. Wash laundry in cold water			
c. [ASK IF PE1c=1] Fully load washing machine			
d. [ASK IF PE1e=1] Fully load dishwasher			
e. Turn off lights in unoccupied rooms			
f. [ASK IF PA1j=1]Use task lighting			
g. [ASK IF PA1i=1] Use lighting timer			
h. [ASK IF PE1j=1]Turn off outside lights by day			
i. [ASK IF PE1h=1] Turn off computers at night/when not in use			
j. [ASK IF PE1h=1] Put computer(s) to sleep			
k. [ASK IF PE1f=1] Turn off TV(s) when not in use			
l. [ASK IF PE1i=1]Turn off video game console(s) when not in use			
m. Switch off power strips or unplug devices when not in use (chargers, TVs, stereos, etc)			
n. [ASK IF PA1l=1] Lower window shades, insulation or quilts			
o. Take short showers			

[ASK IF ANY BA1=1]

BA2. Did you start taking any of the actions we just discussed in the past year?

1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF BA2=1]

BA2a-o. *INT:* Did you start taking any of these actions within the past year? [CHECK BOXES; maintain sub-lettering of BA1]

PHN: Did you start [INSERT EACH BA1=1] within the past year? [MULTIPLE RESPONSE; 1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH BA1=1, changing verb to "ing"]			
b.			

BA3. Do you regularly…[INSERT EACH BA3a-l] [ROTATE MULTIPLE RESPONSE; 1=Yes, 2=No, 96=(Not Applicable), 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Not Applicable (96)	Don't Know (98)
a. Use a portable window fan				
b. Maintain your heating and cooling system				
c. [ASK IF PE1m=1] Change the furnace filter				
d. [ASK IF PE1l=1] Clean the boiler water				
e. Reduce the water heater temperature				
f. Clean or replace air filters				
g. Clear the area around vents				
h. Make sure refrigerator seals are tight				
i. Clean refrigerator coils				
j. Check refrigerator temperature				
k. [ASK IF PE5a=1]Unplug a second refrigerator for weeks to months at a time				
l. [ASK IF PE1q=1] Set the thermostat to recommended set points (e.g. 78° F or higher for cooling/68° F or lower for heating)				

[ASK IF ANY BA3=1]

BA4. Did you start taking any of the actions we just discussed in the past year?

1. (Yes)
2. (No)
98. (Don't Know)
99. (Refused)

[ASK IF BA4=1]

BA4a-l. Did you start… [INSERT EACH BA3=1, adding –ing to action]…within the past year? [1=Yes, 2=No, 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Don't Know (98)
a. [INSERT EACH BA3=1, changing verb to "ing"]			
b.			

Additional Behavioral Actions [ASK IF PART=1]

BA5. Are there any other actions you started taking in the past year to save energy in your home, besides the actions you've already mentioned? Please list up to three actions. [MULTIPLE RESPONSE]

a. [OPEN RESPONSE]
b. [OPEN RESPONSE]
c. [OPEN RESPONSE]
d. No actions

[ASK IF (BA1a-o=1 except IF BA2a-o=1) and BA2=2,98,99]

BA6. The next set of questions is about the actions you've been taking for more than a year. Did you [INSERT each BA1a-o=1 EXCEPT IF BA2a-o=1] more or less frequently in the past year compared with previous years? [1=Increased Frequency, 2=Decreased Frequency, 3=No change in frequency, 98=(Don't Know), 99=(Refused)]

	Increased Frequency (1)	Decreased Frequency (2)	No change in frequency (3)	Don't Know (98)
a. [INSERT EACH (BA1a-o=1 EXCEPT IF BA2a-o=1), using verb tense of BA1]				
b.				

[ASK IF (BA3a-l=1 except IF BA4a-l=1) and BA4=2,98,99]

BA7. Did you [INSERT each BA3a-l=1 EXCEPT if BA4a-l=1] more or less frequently in the past year compared with previous years? [1=Increased Frequency, 2=Decreased Frequency, 3=No change in frequency, 98=(Don't Know), 99=(Refused)]

	Increased Frequency (1)	Decreased Frequency (2)	No change in frequency (3)	Don't Know (98)
a. [INSERT EACH (BA3a-l=1 EXCEPT IF BA4a-l=1) using verb tense of BA3]				
b.				

Participant and Comparison Group Mills Ratio Questions [ASK ALL]

P1: I am going to read a list of statements. Please tell me if you strongly disagree, somewhat disagree, neutral, somewhat agree, or strongly agree. [ROTATE]

Question	1 Strongly Disagree	2 Somewhat disagree	3 Neutral	4 Somewhat agree	5 Strongly Agree
a. I am always looking for ways to improve my home.					
b. I/we always try new technologies before other people do.					
c. I/We trust my/our utility company					
d. We support investment in publicly funded projects that help other people reduce their cost of living.					
e. I do NOT feel responsible for conserving energy because my personal contribution is very small.					
f. My day-to-day life is so busy that I often forget to take actions that save energy.					
g. I regularly try to convince my friends and family to use less energy.					
h. I am more likely to change my actions if people I respect have already taken action.					
i. I am not willing to sacrifice my personal comfort in order to save energy.					

P2. Can you tell me how satisfied you are with Cape Light Compact? Would you say you are (READ CHOICES 1-5)?

1. Very Dissatisfied
2. Dissatisfied
3. Neither satisfied nor dissatisfied
4. Satisfied
5. Very Satisfied
8. (Don't know
9. (Refused)

P3. Have you visited the Cape Light Compact website in the past 12 months?

1. Yes
2. No
8. Don't know
9. Refused

[ASK if P3=1]

P4. How often do you visit the Cape Light Compact's general website?

1. At least every day
2. At least once a week
3. At least once a month
4. At least once every few months
5. At least once a year
6. Never
8. Don't know
9. Refused

Participant Questions for Customers [ASK IF PART=1]

Home Energy Email Report

[READ IF PROGRAM=ENERGIZE]

The next set of questions is about Cape Lights Compact (CLC) Smart Home Energy Monitoring Pilot (SHEMP) program, a program that provided you with online access to information about energy usage in your home, as well as on an in-home display.

First, I would like to confirm which features of the program you have used or accessed.

P1.		Yes (1)	No (2)	Don't know (98)	Refused (99)
[ASK IF PROGRAM=ENERGIZE]	a. Did you receive the Energize in-home display?				
[Ask All]	b. Have you ever accessed the SHEMP website to monitor your energy use?				

[ASK IF P1b = 1]

P2. How often to you log onto the program website?

1. At least every day
2. At least once a week
3. At least once a month
4. At least once every few months
5. At least once a year
6. Never
98. Don't know
99. Refused

[SKIP IF P2=6, 98, 99]

P3. What type of information do you seek out on the site? [OPEN END][Probe for if there is anything else? and accept after three]

[ASK IF P1a=1]
IHD1. Do you currently have the in-home display installed?

1. Yes
2. No

98. Don't know
99. Refused

[ASK IF IHD1 = 2]

IHD2. Why are you no longer using the in-home display?

1. [Open End]
2. (I never set up the device)
98 Don't know
99 Refused

[ASK IF IHD1 = 2 AND IHD2 = 1]

IHD3. Approximately when did you stop using the display?

1. About a week after it was installed.
2. About a month after it was installed.
3. About three months after it was installed.
4. About six months after it was installed.
5. About a year after it was installed.
98. Don't know
99. Refused

[ASK IF IHD1 =1]

P4. How often to you look at your in-home display?

1. At least every day
2. At least once a week
3. At least once a month
4. At least once every few months
5. At least once a year
6. Never
98 Don't know
99 Refused

[ASK IF P4 = 1,2,3,4, 5, or 6]

IH18. How does this frequency compare to when you first set-up the device? Would you say that you look at the device more frequently, less frequently or about the same frequency as when you first set-up the device?

1. More frequently
2. Less frequently
3. About the same frequency
98. Don't know
99. Refused

[SKIP IF P4=6, 98, 99]
P5. What information do you look for on the display? [OPEN END] [Probe for if there is anything else? and accept after three]

[ASK IF IHD1 = 1]

IH4. On a scale of 1 through 5, where 1 is "Not at all easy" and 5 is "extremely easy", how easy is it to understand the information on the in-home display? [1-5, 8=DK, 9=REF]

P6. On a scale of 1 to 5, where 1 is Not Useful at All and 5 is Extremely Useful, how useful would you say the following program offers are:

		Not at All Useful				Extremely Useful	Don't know	Refused
[Ask IF P1b=1]	1. The website	1	2	3	4	5	98	99
[Ask IF P1c=1]	2. The email reports	1	2	3	4	5	98	99
[Ask IF IHD=1]	3. The In-home display	1	2	3	4	5	98	99

P7. Now I would like to ask you about the information you received.

	Has the/have the . . .	Yes	No	Don't know	Refused
[Ask IF P1b=1]	1. website provided you with new ways to save energy in your home?	1	2	98	99
[Ask IF P1c=1]	2. email reports provided you with new ways to save energy in your home?	1	2	98	99
[Ask IF IHD=1]	3. in-home display provided you with new ways to save energy in your home?	1	2	98	99

P8.

	Has the/have the . . .	Yes	No	Don't know	Refused
[Ask IF P1b=1]	1. website provided you with enough information to take energy saving actions in your home?	1	2	8	9
[Ask IF P1c=1]	2. email reports provided you with enough information to take energy saving actions in your home?	1	2	8	9
[Ask IF IHD=1]	3. in-home display provided you with enough information to take energy saving actions in your home?	1	2	8	9

[ASK All]

P9. What, if anything, would make the program more useful to you? [OPEN END]

[ASK All]

P10. Since participating in the program, have you [1=Yes, 2=No, 96-(Not applicable), 98=(Don't Know), 99=(Refused)]

	Yes (1)	No (2)	Not Applicable (96)
a. Discussed or shared ideas on how to save energy with other people in your household?			
b. Discussed or shared ideas on how to save energy with your neighbors?			

P11. How much would you say your experience with the Smart Home Energy Monitoring program has affected your knowledge of ways to save energy in your home? Would you say it didn't change, increased a little, increased somewhat or increased a lot?

1. Didn't change
2. Increased a little
3. Increased somewhat
4. Increased a lot

98 Don't know
99 Refused

P12. Now, thinking about your overall experience with the program, has the program been useful in helping you to save money on your monthly energy bill?

1. Yes
2. No

98. Don't know
99. Refused

P13. This completes the survey. Is there anything else you would like to say about the program?

1. Yes [OPEN END] [Go to closing script]
2. No [Go to closing script]

Extended Demographic Battery [ASK IF PART=0]

Preferred Channels for Energy Usage Information

P7b. We'd like to know how you might like to receive information about your household energy usage. For example, how much energy your home uses, how your energy usage compares to similar homes, or tips for saving energy in your home. Would you like receiving information about your home energy usage…? [ROTATE; MULTIPLE RESPONSE, 1=yes, 2=no, 98=DK, 99=REF]

1. By Paper report
2. By Utility bill
3. By Online website or portal
4. By Email
5. By Text message
6. By Voicemail
7. In another way [SPECIFY]

Utility and Water Heating

S5. Are you responsible for paying any of the following bills? [MULTIPLE RESPONSE]

a. Electric
b. Gas

c. Water
d. Waste & Trash
e. Propane
f. Heating fuel oil
g. Cable Television
h. None
98=(Don't Know)
99=(Refused)

DE1. Do you rent or own your home or apartment?

1.(Own)
2. (Rent)
3. (Other: Specify_____)
98. (Don't know)
99. (Refuse)

DE2. What is your age?

1. (24 yrs or younger)
2. (25 to 34 yrs)
3. (35 to 44 yrs)
4. (45 to 54 yrs)
5. (55 to 64 yrs)
6. (65 years and over)
98. (Don't Know)
99. (Refused)

DE3. Including yourself, how many people live in your household on a full time year-round basis?

1. [NUMERIC OPEN END]

DE4. How many children 18 years or younger live in your household (full time year-round)?

0. (None)
1. (1)
2. (2)
3. (3)
4. (4)
5. (5)
6. (6)
7. (7)
8. (8)
9. (9 or more)
98. (Don't know)
99. (Refuse)

DE5. What is the highest level of education you have completed?

1. (Less than high school)
2. (High school graduate or equivalent)
3. (Some college, no degree)
4. (Associate's degree)

5. (Bachelor's degree)
6. (Graduate or professional degree)
98. (Don't know)
99. (Refused)

DE6. Please stop me when I get to the range of your household's total annual income before taxes:

1. Less than $25,000
2. $25,000 - $34,999
3. $35,000 - $49,999
4. $50,000 - $74,999
5. $75,000 - $99,999
6. $100,000 - $149,000
7. $150,000 - $199,999
8. $200,000 or more
98. (Don't know)
99. (Prefer not to respond)

DE7. Respondent Gender? (Observation – Do not ask)

1. Male
2. Female

U2. How is your hot water heated? [OPEN END]

1. Electricity
2. Natural gas
3. Propane
4. Other [SPECIFY]
8. (Don't Know)
9. (Refused)

Demographics

D1. What kind of home do you live in? [TRACK IN DAILY DISPO REPORT]

1. A mobile home
2. A single-family detached residence
3. A single-family attached residence (for example, a townhouse)
4. An apartment or condominium in a building with 2-4 units
5. An apartment or condominium in a building with 5 or more units
6. Other [SPECIFY]

D2. What is the approximate square footage of your home?

1. [NUMERIC OPEN END]
98. (Don't Know)
99. (Refused)

[ASK IF D2=98]

D3a. How many rooms, excluding bathrooms are in your house?

1. [NUMERIC OPEN END]

98. (Don't Know)
99. (Refused)

[ASK IF D2=98]

D3b. How many bedrooms are in your house?

1. [NUMERIC OPEN END]
98. (Don't Know)
99. (Refused)

[ASK IF D2=98]

D3c. How many bathrooms are in your house?

1. [NUMERIC OPEN END]
98. (Don't Know)
99. (Refused)

D4. When was your house built, approximately?

1. Before 1900
2. 1900 - 1939
3. 1940 - 1959
4. 1960 - 1979
5. 1980 - 1989
6. 1990 - 1999
7. 2000 - 2004
8. 2005 or later
98. (Don't Know)
99. (Refuse)

D5. Over the past year, has there been a change in the number of people who live in your household on a full time year-round basis?

1. Yes, an increase in occupancy
2. Yes, a decrease in occupancy
3. No change
98. (Don't Know)
99. (Refuse)

D6. Over the past year, has there been a change in the employment status of people living in your home? (A change in employment status could be a change in the number of people working, or the number of hours worked by people in your home.)

1. Yes, an increase in employment status
2. Yes, a decrease in employment status
3. No change
98. (Don't Know)
99. (Prefer not to answer)

D7. Are you of Hispanic, Latino, or Spanish origin?

1. Yes

2. No
98. (Don't Know)
99. (Prefer not to answer)

D8. Which of the following best describes your race? [MULTIPLE RESPONSE]

1. White
2. Black or African American
3. American Indian or Alaska Native
4. Asian Indian
5. Chinese
6. Filipino
7. Japanese
8. Korean
9. Vietnamese
10. Other Asian
11. Native Hawaiian or Other Pacific Islander
00. Other [SPECIFY]
98. (Don't Know)
99. (Prefer not to answer)

D9. How would you characterize yourself in terms of politics? Would you say you are:

1. Very liberal
2. Somewhat liberal
3. Moderate
4. Somewhat conservative
5. Very conservative
98. (Don't Know)
99. (Prefer not to answer)

Thank you for your participation. The Cape Light Compact value your opinion. Your responses have been recorded and all of your responses will be kept confidential.

Those are all the questions I have. Thank you for taking this survey.

E. CLC SHEMP REGRESSION COEFFICIENTS

Regression Results

Table 21. Model 1 Energize 24-Month Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.88936	0.00353	251.89	<.0001
LISF_post	1	2.49796	0.54164	4.61	<.0001
MFR_post	1	-3.36088	1.34238	-2.5	0.0123
RHE_post	1	-0.34529	0.16339	-2.11	0.0346
RP_post	1	-0.67095	0.17885	-3.75	0.0002

Table 22. Model 2 Energize 24-Month Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.90133	0.00395	228.27	<.0001
LISF_post	1	2.19904	0.68252	3.22	0.0013
MFR_post	1	-4.59681	1.69234	-2.72	0.0066
RHE_post	1	-0.19865	0.23653	-0.84	0.401
RP_post	1	-1.42533	0.26198	-5.44	<.0001

Table 23. Model 1 Energize 12-Month Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.87928	0.00369	238.58	<.0001
LISF_post	1	-1.12553	0.42065	-2.68	0.0075
MFR_post	1	-4.91961	0.98589	-4.99	<.0001
RHE_post	1	-0.60758	0.16502	-3.68	0.0002
RP_post	1	-0.20891	0.18027	-1.16	0.2465

Table 24. Model 2 Energize 12-Month Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.88629	0.0042	211.27	<.0001
LISF_post	1	-2.35481	0.4699	-5.01	<.0001
MFR_post	1	-6.11385	1.0833	-5.64	<.0001
RHE_post	1	-0.64789	0.2304	-2.81	0.0049
RP_post	1	-0.22649	0.25317	-0.89	0.371

Table 25. Model 1 Legacy Standard Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|

pre_avgdailykwh	1	0.85176	0.00608	140.2	<.0001
LISF_post	1	-0.72029	0.76497	-0.94	0.3464
RHE_post	1	-1.21223	0.25276	-4.8	<.0001
RP_post	1	-1.27776	0.24021	-5.32	<.0001

Table 26. Model 2 Legacy Standard Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.87968	0.00687	127.99	<.0001
LISF_post	1	-0.9496	0.93353	-1.02	0.3091
RHE_post	1	0.14422	0.40389	0.36	0.721
RP_post	1	-1.50342	0.35116	-4.28	<.0001

Table 27. Model 1 Legacy Low-Trend Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.85261	0.00607	140.5	<.0001
LISF_post	1	-0.63189	0.69888	-0.9	0.3659
RHE_post	1	-0.71546	0.24862	-2.88	0.004
RP_post	1	-1.51638	0.21947	-6.91	<.0001

Table 28. Model 2 Legacy Low-Trend Matches

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
pre_avgdailykwh	1	0.88448	0.00684	129.39	<.0001
LISF_post	1	-1.08412	0.81371	-1.33	0.1828
RHE_post	1	1.55973	0.39502	3.95	<.0001
RP_post	1	-2.02836	0.29419	-6.89	<.0001