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Pacific Gas and Electric Company's Home Area Network (HAN) Pilot – Final Report

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1 Executive Summary

This report documents the impact and process evaluation of the Pacific Gas and Electric Company (PG&E) home area network (HAN) pilot. The HAN pilot was launched to employees in March 2012 and to non-employee customers in fall 2012 to test new in-home display (IHD) technology designed to provide residential customers with the capability to monitor their energy usage in real time and help them better understand the monthly cost of their energy consumption. The pilot was designed to assess whether customers would use the IHDs to determine how their homes use electricity and whether they would use the device to identify opportunities for reducing consumption.

The pilot was designed to accommodate 500 participants. Sixty-nine IHDs were first installed as a “soft launch” in the homes of PG&E employees followed by 354 further installations in the homes of customers in the east bay communities of Orinda and Moraga. All of the pilot’s IHDs were professionally installed by a technician and by appointment only.

This initial HAN deployment was implemented pursuant to Ordering Paragraph 11 of California Public Utility Commission (CPUC) decision 11-07-056, requiring the California investor-owned utilities (IOUs) to file HAN Implementation Plans. PG&E filed their HAN Implementation Plan on November 28, 2011, stating a HAN Initial Deployment starting in March 2012. The IOU HAN Implementation Plans were resolved on September 27, 2012 under Resolution E-4527. Funding for each IOU’s HAN activations were provided by each utility’s smart meter funding application(s).

1.1 Load Impact Summary

The impacts of the IHDs on customer electricity consumption were estimated by comparing the customers’ actual electricity consumption before and after exposure to the IHDs with the energy consumption of a control group identified through propensity score matching. While we recognize the superiority of a randomized controlled trial (RCT) in experiments involving feedback, it was not possible to employ randomization in this case because of the limited time available to recruit customers to the experiment.

Instead, a control group was selected after the treatment group was identified. The control group was designed to be as similar as possible to the treatment group based on observable variables prior to the onset of the treatment (i.e., on-peak and off-peak usage, customer participation in time varying rates and several other factors). The control group selection was made using a statistical matching procedure known as propensity score matching.

To quantify the estimated difference in daily electric usage between the IHD pilot participants and the matched control group, FSC estimated a difference-in-differences panel regression model expressing daily usage (kWh) as a function of treatment, time and customer-specific effects. Importantly, this analysis uses both pre and post-treatment usage data for both the treatment and matched control groups. This approach accounts for pre-existing differences between the treatment and control group’s electric usage. The control group is a very powerful tool for explaining the electric usage patterns of the pilot participants – during the pre-enrollment period, the control group’s usage is highly correlated with usage of customers who eventually received an IHD. The average usage in the control group explains 97% of the variation electricity consumption in the treatment group without any additional modeling.

Using the panel regression method, the average daily load reduction due to exposure to the IHD is estimated to be 5.6%. The standard error of this estimate is approximately 1.2%, yielding a 95% confidence interval of +/- 2.4%. This estimated load reduction is statistically significant. The panel regression results were validated using an alternate difference-in-differences model that relied on an ARIMA time series regression technique which also produced estimated daily energy savings of 5.5% but with smaller standard error of 0.3%, yielding a 95% confidence interval of +/- 0.7%.

1.2 Survey and Focus Groups Summary

To evaluate the experience of Contact Center Operations (CCO) and Customer Service Offices (CSO) during the HAN pilot experience, a focus group including 10 CCO and CSO staff members was conducted in July 2013. CCO and CSO are the departments that handled HAN customer inquiries. During the focus group, service representatives expressed a desire for training to occur both before the pilot's rollout in addition to additional training during implementation for both senior service representatives (SSR) and customer service representatives (CSR). Representatives also wanted a more accurate troubleshooting guide as well as increased information sharing between HAN, SmartMeter™ Operations Center (SMOC) and CCO. As a result of this feedback, targeted and improved training was provided to these groups, and process documentation was enhanced (see Appendix C).

To assess customer experiences with the HAN devices and other program components, two online surveys were administered to pilot participants – one shortly after the pilot commenced, in November 2012 – and another shortly before the pilot ended, in April 2013. A total of 214 out of 354 participants (60%) completed the first survey. While 282 participants (67%) completed the second survey, a comparison of the initial and exit surveys found that participants looked at the IHD less frequently at the time of the exit survey than they did at the time of the initial survey. On the other hand, exit survey respondents reported taking more energy-saving actions than the initial survey respondents. Responses to other questions remained consistent across the two surveys. The IHD's "likeability" had staying power between surveys, with 65% of initial and 61% of exit survey respondents giving the device high scores. Customers consistently valued the IHD at \$22 per device and operability of the device, as reported by respondents, remained constant across the study period with about 30% of devices reported to be non-functioning. Very few respondents of both surveys reported contacting PG&E for IHD support, and when they did about half of these customers reported being satisfied with the support provided by customer service representatives.

To more fully understand how customers were using and responding to the IHD and to assess the likely response of customers to PG&E's future plans for supporting IHDs, 2 focus groups (14 customers total) were conducted with customers who had experience with the IHD for a period of at least 6 months. One group consisted of customers who said they were highly satisfied with their experience with the IHD and another group consisted of customers who expressed dissatisfaction. Key findings of the focus groups include:

- Most participants used the IHD to experiment and discover how much electricity individual appliances use. Dissatisfied customers, however, said that they thought the device should display end-use loads without manual calculation.
- Most consumers in both focus groups reported that their IHD is located in common areas of the home, that they were in operation at the time of the focus groups and that they continue to monitor them at least daily – sometimes more often.

-
- The satisfied focus group participants made some household changes as a result of what they learned from their IHDs.
 - The dissatisfied focus group participants discussed feeling frustrated with the tiered electricity pricing structure. These customers learned that their electricity usage is subject to tiered pricing by using the IHD, but they could not understand how to schedule their electricity consumption in relation to the tiers.

Focus group participants articulated clear preferences on some issues pertaining how they think PG&E's HAN program should move forward:

- Most participants support PG&E's intention to provide the metering, communications infrastructure and support to enable customers to use HAN devices, but not to provide such equipment directly to them, or to assist customers with installing or operating them.
- A surprise finding from the exit survey was that customers stated that they preferred the standalone IHD to a smart phone app. Customers were also asked during the focus group discussions whether they preferred something that displayed information on their computer, a smartphone app or on their television, and if they preferred the stand-alone IHD, why. With few exceptions, customers in the focus groups said they preferred the stand-alone IHD.

2 Introduction

The Pacific Gas and Electric Company (PG&E) IHD pilot was launched to help participating residential customers monitor their electricity usage in real time and better understand the monthly cost of their electric consumption. The IHD enables customers to see:

- The price of electricity and how it changes throughout month as the customers move from tier-to-tier;
- The amount of electricity being used at the moment, month-to-date and the dollars and cents cost of that usage; and
- The temperature outside (if the customer elected to connect the device to their home wireless network).

The overarching objective of this pilot was to demonstrate the additional value stemming from PG&E's SmartMeter™ investments that can be created with the home area network (HAN) platform. The launch of this pilot was timed to meet a regulatory mandate start an initial deployment by March 1, 2012.

Two key goals of this pilot were the following:

- To support a good customer experience with receiving, installing and using new IHD technology; and
- To collect feedback on the customer pilot experience and learn how HAN program operations can be optimized or improved.

A third goal was to test the IHD's effectiveness at creating engagement between customers and their energy use and estimate the impact of increased engagement on electric consumption. The IHD allows customers to observe how their electricity consumption and costs change as they elect to use different appliances, or use the same appliances differently. For example, customers can see the difference in electricity consumption when all of the home's lights are on and when they are all off. Or they can use the IHD to see how their electricity use and cost varies when they are using different energy using appliances (e.g., washing machines, dryers, pool pumps, spas, etc.).

The pilot was designed to accommodate up to 500 participants. Installations began with employees on March 1, 2012 and with nonemployee customers on October 1, 2012. By October 27, 2012, the Control4 IHD was professionally installed, by appointment, in the homes of 69 PG&E employees and 354 customers – a total of 423 devices. Customer-facing marketing materials are provided in Appendix A.

2.1 Evaluation Goals and Objectives

The primary objectives of this evaluation are to estimate average monthly load impacts attributable to the IHD's presence in the home and to conduct a process evaluation to understand and describe the participants' experience and satisfaction with using the IHD.

The load impact estimation is accomplished by using hourly load data recorded by participants' SmartMeters™ both before and after introducing the IHD to their household. The load impact evaluation also uses SmartMeter™ data from a control group of customers who did not participate in the pilot.

The process evaluation relies on five sources of information:

- Two surveys of pilot participants, one four to six weeks after the installation of the IHD and another six months after installation. These surveys inquired about IHD functionality and use, customer satisfaction with IHD installation, reported behavioral changes in response to IHD information and overall satisfaction with the pilot;
- IHD-related calls to PG&E's call center operations (CCO) were catalogued and reviewed for determining the types of issues brought to CCO and issue-resolution success rates;
- Recordings of a subset of IHD-related calls to CCO were reviewed to document the questions and issues raised by participants;
- A focus group with seven customer service representatives (CSRs) and senior service representatives (SSRs) was held to learn about how well CCO staff felt they could meet pilot participants' expectations and what resources could have best enabled them to meet participants' needs; and
- Two focus groups with pilot participants at the conclusion of the pilot.

2.2 Report Overview

The remainder of this report is organized as follows. Section 3 presents the estimate of load impacts. Section 4 presents the results of the CSR and SSR focus groups. Section 5 presents the summary of inbound IHD-related calls to CCO. Section 6 presents results from the two customer surveys. Section 7 concludes this report with results from the two end-of-pilot customer focus groups conducted with both satisfied and dissatisfied pilot participants.

3 Load Impacts

IHDs provide real time information showing customers how much electricity they have used, the cost of that electricity since the start of a month or billing period and the instantaneous usage and cost associated occurring at any point in time throughout the day. Such feedback makes it easier for consumers to understand how their behavioral decisions (both purchase and usage behaviors) impact electricity use and costs. Monthly bills are the result of numerous daily decisions over a 30-day billing period and the mix of appliances that exist in the home. As such, it is impossible for consumers to understand what impact behavior changes have on their bills except in a very general sense (e.g., “If I run my air conditioner less, my bill will probably be lower, but I wonder how much?”). With an IHD, customers can turn appliances on and off and observe the difference in the rate of electricity usage and cost. Equipped with better information, consumers should be able to make more knowledgeable decisions about energy use. Some recent evidence suggests that this can indeed occur.¹

3.1 Analysis Approach

The most robust approach for evaluating the energy impacts due to IHDs involves:

- 1) Randomly assigning customers to a treatment group that receives the IHD and a control group that does not. This is a research design called a randomized controlled trial (RCT);
- 2) Measure usage prior to, during and after exposure to the treatment;
- 3) Use relatively large sample sizes ensure statistical precision; and
- 4) Rely on repeated measurements for both treatment and control group customers before and after the IHDs are deployed (which bolsters statistical power) to further enhance statistical precision.

A control group provides information about how customers with IHDs would have used electricity had they not been exposed to the IHD. However, on its own, the use of a control group does not guarantee accurate results. Because customers self-selected into the IHD pilot, participants are, almost by definition, different from those who are offered participation but decline. Random assignment helps ensure that the only systematic difference between the two groups is the fact that one group had IHDs while the other group did not. In other words, random assignment helps eliminate alternative explanations for changes in energy consumption. Pretreatment data allows for verification that the differences in energy consumption were caused by the introduction of IHDs and not by pre-existing differences. It significantly bolsters the precision of the estimates and the ability to distinguish the effect (the signal) from variation in electricity use (the noise). Large sample sizes reduce the likelihood that observed differences are due to random chance. Finally, repeated observations also reduce the likelihood that observed differences are an anomaly.

¹ Faruqui, Ahmad, Sanem Sergici and Ahmed Sharif. “The Impact of Informational Feedback on Energy Consumption-A Survey of the Experimental Evidence.” Prepared by The Brattle Group. *Energy*. Vol. 35, No. 4 (April 2010): 1598-1608.

Neenan, B., J Robinson and Richard N. Boisvert. “Residential Electricity Use Feedback: A Research Synthesis and Economic Framework”. Prepared by EPRI. Palo Alto, CA (2009): 1016844

This study relies on pre- and post-treatment data, uses relatively large sample sizes and includes repeated measurements of each participant's hourly usage both before and after the IHD's were administered. However, we were not able to implement random assignment of IHD's to customers who self-selected into the pilot and instead relied on quasi-experimental methods to eliminate alternative explanations to the change in energy consumption besides the IHD. The study findings rely on a combination of propensity score matching using pre-treatment data and a difference-in-differences estimation.

Propensity score matching is an approach for developing control groups that addresses self-selection based on observable differences between HAN pilot participants and nonparticipants. It is used to identify statistical look-alikes based on observable characteristics from a large pool of control group candidates. Propensity score matching works best when there are many observable characteristics and many potential control group candidates. For example, if the control group is nearly identical across many characteristics such as climate, electric rate and proportion on PG&E's Balanced Payment Plan (BPP)², it decreases (but does not eliminate) the likelihood of bias. The main critique of propensity score matching is that it does not (and cannot) control for unobservable differences between the treatment and control groups. It cannot guarantee that a factor not included in the selection/matching model does not cause the differences in consumption between the IHD and control group customers. For example, while the location, size, rate and other observable characteristics of participants may be the same, it is possible that another unobserved factor – i.e., the motivation or desire of the homeowner to reduce their energy use – causes the difference in consumption between the treated and control group. However, for such an unobserved factor to bias results it would have to satisfy three conditions. It would need to:

- Be related to the variable of interest, monthly or daily electricity use;
- Affect the pilot participants differently than the control group; and
- Be weakly related or not at all related to the factors included in the matching process.

The likelihood of inaccurate or invalid study results is reduced through careful use of pretreatment data. FSC selected the control group based on consumption patterns during periods when neither IHD participants nor control group customers had IHDs. In other words, the control group customers not only have the similar characteristics but also used electricity in the same manner as IHD participants during periods preceding the study (pretreatment data period). Matching on electricity consumption patterns during pretreatment data periods substantially lowers the chance that an unobserved factor leads to bias in the results simply because unobserved factors must be correlated with energy use for them to bias results.

The robustness of the results is enhanced further by analyzing the data using a difference-in-differences method, a standard statistical technique used to account for pre-existing differences between treatment and control groups. This approach nets out differences between the control and IHD groups observed during the pretreatment data period. In other words, differences that could not be accounted through developing a matched control group may be accounted for in the difference-in-

² BPP is a program that allows the customer to be billed a consistent monthly amount due based on average monthly energy use, rather than actual monthly energy use.

differences estimation. This technique improves precision of results and improves the causal link regardless of whether control groups are developed through random assignment or by matching.

3.2 Pilot Recruitment

FSC mailed offers to participate in the IHD pilot to 3,635 residential customers in Orinda and Moraga. These two east bay communities were chosen for recruitment in order to minimize installation costs and management of logistics. Orinda and Moraga are also in the same baseline allowance territory, and thus face the same tiered electricity prices. The recruitment list of customers was prescreened to only include dual-fuel customers taking the E1 electric rate. There were also screens to ensure that all potential recruits had General Electric (GE) SmartMeters™ with 2.10.8 firmware that recently reported excellent communication rates. Medical baseline, net metered, SmartRate™, Direct Access, Community Choice Aggregation (CCA) and BPP customers were also excluded from the recruitment list. All 3,635 customers on the list also received a follow-up recruitment telephone call. During outbound or inbound recruitment calls, volunteers were further screened to verify that they were the individual in the household responsible for paying the PG&E bill, that they did not intend to move within the next 6 months and that they lived in a single family dwelling where the meter was within 75 feet of the home.

The Control4 IHDs were installed in the home by a technician and by appointment. 366 installation appointments were made and 354 devices were successfully installed. The remainder of the 3,635 customers who did not get an IHD installation appointment did not respond to the mailing or follow-up telephone call. The in-home installation appointment included the following steps:

- Customer signs participation agreement;
- Customer selects location for the IHD;
- Installer powers up IHD and checks for connectivity with the SmartMeter™, moving the IHD to a different location in the home if necessary;
- Installer connects IHD to the customer's wireless network if they wish use to use the IHD's weather reporting functionality;
- Installer registers IHD with PG&E customer information system;
- Installer instructs customer on how to use the IHD; and
- Installer leaves behind welcome kit.

The load impacts estimation described below utilized interval data from these 354 customers in addition to interval data from a matched control group. There are various methods that can be used to conduct the matching process. The method used here is described below.

3.3 Propensity Score Matching

Propensity score matching was used to select a valid control group. This method is a standard approach for identifying statistical look-alikes from a pool of potential group candidates³ and it

³ For a discussion of the use of propensity score matching to identify control groups, see Imbens, Guido W. and Wooldridge, Jeffrey M. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature* 47.1 (2009): 5-86.

explicitly addresses self-selection into the pilot based on observable differences between pilot participants and nonparticipants. The control group was selected from a large, randomly drawn pool of residential customers in Orinda and Moraga.

With propensity score matching, customer characteristics are weighted based on the degree to which they predict pilot participation and are used to produce a propensity score. For each participant, the control group candidate with the closest propensity score was selected.⁴ Weather conditions were not factored into the match because all customers in the pool of potential matches face the same weather conditions as the participants. Electric consumption and customer characteristics from the pretreatment period were used to calculate the propensity score:

- Average summer hourly usage during on-peak (12–6 PM) and off-peak periods (remaining hours);
- Average winter hourly usage during the on-peak and off-peak periods;
- BPP status during the pretreatment period; and
- SmartRate™ status during the pretreatment period⁵.

Table 3-1 compares the customer characteristics of the matched control group and the pilot participants. For example, CARE customers represent 1% of all customers in both the treatment and matched control groups; the treatment and control groups are almost statistically identical for most customer characteristics tested. The t-statistic indicates how different the treatment and control group are. A t-statistic of 0 indicates that the two groups are identical with respect to that variable, while a positive or negative t-statistic indicates that one group has for example, more or less SmartAC™ customers than the other. The p-values indicate if the differences are statistically significant. The matched control group and treatment group are statistically different with respect to the proportion of customers participating in SmartACTM and the proportion of customers taking all-electric service from PG&E. While the differences are statistically significant with a 5% confidence level, these two subgroups of the treatment and control groups are also small and are consequently not likely to exert much influence on the outcome of the study.

Table 3-1: Comparison of Customer Characteristics of Treatment and Matched Control Group

Variable	HAN Treatment	Control Group	t-statistic	p-value
BPP	0.00	0.00	.	.
CARE	0.01	0.01	0.00	100%
SmartAC™	0.12	0.07	1.93	5%
SmartRate™	0.04	0.04	0.00	100%
All-electric	0.00	0.01	-2.01	5%

⁴ Matches were restricted to a tight range: if customers within a very similar propensity score (<0.0094 difference) could not be found, those customers went unmatched. All treatment customers were matched.

⁵ The control pool, like the treatment group, excluded customers who were on SmartRate™ before recruitment began. This variable that is being used for the match indicates those customers who enrolled in SmartRate™ after recruitment began but before the installation period.

Table 3-2 presents comparisons between the treatment and matched control groups on the basis of average summer and winter load shape characteristics. For example, the average summer peak hourly kWh would be average hourly usage between 12–6 PM averaged per customer from May 2011 – October 2012. The treatment and control groups have almost identical load shapes before the onset of the IHD treatment; no differences in hourly or peak load are statistically significant.

Table 3-2: Comparison of Load Shape Characteristics of Treatment and Matched Control Group

Usage Variable	Summer				Winter			
	HAN Treatment	Control	t	p	HAN Treatment	Control Group	t	p
Peak	1.29	1.27	0.17	86%	1.24	1.25	-0.16	87%
Off Peak	0.99	0.98	0.21	83%	1.13	1.12	0.15	88%
Average Daily kWh	25.53	25.30	0.21	83%	27.69	27.62	0.06	95%
Pct of Load on Peak	0.29	0.29	-0.44	66%	0.27	0.27	-0.75	46%
Hour ending 1	0.71	0.74	-0.76	45%	0.74	0.80	-1.37	17%
Hour ending 2	0.61	0.65	-1.07	28%	0.67	0.71	-0.80	42%
Hour ending 3	0.57	0.60	-0.88	38%	0.66	0.67	-0.21	84%
Hour ending 4	0.56	0.58	-0.53	60%	0.66	0.66	-0.08	94%
Hour ending 5	0.58	0.57	0.16	87%	0.69	0.68	0.23	82%
Hour ending 6	0.61	0.63	-0.45	65%	0.77	0.77	0.10	92%
Hour ending 7	0.77	0.79	-0.47	64%	1.02	1.02	-0.01	99%
Hour ending 8	1.01	0.98	0.62	53%	1.31	1.29	0.43	67%
Hour ending 9	1.02	0.97	0.94	35%	1.23	1.21	0.36	72%
Hour ending 10	1.04	0.98	0.96	34%	1.19	1.16	0.41	68%
Hour ending 11	1.10	1.08	0.36	72%	1.20	1.17	0.45	65%
Hour ending 12	1.17	1.13	0.53	60%	1.20	1.17	0.44	66%
Hour ending 13	1.18	1.18	0.07	95%	1.16	1.18	-0.34	73%
Hour ending 14	1.20	1.20	0.01	99%	1.13	1.17	-0.48	63%
Hour ending 15	1.23	1.23	0.01	99%	1.11	1.13	-0.30	76%
Hour ending 16	1.26	1.26	-0.01	99%	1.11	1.11	-0.08	93%
Hour ending 17	1.31	1.28	0.32	75%	1.17	1.16	0.31	76%
Hour ending 18	1.38	1.35	0.45	66%	1.48	1.45	0.53	60%
Hour ending 19	1.46	1.44	0.30	76%	1.70	1.67	0.60	55%
Hour ending 20	1.48	1.50	-0.30	76%	1.73	1.74	-0.25	80%
Hour ending 21	1.54	1.54	0.03	98%	1.71	1.70	0.09	93%
Hour ending 22	1.48	1.44	0.61	55%	1.56	1.53	0.47	64%
Hour ending 23	1.22	1.18	0.72	47%	1.26	1.24	0.31	76%
Hour ending 24	0.91	0.91	0.05	96%	0.94	0.96	-0.36	72%

Figures 3-1 and 3-2 show the average winter and summer electricity load shapes for treatment and control group customers prior to exposure to the IHD treatment. Specifically, Figure 3-1 presents the average daily load shape from November 2011 to April 2012. Figure 3-2 shows the average daily load shape from September 2011 – October 2011 and May 2012 – September 2012. The load shapes are nearly identical, a further indication that the propensity score matched group is sound and that the groups are virtually identical before the onset of the treatment. During winter months, average hourly usage differences between treatment and control range from -2.4% to 6.9%; during summer months, the differences in average hourly consumption range from -5.3% to 6.0%. However, the difference-in-differences model compensates for the differences that are present in the pretreatment period. The impacts calculated using the regression will not attribute pre-existing differences between treatment and control to the IHD.

Figure 3-1: Control and Treatment Group Usage Comparison – Pretreatment Winter

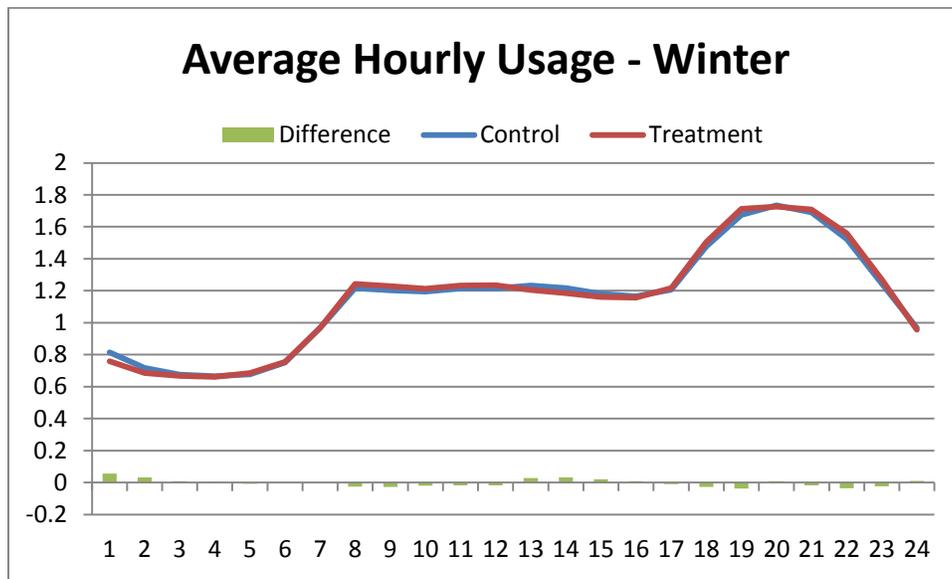
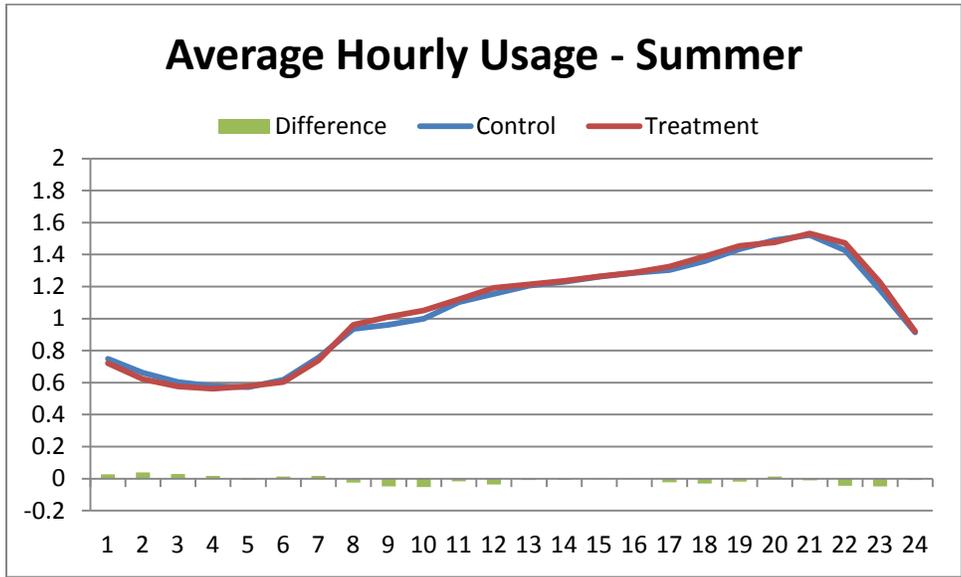
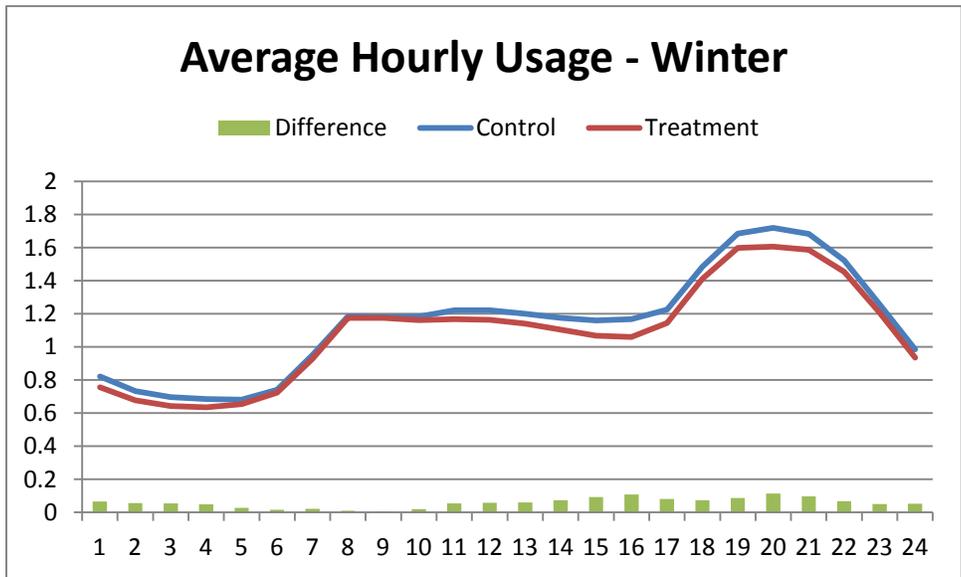


Figure 3-2: Control and Treatment Group Usage Comparison – Pretreatment Summer



This same comparison is made in Figure 3-3 for customers in the post-treatment period (which only included winter months) which indicates a reduction in usage.

Figure 3-3: Control and Treatment Group Usage Comparison – Post-treatment

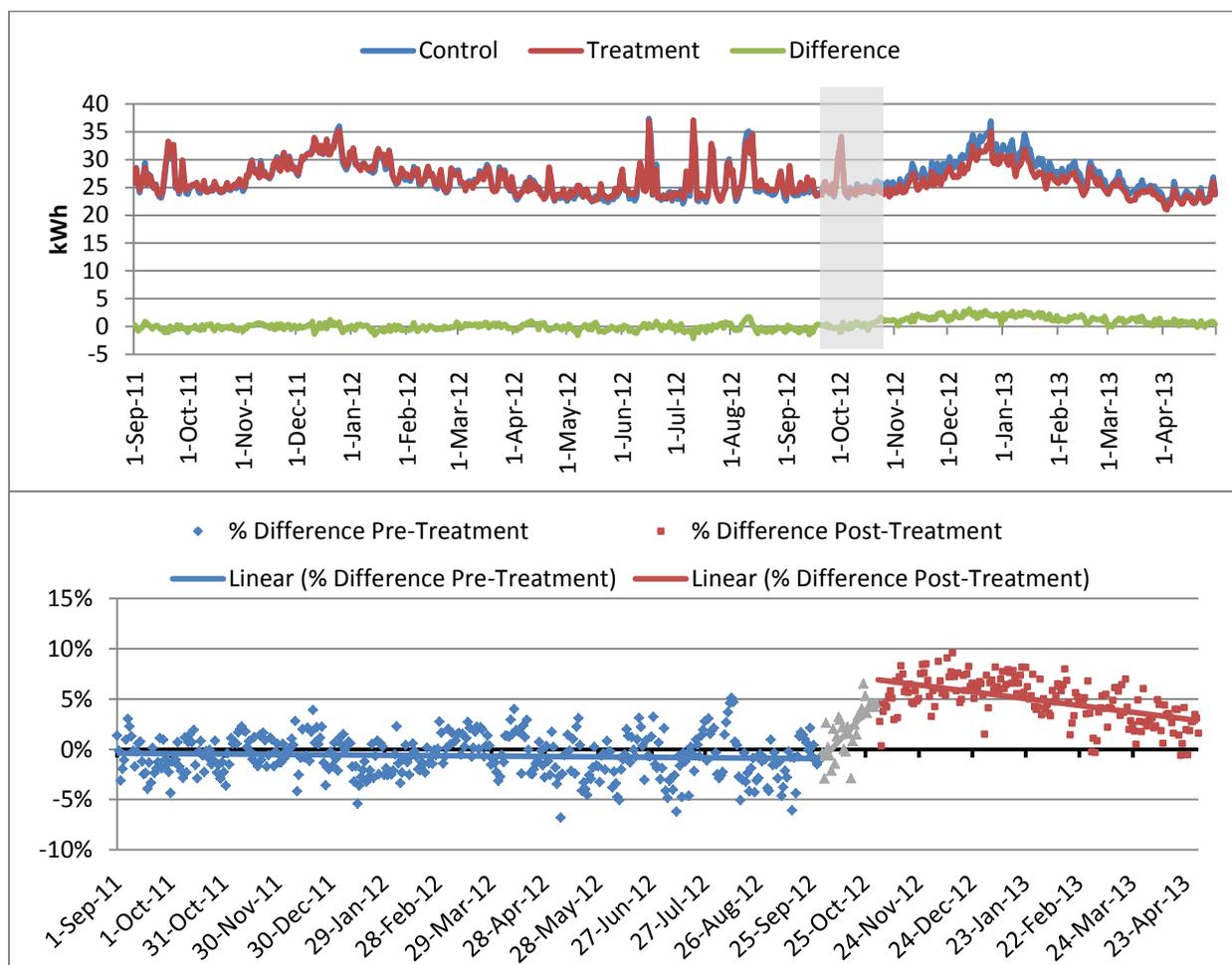


This difference in usage is also apparent at daily level, and becomes especially notable when comparing the pretreatment and posttreatment periods side by side in Figure 3-4. The area that is shaded grey indicates the installation period. The green line in the first graph represents the difference between average daily usage. The difference visibly increases at the start of the treatment period. During the pretreatment period the difference in average daily consumption ranges from - 6.8% to 5.1% between the treatment and control groups. During the posttreatment period the differences range from -0.6% to 9.6%. This is more apparent in the bottom scatter plot that shows

the difference between average daily usage as a percent of the control's usage. The timing of the change in energy consumption is strong evidence that the IHD installation led to changes in energy consumption.

Figure 3-4 also highlights the importance of the fact that both pre- and posttreatment usage data for the treatment and matched control groups is available for this analysis and that the analysis accounts for the small, but present, pre-existing differences between the treatment and control group's electric usage. Estimates of the daily electric usage savings due to the IHD, taking into account the pre-existing differences between the pilot participants and their matched control group, follow in Section 3.4.

Figure 3-4: Control and Treatment Group Daily Usage Comparison – Pre and Post-treatment (Treatment Period in Grey)



3.4 Regression Results

To quantify the estimated difference in usage, and the uncertainty of that estimate, between the pre and post-treatment periods of the two groups, FSC estimated a panel regression. This difference-in-

differences model used daily kWh usage as the dependent variable with daily and customer dummy variables (known as time and fixed effects) and a treatment period indicator as the independent variables. Standard errors calculated using the panel model rely on clustered standard errors and are conservative – that is, the level of precision of the estimate would be higher if we explicitly modeled the auto-regressive processes assumed to be present in daily electric consumption data⁶. The panel regression results (with errors clustered at the customer level) are summarized in Table 3-3, indicating statistically significant savings from the HAN customers of 5.6% on average per day. The 5.6% decrease represents an average reduction of about 1.55 kWh per day. Regression specifications are presented in Appendix B. These regressions were estimated excluding the installation period of October 2012.

Table 3-3: Panel Regression Results – Average Daily Impact on Electricity Usage

Measure	Average Daily Impact	Standard Error	95% CI	
			Lower	Upper
kWh	-1.55	0.34	-0.88	-2.22
Percent	-5.6%	1.2%	-3.2%	-8.0%

An alternate way to estimate difference-in-differences with a long time series data set is to

1. Calculate the average usage for customers in the treatment and control groups on a daily basis and find the difference between the two. This difference can be observed visually in the upper half of Figure 3-4.
2. Next, regress the difference between the two groups as a function of the treatment period and any other explanatory variables. Conceptually this is illustrated in the bottom half of Figure 3-4.

An advantage of this approach is that it enables explicit modeling of autoregressive processes inherent in time series. It also allows for additional explanatory variables. This approach works when the dataset consists of a balanced panel and a clear treatment start date is present that is the same, or close to the same for all customers in the treatment group.

We apply this alternate approach as a check of the robustness of the daily kWh savings estimate, that is, to develop confidence that the results here are not simply an artifact of model specification. The regression was estimated using ARIMA, a standard technique for time series that ensures correct standard errors when auto-regressive processes are present. The first ARIMA model uses only one variable that indicates the post-treatment period. The second ARIMA model uses additional month and day of week dummy variables to take into account seasonal and day of week trends. Table 3-4 summarizes these estimates which are very similar, but show smaller confidence bands. The first ARIMA model estimate is directly comparable to the panel model and produces nearly identical results, with the only difference in results appearing in the narrower confidence band.

⁶ Cluster-robust standard errors do not control well for serial correlation when the dataset under analysis has many customers but many time periods. See “Microeconomics using Stata. Cameron, A. Colin and Trivedi, Pravin K.

Table 3-4: ARIMA Regression Results – Average Daily Impact on Electricity Usage

Model	Measure	Average Daily Impact	Standard Error	95% CI	
				Lower	Upper
1. Treatment Only	kWh	-1.52	0.09	-1.34	-1.70
	Percent	-5.5%	0.3%	-4.9%	-6.2%
2. Treatment Plus Explanatory Variables	kWh	-1.42	0.10	-1.21	-1.62
	Percent	-5.1%	0.4%	-4.4%	-5.9%

With the significant and robust estimate of daily energy savings attributable to the IHD in hand, revisit Figure 3-4: a downward trend, over time, is visible in the differences in daily usage between the two groups. Will this downward trend continue over time until there are no statistically significant differences in electric usage between the two groups? Will the trend reverse course during the summer period when air conditioners are running? Or will the trend level off somewhere between 0% and 5% and persist over time? Only time and further analysis can tell.

4 PG&E CCO Pilot Experience – CSR and SSR Focus Group

A single focus group was conducted on July 10, 2013 at the PG&E campus in Fresno, California where most customer service representatives (CSRs) who take HAN-related calls are located. The session was one and a half hours in duration and was facilitated by an FSC consultant. A digital audio recording of the session was made with the consent of everyone in attendance.

The participants represented the full range of PG&E customer service staff that handle inbound HAN-related customer calls and emails. Seven CSRs who work at the Fresno-based call center operations (CCO) participated. All of these CSRs reported at least two years of service at PG&E, with some citing more than five years of call center experience. One CSR and a CSR team lead also attended who work in the customer service office (CSO) setting and who also have customer-facing responsibilities for the IHD pilot and continuing HAN project. A project manager from Customer Service Business Operations also attended, whose role is to provide support and resources to the CCO and CSO staff so they can effectively provide the required level of customer service for initiatives such as the HAN project. A member of the HAN team also called in to listen and gain firsthand insights from the focus group discussions.

The focus group was conducted at a point in time well beyond the conclusion of Phase 1 of the IHD pilot, which concluded April 30, 2013, and well into Phase 2, which began in January 2013. It was not possible to segregate the afternoon's discussion of customer service experiences by phase of the pilot. This chapter emphasizes key findings from the focus group related to Phase 1, but also presents findings pertaining to Phase 2, which are potentially more relevant for the HAN project on a going forward basis.

4.1 CCO and CSO Duties

Three senior service representatives (SSRs) who take calls coming through the Energy Cost Inquiry (ECI) line were trained in spring 2012 to support Phase 1 of the IHD pilot. Since the IHDs were installed and paired with the meter by an installer who visited each participants' home, the only HAN-related role for these SSRs was to provide first-level troubleshooting assistance in the event that an IHD were to malfunction. The troubleshooting steps that these SSRs had at their disposal were limited to powering the device off, removing the batteries, and powering on again, in addition to moving the device closer to the meter. When these actions failed to help restore the device's functionality, the SSR handed off the issue to the SMOC or HAN team via email.

When Phase 2 began in January 2013, CSO representatives took on the responsibility of receiving customer requests for HAN eligibility checks, via an emailed form. This work includes checking customer eligibility (eligibility criteria center on meter type, firmware, security certificates associated with the meter and customer class), informing the customer of their eligible/ineligible status, receiving the IHD's MAC address and install code from the customer and registering the device in HCM.

Forty CCO CSRs who work the Smarter Energy (SEL) and Energy Cost Inquiry (ECI) lines were also trained in January 2013 to support Phase 2. They were trained on the same troubleshooting topics that Phase 1 SSRs handle, but were also trained in carrying out the last step of the HAN device (which could be a gateway, PCT or IHD) installation process. This final step was completed by the Phase 1 installers, but during Phase 2 the customer must call in to the HAN line to complete it: the HAN device

must first be associated to the correct meter, by means of the CSR remotely activating the Zigbee radio in the SmartMeter™ and initiating communications between it and the device.

4.2 CSR and SSR Training

The Phase 1 SSRs and Phase 2 CSRs report that they participated in a two-hour training session on what the IHD devices do, how they integrate with the PG&E SmartMeter™ system, how to join them to the SmartMeter™ and how to troubleshoot problems with the IHD and SmartMeter™ not connecting. The CCO Project Manager received an in-depth training from the HAN program team regarding the program details as part of a “train-the-trainer” effort. The initial SSRs and CSRs that were trained to take HAN Pilot Phase 1 and Phase 2 calls received a high-level training from the CCO Project Manager, to prepare them for handling customer calls and troubleshooting inquiries.

The Phase 1 SSR training session was provided a number of months in advance of the pilot’s start, with no refresher sessions once the pilot began. While early is certainly better than late, the significant length of time between training and handling customer calls was noted to be an added challenge for the SSRs who took the first Phase 1 calls.

Many focus group discussants characterized their training as too short and as only an overview of the initiative. A number of CSRs reported that they did not feel confident in their ability to effectively handle HAN-related calls, even after the initial training session. The focus group discussions also revealed that SSRs were not included in the Phase 2 training. While inbound HAN calls are routed to CSRs who have received the training, in the event that a customer is not satisfied with the service or solutions that the CSR can provide and “wants to talk to someone,” standard procedure is to escalate the call to the SSR on duty. Unfortunately, these SSRs not only do not have any additional resources at their disposal for resolving HAN-related issues, but they are also likely to be less prepared to help than the CSR who originally took the call. Training materials were updated and improved training was delivered to these audiences after the focus group, to improve customer service capabilities in Phase 2. Enhanced training levels and access to specialized applications were provided to SSRs to better empower them to provide assistance in escalated situations (see Appendix C).

One CSR suggested that a post-training follow-up Q&A session would be very helpful. She described “feeling pretty good” coming out of the initial training, but then feeling blindsided by questions and problems coming to her on the HAN line, describing it as learning about how much she must not know about the HAN process (“things that you didn’t know you didn’t know.”) A Q&A session a few weeks after the beginning of Phase 2 would have gone a long way towards filling in the CSRs’ knowledge gaps quickly.

CSR and SSRs who were trained to handle both Phase 1 and Phase 2 customer calls report that the training materials they received were the same for both Phase 1 and Phase 2. This outcome may have been of some consequence for the call center staff handling Phase 2 calls. Phase 1 customers were not subject to the same process that Phase 2 customers are now, with respect to requesting an eligibility check, purchasing an IHD (if eligible to connect it to their SmartMeter™), registering the IHD’s MAC address with PG&E and working with a CSR via telephone to join the IHD to the meter. Many of the CSRs participating in the discussion described how difficult it was to help Phase 2 customers through the process when they didn’t fully understand the process from either the customer’s perspective or the back-office PG&E perspective. During the focus group discussions, the

SSR and CSRs from CCO took advantage of the opportunity to interact with CSO staff to learn about how the entire HAN device enrollment process works from start to finish and commented on how valuable the information was for them. From these interactions and discussions it was clear that CCO staff stand to benefit from gaining a full understanding of both the front-office and back-office processes associated with HAN enrollment, that is, from learning about the processes that are handled by CSO (customer enrollment and device registration). One SSR volunteered that he thought that the Phase 1 and Phase 2 rollouts should have specifically included CSO staff so that team members could acquire (and share) first-hand experience with how the enrollment, set-up and troubleshooting processes work. As a result of feedback obtained through this focus group, Phase 2 training materials were enhanced to include information about the enrollment process and all processes. This enhanced training was delivered to all Phase 2 representatives, to provide a thorough view of the customer experience to all representatives (see Appendix C).

The discussions with call center staff revealed that the train-the-trainer approach to educating SSR and CSRs on a new and evolving HAN initiative and program was not effective in transferring program knowledge from the HAN team to CCO staff who ultimately handled HAN-related customer calls. It appears that a significant amount of information about the pilot was lost in translation between the train-the-trainer sessions and the training sessions that the SSRs and CSRs received. The new training approach for delivery in the future, as a result of this focus group finding, is to have training delivered by or attended by a subject matter expert or project manager. During the re-training for Phase 2 representatives after this focus group, CSRs in the CSO organization and SSRs were provided training facilitated directly by the CSBO project manager, and CCO trainings were delivered by a project manager when possible.

4.3 CSR and SSR Resources

The CSRs spoke highly of the HAN article in GenRef; that the material in the article was useful and served well for connecting a customer's IHD to the SmartMeter™ at the premise. There were a number of comments that the process of using the article was "slow" in that it has a lot of pictures that take time to download and also in relation to the time it takes to successfully join the device to the meter. At least one CSR has printed the article so that she has faster access to the information when a customer calls. When probed about the issue of how long it takes to join a meter to a HAN device, CSRs stated that the slowness of the process is a consequence of the fact that HAN calls are few and far between; the joining process isn't done very often so the steps haven't had a chance to be committed to memory yet. This is in contrast to many of the other tasks that the CSRs complete often; they are able to complete day-to-day tasks quickly and with proficiency, but the HAN joining process still feels slow and inefficient in comparison.

The GenRef article does not, however, provide much information to help the CSRs troubleshoot problems with the IHD very effectively. More often than not, CSRs are forced to escalate requests for help with the device to either the HAN team or the SM OC. As a result of receiving this feedback, GenRef was updated to include troubleshooting steps for a variety of situations that might impact the pairing process.

One SSR suggested that a HAN glossary be provided as a resource to CSRs and SSRs. There are a number of new or technological HAN-related terms that are easily mixed up or misunderstood by both

CCO/CSO staff and customers. The glossary, for instance, could explain the difference between joining a meter and HAN device (which happens in the back-office) and pairing a meter and HAN device (which happens in the front-office). This feedback led to updating the language in the protocols documented in GenRef for better clarity, and an updated glossary that explains industry and internal company terminology used throughout the enrollment process.

Many CSRs agreed that they would like a better news channel for HAN program developments, with some stating that they feel like they are the last to know about HAN program news or changes. While email communications on program updates from the HAN team could be effective, many CSRs spoke of being inundated with email updates from other areas of the company already and that HAN emails could end up lost in the noise. In this case, the HAN team might work with the Customer Service Business Operations project manager as a liaison, who already has an established efficient and effective communication channel with CCO HAN staff. The CSBO project manager established a weekly communications which serve to share information about general program developments, eligibility updates, operational news that impacts the HAN program and reminders. The weekly communication is a channel that provides consistency in messaging to the HAN representatives as the audience targets both CCO and CSO representatives (see Appendix C.1). Given the current division of HAN customer service responsibilities between CCO, CSO and the HAN team, the focus group participants identified some ways that customer service handoffs between these teams can be better achieved for Phase 2 and beyond. The CSRs make frequent use of the CC&B screen to document how a customer issue was handled or handed off to another area. CC&B provides a way to annotate the account with a description of a customer interaction so that if the customer calls again, the next CSR can see it and be aware of what has already happened. The HAN team, SMO and CSO do not make use of CC&B to document HAN-related work that affects individual customers or handing off customer issues to other areas. While some CSRs suggested that emails between individuals on the HAN team, SMOC, CSO and CCO can help with “keeping everyone on the same page” with respect to a particular customer issue, the information that email exchanges convey doesn’t help those CSRs who aren’t on the distribution or didn’t handle the original call. Getting access to and using the CC&B screen and having all HAN support organizations use it to track customer-specific interactions and actions taken can go a long way to resolving the customer service issue as fast or efficiently as possible. As a result of this focus group feedback, standardized and recommended customer interaction verbiage was documented, provided and trained to all representatives in an effort to create consistency and understanding amongst those reviewing customer accounts. This effort will ensure anyone referencing a customer account will be able to comprehend the enrollment status of a HAN customer, and what actions must be taken to properly handle any issues that arise (see Appendix C.1).

4.4 Phase 1 Customer Service Challenges

The majority of the CSRs participating in the focus group were not handling HAN-related calls yet during Phase 1, but two SSRs were present who provided HAN customer service during Phase 1. As a result, discussion pertaining to Phase 1 issues in particular was limited, but this was also due to the fact that the Phase 1 HAN role for the CCO was also limited in comparison to Phase 2 CCO responsibilities.

Phase 1-trained SSRs described the participants of the pilot as tech-savvy customers who were busy and often in a rush during their interactions with the call center. Since their IHDs were professionally

installed, most Phase 1 calls to CCO were about the unit malfunctioning or showing a blank display. The SSRs who took those calls said that they had no resources at their disposal for effectively troubleshooting those problems and would nearly always have to escalate them to the HAN team. The “turn off, take out the batteries, turn on” routine usually did not work for these Phase 1 problems. Since the IHDs were installed by PG&E, these tech-savvy customers expected the call center staff to easily resolve IHD problems. Being unable to meet these customers’ expectations was challenging for the CSRs. Enhanced troubleshooting steps were documented and expanded training was provided to representatives as a result of this feedback.

4.5 Phase 2 Customer Service Challenges

CSRs trained to take HAN calls, together with the customer on the phone, finalize the IHD installation process. Focus group participants note that, while they have clear instructions in GenRef that guide them through the pairing process, they do face some challenges in working with the customer to complete the connection. Some CSRs reported facing complaints from customers who, once on the phone with CCO, are surprised by details of how the process does or doesn’t work. Some customers were surprised to learn that they have to call PG&E from home with the IHD accessible to them in order to pair the device with the meter. For example, a customer can’t call PG&E from work to ask PG&E to pair the IHD located in the home. Another limitation is that there are not yet HAN-trained staff covering all hours of weekdays and weekends at PG&E’s CCO. These limitations are all understandable from the perspective of the CSRs given the program’s nascent status. But the CSRs did uniformly agree that these customer-facing limitations to or requirements for completing the installation and pairing process should be better, possibly more redundantly, communicated to the customer.

Other CSRs expressed the desire to know more about the pairing process so that they can more effectively troubleshoot problems associated with the device communicating with the meter. For example, a customer might ask, “Why did my IHD become unpaired with the meter?” Representatives shared that the only response to such a basic question that they are informed to provide is simply, “I don’t know!” Enhanced troubleshooting steps have since been added to process documentation and shared with these representatives, to better empower them to provide assistance in situations such as this (see Appendix C.1)

While the CCO is not currently responsible for the part of the process where a customer contacts PG&E to inquire about HAN eligibility, CCO CSRs have had to contend with issues around eligibility check requests. Customers are currently informed that the eligibility check can take up to five days. However, there have been periods of time where there is a general backlog of eligibility check requests due to high demand or technical difficulties. Challenges with verifying HAN eligibility can also present themselves on a customer-specific basis for a variety of reasons. In these cases, CSRs have fielded calls from customers wanting a status update or to directly inquire about their eligibility. However, the CSRs don’t have any information about the status of any particular customer’s eligibility request and they are not able to check their eligibility themselves. The only avenue available for addressing the customer’s request for information is to escalate the call to the HAN team via email. During times of high volumes of eligibility requests (which come to the CSO as emails), these further emails from CSRs only exacerbate the problem.

The participating CSRs widely agreed that these eligibility-related inquiries could be better handled with the enhancements to the CCO/CSO/HAN-team communications described above. When there is a general backlog, it may be difficult to get such a program status update through the queue that is typically associated with getting updates made on the PG&E website. Likewise, it may be difficult to integrate a temporary status update into system-generated emails that are sent in response to eligibility check requests. In these cases a group-level communication from the HAN team or CSO HAN team to the CCO HAN team that outlines the situation can go a long way towards more effectively handling these kinds of calls. In the case of challenging cases specific to a single customer, using CC&B could be very useful for tracking the status of the more difficult or long-lived customer requests or issues. As a result of this feedback, the weekly HAN email update coming from the CSBO project manager was identified as the proper communication channel that will be used to share any updates on operational delays with processing eligibility requests. Additionally, operational delays were tackled and eliminated through re-training the CSO representatives, daily reports to monitor queue status, and discussions to alert management to the service level delays being experienced. Dedicated representatives were directed to ensure proper management of queues, and service levels have since leveled off at the appropriate response time of under 5 business days (see Appendices C.1 & C.3).

4.6 CCO Recommendations for HAN in the Future

Discussions about how to improve HAN customer service in the near-term and in the long-term focused on enabling the customer to connect their HAN device more quickly than is currently possible. In the future state, the focus group participants believe that joining and pairing the meter with HAN devices should be accomplished with self-serve functionalities in MyEnergy. There was no discussion of future state processes for eligibility checks, perhaps there is the expectation that in the future all meters will be HAN-eligible. CCO staff recognized, however, that self-service joining and pairing may not work perfectly in every case, even with robust online help content. With this in mind, CSRs thought that the joining and pairing process should also be able to be completed by CSRs so as to be able to provide customer service to those who do not prefer a self-service model or to assist those who have trouble with it. It was also mentioned that in the future, many more CCO staff will need to be trained to learn how to provide HAN support.

In the meantime, many of the participants thought that any steps to eliminate any of the bifurcation in the eligibility/joining/pairing process between CCO and CSO staff would speed things along greatly for the customer. Participants shared that customers expect to be able to setup their device connection as quickly as it took to purchase the device.

Note that many process improvements have been made since the focus group was held. A selected list of Contact Center & Customer Service Operations improvements can be found in Appendix C.

5 PG&E CCO Pilot Experience – Inbound Call Summaries

All HAN-related phone calls to the PG&E CCO were documented during the first phase of the IHD pilot. Out of a total of 62 received calls, 44% were resolved on the first call and the remaining 56% were escalated to SmartMeter Operations (SMOC). On average, all questions and issues were resolved within 30 days. However, the longest unresolved issue lasted for 108 days.

Amongst issues resolved during the first call, example customer inquiries included:

- How do I enroll in the HAN pilot;
- Can I get help connecting my device to my wireless network;
- How do I reset the device? Can I get help resetting the device;
- Can I get help navigating to the device home screen;
- How do I get usage information;
- I have concerns regarding the device's security; and
- How does HAN reduce costs?

Out of the 35 issues brought to the SMOC, the majority (59%) had to do with questions about the device. The remaining 41% of calls escalated to SMOC were about the HAN program and device communications. There was one call related to billing.

Issues that were escalated to the SMOC included:

- Device cannot connect to both SmartMeter™ and the customer's wireless network;
- Device cannot connect to the SmartMeter™;
- There is no communication between SmartMeter™ and IHD; and
- Usage is visible, but price information is not.

The recordings of 23 calls from both Phase 1 and Phase 2 of the IHD pilot were selected as examples for review and summary. The majority of calls fell into four categories:

- Customers who were concerned about their high energy usage and were informed about the HAN device;
- Customers who called in to match up their IHDs to their meters;
- Customers who called about their eligibility for a HAN device or to sign up for a HAN device; and
- Customers who wanted to confirm that they could keep their HAN device after the pilot with no extra fees.

Customers who called in concerned about their high energy use were informed about the IHD as a possible method for pinpointing devices and appliances that use relatively large amounts of electricity. This was the basis for four of the calls. The remaining two were slightly different. One was a customer calling in about above average energy usage reported by her IHD. This customer wanted assistance to determine what was causing the increase. Another customer was actually interested in a plug-in device such as the Kill A Watt®, but the call center agent mistook his description of what he wanted for that of an IHD. During one phone call the agent directed the customer to enroll in the pilot through the PG&E website, however in all other instances it was brought up in an off-hand manner – it

seems unlikely that the customer would end up purchasing an IHD. Otherwise, most of these phone calls could be considered successful: customers were informed of ways they could monitor their electricity usage and find what was causing high electric consumption in their household.

Seven calls that had to do with pairing IHDs to meters. There was one successful pairing and five unresolved pairing issues. There was also one call with a customer who was not a part of the pilot program. The five pairing issues included:

- Unable to match up a Rainforest Eagle device with the SmartMeter™ because of a missing handbook (Phase 2);
- MAC address not matching up with badge number (Phase 1 or Phase 2);
- CSR's computer reported successful matchup while customer's device did not show any changes (Phase 2);
- During the first attempt to join a device, the CSR sees that the only available option is to rejoin the device. This is probably what caused the initial join failure (Phase 2); and
- Rainforest Eagle firmware update was necessary in order to join it with the SmartMeter™ (Phase 2).

The last customer who was not a part of the HAN pilot had bought his own IHD and wanted to join it to his meter. He was informed that he would be notified as soon as this functionality was available to the general public. Overall, only two of these calls successfully resolved the customer's issue. Of the five unsuccessful calls listed above, three were escalated to SSRs. One customer was left to find his Rainforest Eagle handbook. It was suggested to the last customer that he consult with the device manufacturer's customer service center.

There were three calls that had to do with eligibility and signing up for HAN (Phase 2). Two of these calls were about the long wait time between requesting the eligibility check and being sent the eligibility confirmation. One customer had received confirmation that PG&E had received his request and had waited the suggested amount of time without hearing back. He reported sending two follow-up emails. Both responses to his emails said that they would get back to him shortly, however this did not happen. The other customer asked if this process was made intentionally hard in order to deter customers from enrolling into the program. The third call was from a customer who wanted to sign up via phone because the website was confusing or not working properly. The first call was unresolved and brought up to a supervisor. The second was told to wait a bit longer and the third was too impatient to allow the CSR to walk through the website with her so she decided to check the website again another day.

There were two calls pertaining to keeping the IHD after the pilot was finished (Phase 1). Both customers wanted to know if they could keep it free of charge. One was informed that he could, and the other was transferred to a supervisor.

The subjects of the remaining five calls were varied. One was an appointment cancellation for an IHD installation (Phase 1). The customer was not sure what kind of appointment it was and the agent mistook the appointment for a SmartAC™ appointment because he believed the IHD program to be in place and not recruiting new customers. However, in the end it was resolved. Another call had to do with connecting the IHD to a new wireless network (Phase 1 or Phase 2). The agent didn't seem very familiar with the topic but had a troubleshooting guide that he referred to. Although not resolved,

there was a possible solution that was suggested. One call was another PG&E employee looking for information as well as a demonstration device for an upcoming Earth Day booth. He was referred to the HAN program manager. Another call was from an aggravated customer who was frustrated that after he got his IHD, his gas bill would only come every two months instead of every month (Phase 1). This was unresolved and the agent said she would call back with a resolution.

Lastly, there was a call from a HAN customer who said that this number was referred to him after the original HAN number given to him to contact did not work. The agent did not know much about HAN and therefore transferred him to his supervisor. This is a common theme that occurred in many of the calls that weren't in the first two categories. In many cases, call center agents did not know much about the HAN and had to escalate calls to their supervisors. Call center agents were empowered to assist with general program questions and device pairing (see Appendix C for improvements made to training).

6 Customer Survey Results

Two online surveys were administered to IHD pilot participants, one shortly after the pilot commenced, in November 2012, and another shortly before the pilot ended, in April 2013. The non-PG&E employee participants were invited via email to take the first survey after they had four to six weeks of experience with their IHDs. 214 of 354 participants completed the first survey, yielding a 60% response rate.

The second survey was given after participants had six months of experience with their devices. FSC mailed letters announcing the close of the PG&E IHD pilot to 430 pilot participants (both employees and general customers) on Friday, April 19, 2013. The closure letter thanked participants for their participation and notified them they may keep or return the Control4 IHD to PG&E. In the event customers elected to keep the device to continue to use it, the letter stated that the up-to-date pricing information presented by the IHDs will no longer appear and that PG&E technical support will no longer be offered after April 30, 2013. Web links to web-based exit surveys were emailed to 418 IHD participants for whom FSC had valid email addresses on Monday, April 22, 2013. FSC received 282 completed exit surveys from pilot participants, representing a 67% response rate.

This section presents key results from both the initial and exit surveys, compares results from questions that appeared in both surveys and also compares initial survey responses to final survey responses on an individual customer basis.

6.1 Key Findings from the Initial Survey

Results from the initial survey, fielded to non-employee IHD pilot participants in November 2012, were documented in a 12-page memorandum to PG&E on December 12, 2012. The key findings of the initial survey are summarized here, but the details of these results are fully documented in the memorandum.

After four to six weeks with the IHD device in the home, the initial survey revealed that:

- 83% of the respondents look at the device at least once a day;
- 84% of respondents have discussed their energy use with someone else in their household based on information gained from the IHD;
- The installation process received very high satisfaction ratings, with an average score of 8.8 out of 10, where 10 is the highest rating for satisfaction;
- 45% of respondents believed they had saved energy due to the device;
- While customers generally reacted positively to the device, they only expressed a willingness to pay an average of \$22 for it;
- Before concluding and thanking participants for their time and participation in the pilot and survey, the exit survey asked customers for any further feedback on the pilot. 85 respondents took the opportunity to leave final comments when asked, "what feedback, if any, do you have concerning your participation in this pilot?"
 - Fifty-three (61%) of the final comments referenced being happy with participating in the pilot, enjoyed having the device, found the device interesting, or stated that the IHD is a good idea;
 - Ten (11%) respondents stated they were disappointed with the IHD pilot;

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- One (1%) respondent indicated they wished the IHD information was available on an app; and
 - Two (2%) respondents referenced the desire to see gas consumption data on the IHD.

6.2 Key Findings from the Exit Survey

Results from the exit survey, fielded to all IHD pilot participants in April 2013, were documented in a 17-page report to PG&E on May 21, 2013. The key findings of the exit survey are summarized here, but the details of these results are fully documented in the report.

After six months with the IHD device in the home, the exit survey revealed that:

- 83% of respondents report their IHDs are still working;
- The 73 (26%) customers who reported in the exit survey that their IHDs have not appeared to work in the last 30 days reported the following problems:
 - IHD connectivity with wi-fi or the SmartMeter™ (14 responses);
 - Erroneous low battery indicator (4 responses); and
 - IHD “blank,” “freezing” or “resetting” (17 responses)
- 78% of respondents report looking at their IHD two or more times per week, during the past week;
- 61% of respondents gave the Control4 IHD a rating of 8, 9 or 10 (on a scale of 1 to 10, where 1 means “do not like” and 10 means “like very much”) when asked how much they like the IHD; 22% of respondents gave the IHD a rating of 5, 6 or 7; 6% of respondents gave the IHD a rating of 4 or less;
- Respondents decisively found the device useful for saving energy and the device did not precipitate worries about the privacy of their electric consumption data. Ratings reflecting the ease of usability and willingness to recommend to others were also strong. However, the degree to which the device empowered the household in controlling energy use was varied;
- While 20% of responses indicated the information provided by the IHD would be welcomed on multiple platforms – standalone unit, phone app and webpage – more than half of the responses indicated the standalone unit is useful and preferred. The weather function was judged to not be a very important feature of the device. Participants viewed the dollar cost of their energy consumption as the preferred and most valued information displayed by the IHD;
- The average participant cited \$22.36 as the amount they would pay for the device in a retail setting; however, 17% of respondents gave the IHD a retail value of \$0, indicating they would not pay for the IHD at any price;
- More than 50% of respondents reported using the IHD to determine how much energy individual appliances used in the past 30 days, and more than 50% of respondents also reported that information obtained by using the IHD was a subject of conversation with guests or adults outside the household; and
- 10% of the 39 customers who reported their IHDs as not working called PG&E for assistance with the IHD. Half of these customers were satisfied with the results of contacting PG&E for help with their IHD.
- 54% of respondents believed their household reduced its energy as a result of receiving the IHD. 64% of respondents reported they made changes in the way they use electricity at home, based on information provided by the IHD.

Before concluding and thanking participants for their time and participation in the pilot and survey, the exit survey asked customers for any further feedback on the pilot. 146 respondents took the

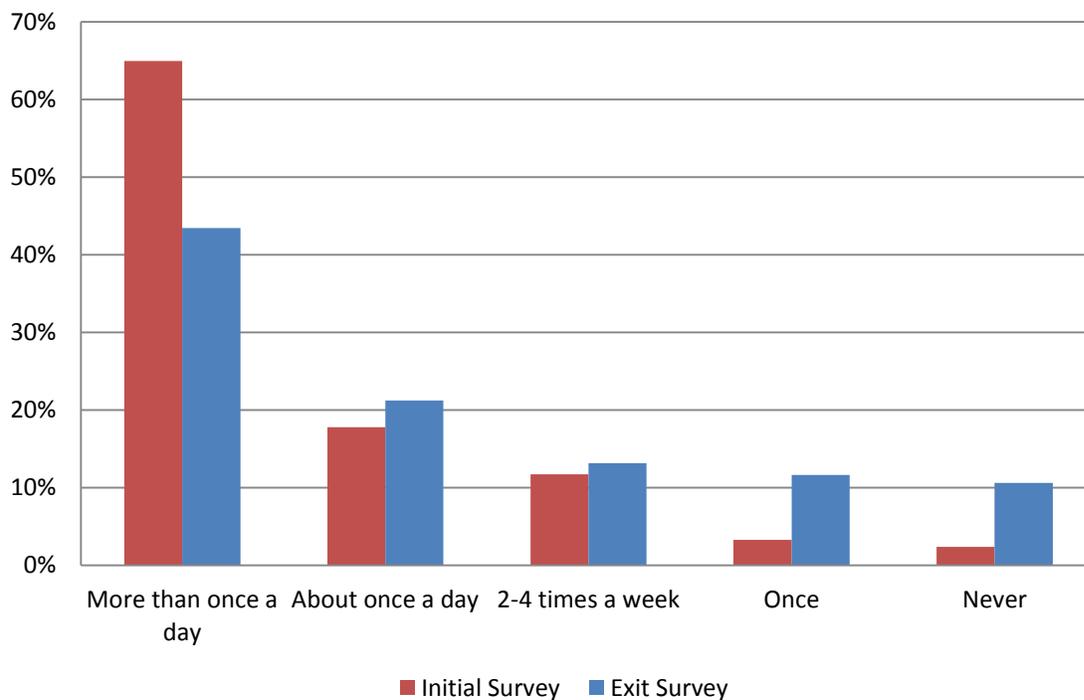
opportunity to leave final comments when asked, “what feedback, if any, do you have concerning your participation in this pilot?”

- Sixty-one (42%) of the final comments referenced being happy with participating in the pilot, enjoyed having the device, found the device interesting, or stated the IHD is a good idea.
- Six (4%) respondents stated they were disappointed with the IHD pilot.
- Six (4%) respondents indicated they wished the IHD information was available on an app.
- Two (1%) respondents referenced the desire to see gas consumption data on the IHD.

6.3 Comparing Initial and Exit Survey Results

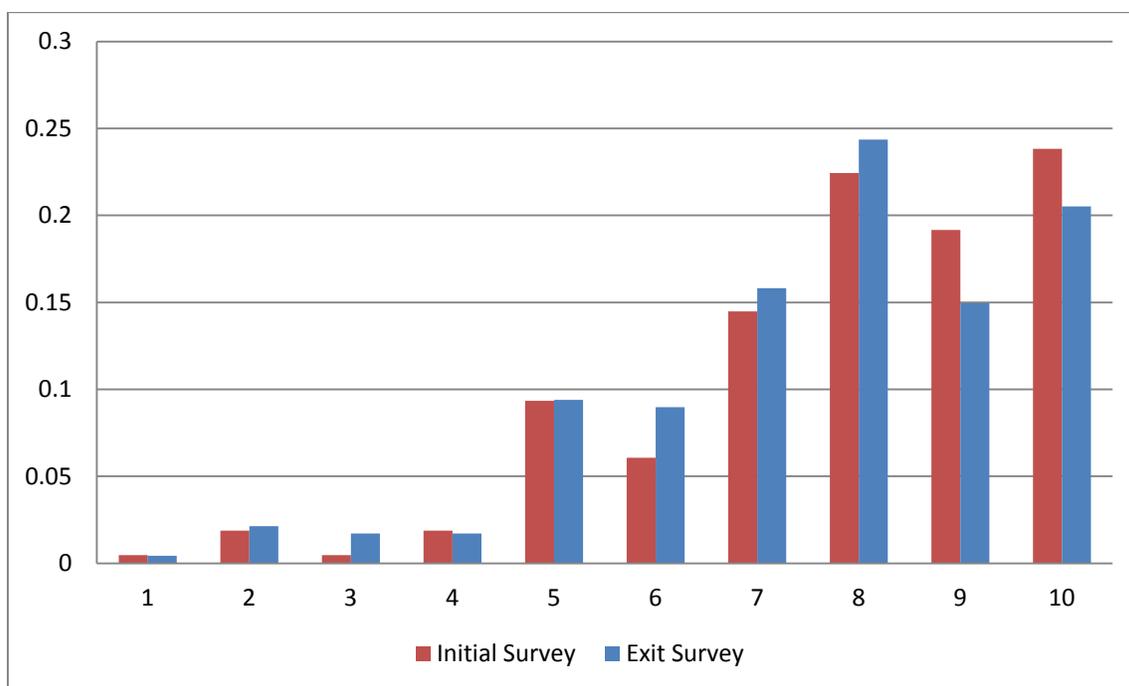
The reported frequency with which customers look at the IHD declined by the end of the pilot. Figure 6-1 presents how often respondents report looking at their IHD initially and at the time of the exit survey. 94% of participants initially reported looking at their IHDs at least twice a week while this number decreased to 78% by the time of the exit survey, a statistically significant change ($p= 0.00$) in reported viewing frequencies. These reports should not be surprising with respect to thinking of the IHD as a new consumer electronic device in the home that may lose novelty after an initial period of time. However, it may not necessarily hold that taking note of the information on the IHD with less frequency means that behavioral changes initially made in response to the information presented by the IHD are no longer in effect. It also may be that by the time of the exit survey customers have learned what their electric usage patterns are and don’t need to refer to it as often.

Figure 6-1: “In the past week, about how often did you look at your IHD?”
($n_i = 214, n_e = 198$)



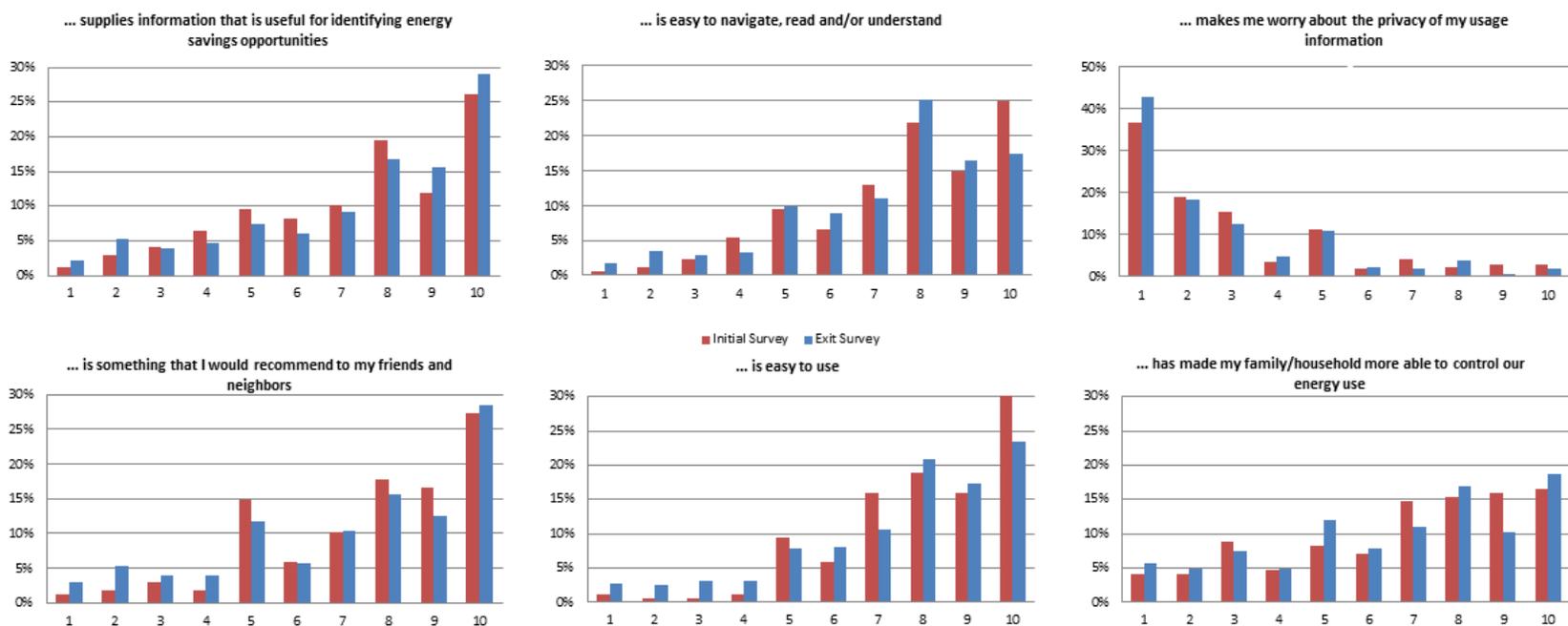
Both surveys also asked participants about their overall impression of the IHD, inquiring about how much they liked the Control4 IHD on a scale of 1 to 10, where 1 means they “do not like the IHD” and 10 means they “like the IHD very much.” Figure 6-2 presents the distribution of how respondents scored the IHD in terms of how much they liked it overall in both surveys. The overall impression did not change much between the initial and exit surveys; the device’s “likeability” had staying power. 140 (65%) of the initial respondents and 173 (61%) of the exit respondents gave the IHD the highest likability scores of 8, 9 or 10; 64 (30%) originally and 91 (32%) later respondents gave the IHD a more neutral score of 5, 6 or 7; 10 (5% of initial respondents) and 18 (6% of exit respondents) respondents gave the IHD the lowest likeability scores. There was no statistically significant difference in the change between the IHD’s likeability scores in the initial and exit surveys.

Figure 6-2: "What is your overall impression of your IHD?"
 1 = "do not like" 10 = "like very much"
 (n_i = 214) (n_e = 234)



The two surveys asked participants whether or not they agreed or disagreed with several statements describing how useful or easy the IHD was to use, whether the device brings to mind concerns about data privacy, and whether or not they would recommend the device to friends and neighbors. Figure 6-3 presents the distribution of responses to these questions. Respondents decisively found the device useful for saving energy and the device did not precipitate worries about the privacy of their electric consumption data. Ratings reflecting the ease of usability and willingness to recommend to others were also strong, however the degree to which the device empowered the household in controlling energy use was much more varied. Customers responding in the exit survey seemed to find the device a little less easy to navigate and understand than those in the initial survey. These differences were, however, not statistically significant.

**Figure 6-3: “Please indicate whether you agree or disagree with the following statements”
(1 = "strongly disagree" 10 = "strongly agree")
(n_i = 214) (n_e = 234)**



Pilot participants were also asked a series of questions regarding how they viewed certain features of the Control4 IHD that was tested in the pilot. While 20% of exit responses indicated that the information provided by the IHD would be welcomed on multiple platforms – standalone unit, phone app and webpage – more than half of the responses indicated the standalone unit is useful and preferred. The responses were very similar in the initial survey. The percent of customers who preferred the standalone unit was significantly lower in the exit survey ($p=0.024$). Preferences for other platforms did not vary across the two surveys. The weather function of the IHD was judged to not be a very important feature of the device on both surveys; appreciation for the weather function did not vary significantly across the two surveys. These questions also revealed that, in both surveys, participants viewed the dollar cost of their energy consumption as the preferred and most valued part of the IHD. Figure 6-4 presents the distribution of responses to these questions pertaining to specific IHD features, for both the initial and exit surveys.

Figure 6-4: Responses to Survey Questions about IHD Features
(n_i = 214) (n_e = 234)

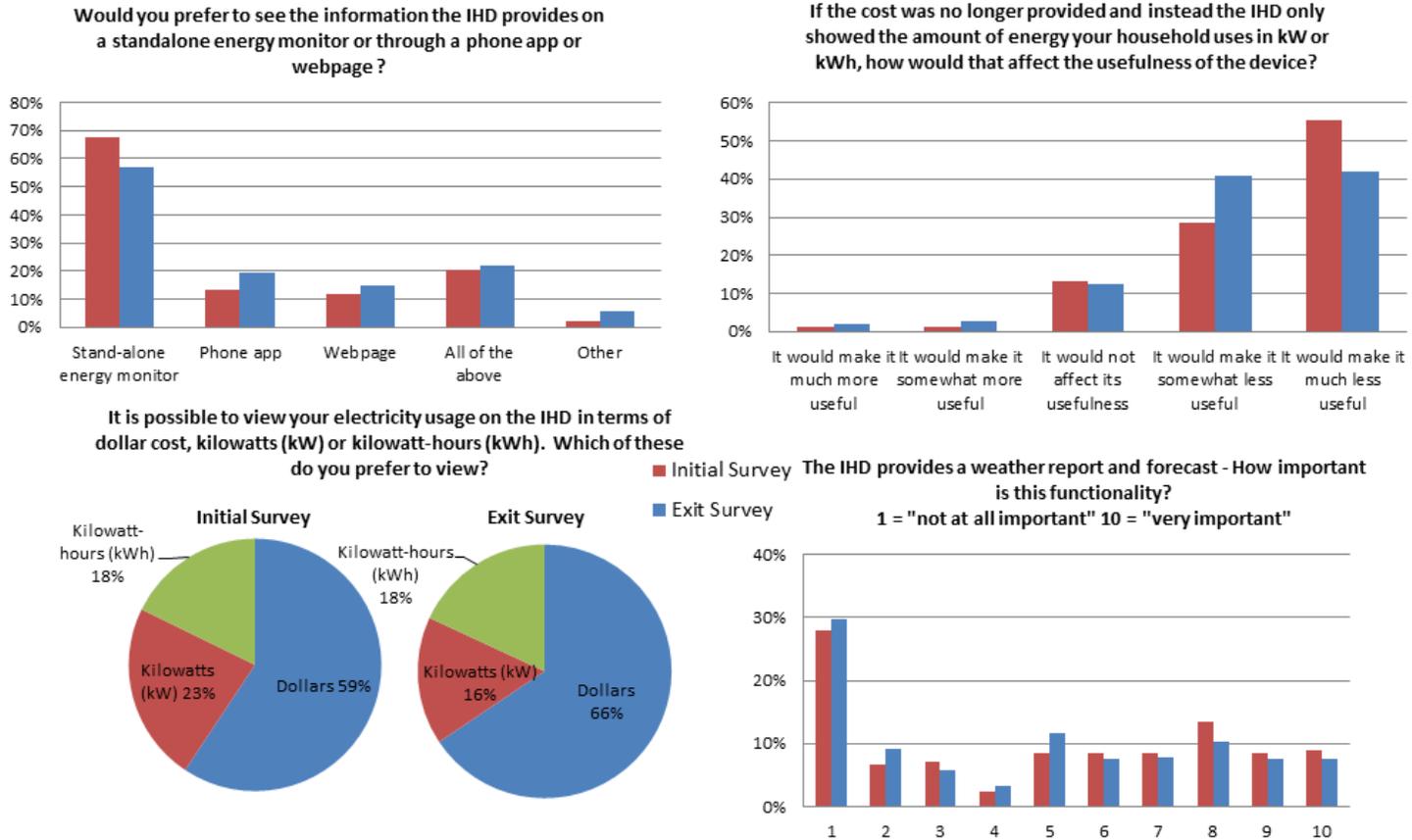
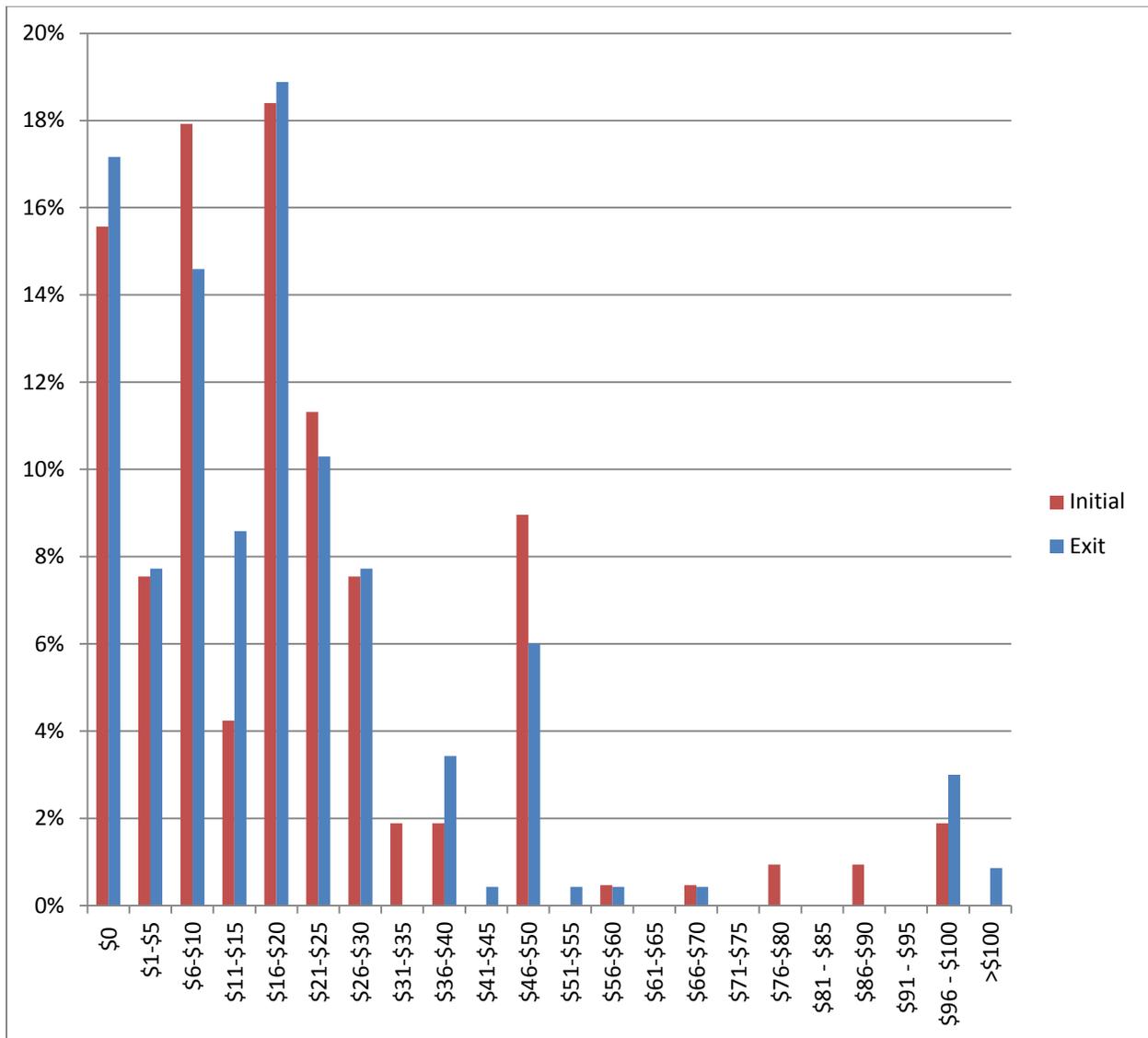


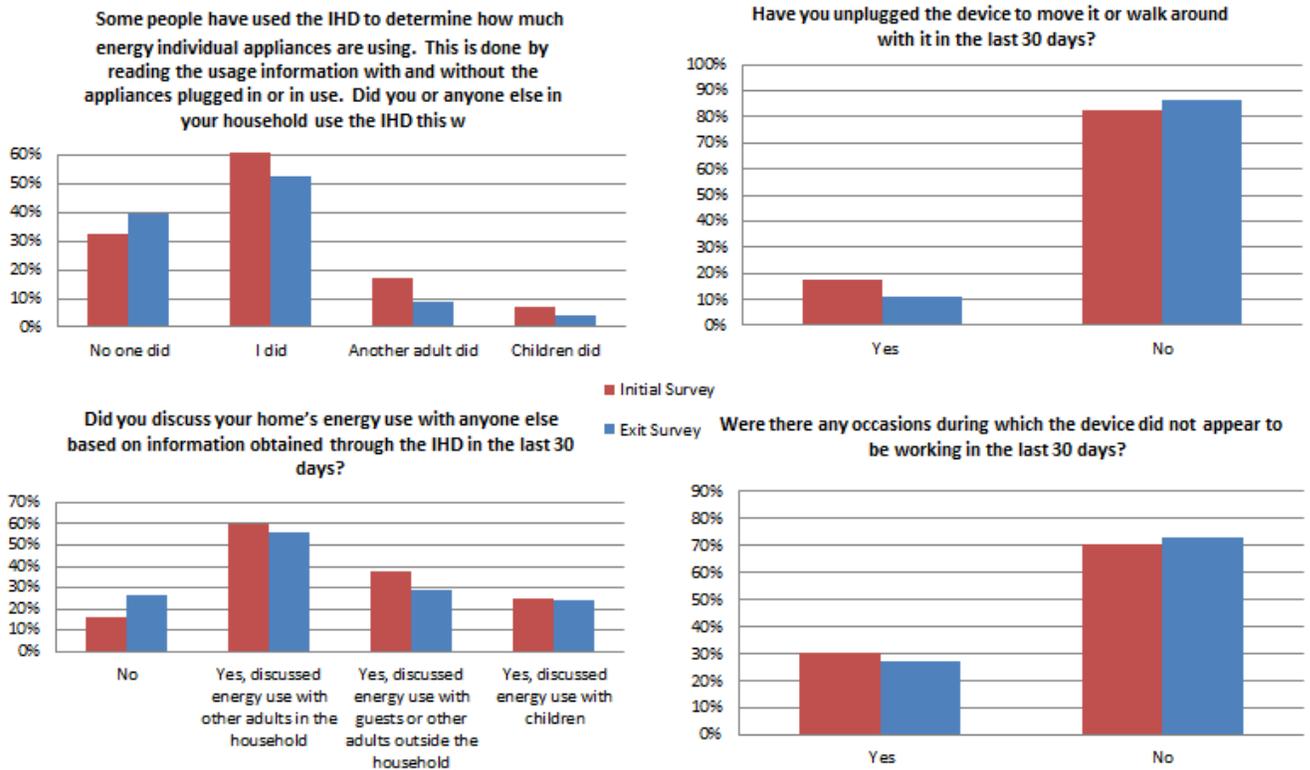
Figure 6-5 below presents the distribution of responses to the question of how much the participant would pay for the Control4 device at a retail store. The average response initially was \$21.69 but became slightly higher for the exit survey at \$22.36; however, 33 (15%) of the initial respondents and 47 exit respondents (17%) gave the IHD a retail value of \$0, indicating they would not pay for the IHD that was tested in this pilot at any price. There is not a significant difference between the perceived retail value of the tested IHD among the initial and final survey respondents.

Figure 6-5: Perceived Retail Value of the IHD



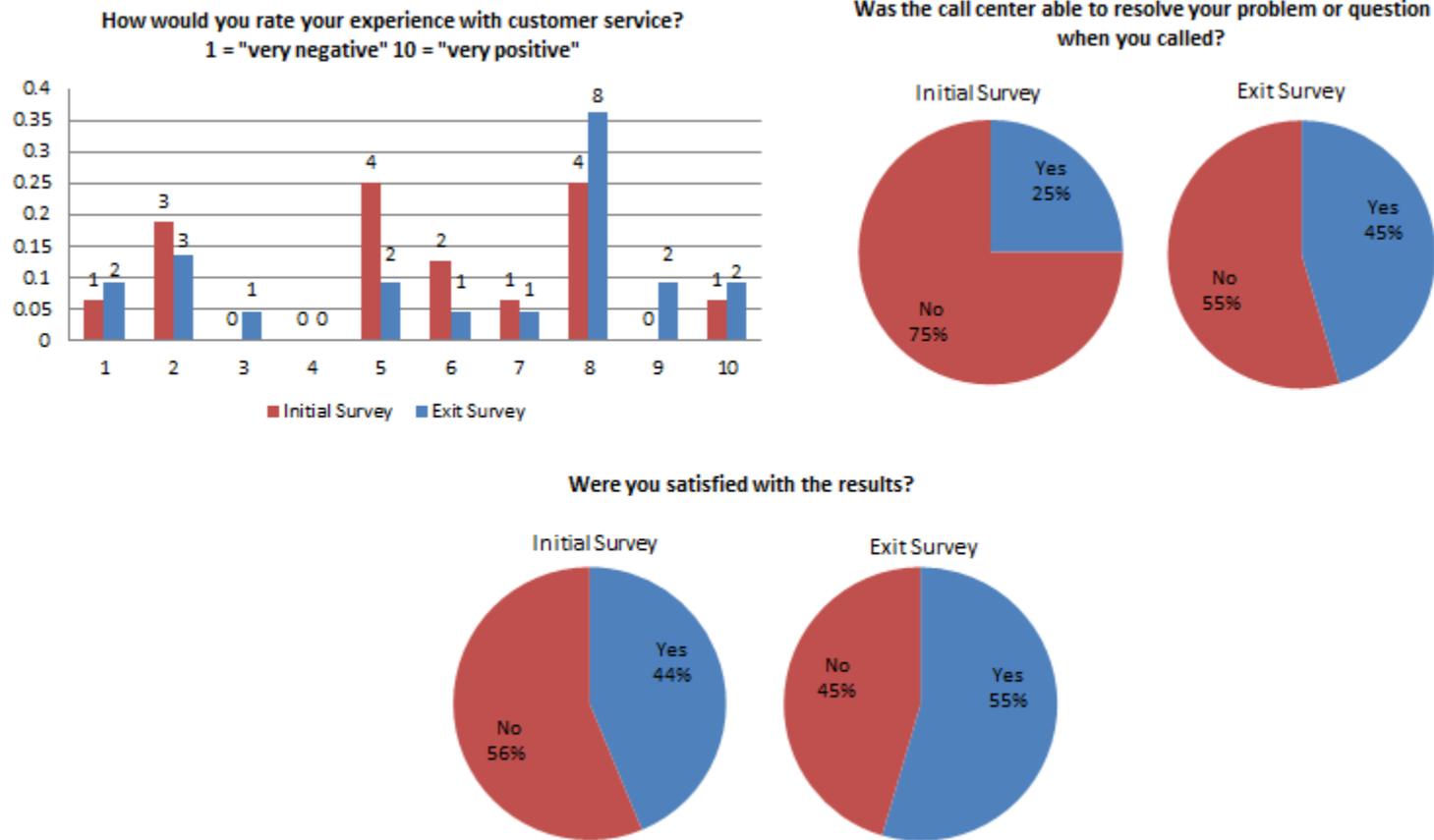
The surveys further asked pilot participants about how they’ve been using their IHD. The exit survey was specific in requesting answers to these questions only with respect to the 30 days prior to taking it. By asking for information on how participants use the IHD at the beginning of the pilot and at the end, and at the end only asking about how it is used recently, there is greater confidence in comparing these responses on a beginning-of-pilot and end-of-pilot basis. Responses to the questions about recent IHD usage are shown in Figure 6-6. The number of responses to these questions vary for the exit survey, between 234 and 218, because each question gave the participant the opportunity to state, “I stopped using or discarded the device more than 30 days ago.” The responses to these questions were very consistent across surveys. The only significant difference in responses, between the initial and final surveys, is that the percent of respondents reporting that they did not discuss their home’s energy with anyone else significantly increased ($p=0.009$) in the final survey.

Figure 6-6: Participants' Usage of the IHD in the Past 30 Days



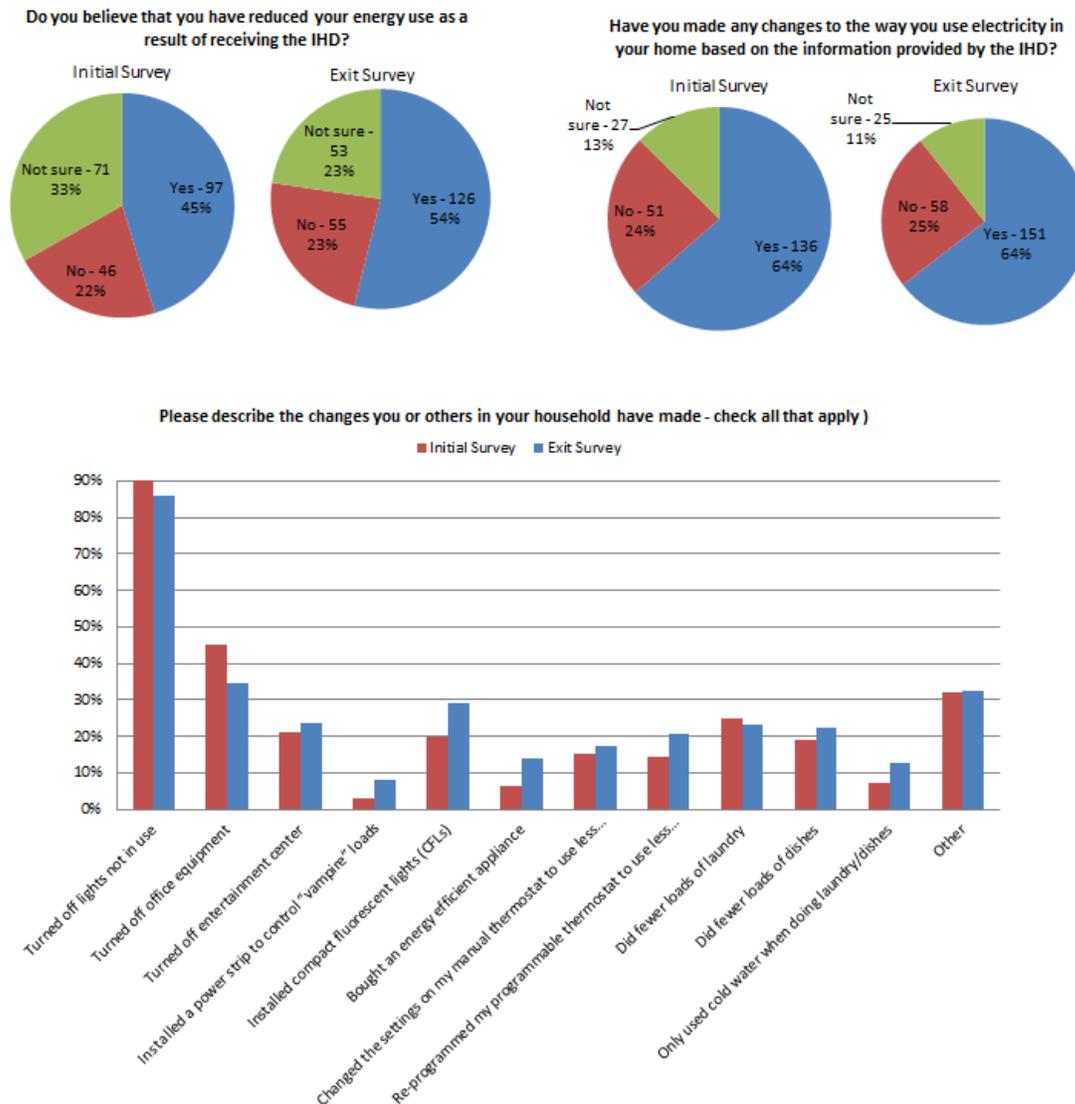
Relatively few, 16 out of 214 (7%) of the initial respondents and 22 out of 234 (9%) of the exit respondents reported contacting PG&E for IHD support. The surveys asked those customers who reported contacting PG&E for IHD support about their experience with PG&E customer service representatives. 44% of the initial survey customers who noted contacting PG&E for help with their IHD reported satisfaction with the customer service and a higher percentage, 55%, of exit customers were satisfied with the experience. Figure 6-7 summarizes results from the customer service survey questions. There were no statistically significant differences in the responses to these questions between the initial and exit surveys.

Figure 6-7: Experience with PG&E Customer Service



Both the initial and exit surveys also inquired about participants' perception of how the IHD has impacted household electricity consumption and whether the device's presence in the home has prompted specific behavioral changes or investments. Among the initial and exit survey respondents, about the same percentage of participants believed they made a change due to their IHD, but a significantly greater ($p=0.041$) percentage of the exit survey respondents believe these changes reduced their energy usage. A strong majority (64%) of both groups report the IHD has prompted changes to the way the household uses electricity with no significant difference between the two groups. When asked about specific changes the IHD has prompted in the household, these respondents widely reported turning off lighting when not in use. Other frequently reported changes include turning off home office equipment and entertainment center devices and installing compact fluorescent light bulbs. There were no significant differences in respondents' reported household changes between the initial and final surveys. The "other" category was also frequently checked. The write-in responses associated with "other" often mentioned using appliances with the largest load less frequently (hot tubs, pool pumps, microwave and conventional electric ovens, dryers, electric heaters). Figure 6-8 presents the results of these questions concerning the impact of the IHD on electric consumption behaviors in the home.

Figure 6-8: IHD-inspired Changes in the Household



In summary and review, the initial and final surveys reveal that the IHD tested in this pilot was very well received by pilot participants in addition to well-used:

- Even at the end of the pilot, 78% percent of respondents report looking at their IHD at least twice a week;
- Over 60% give the IHD a very high likeability score;
- More than 50% strongly agreed with the statement that the IHD is useful for identifying energy savings opportunities and that they would recommend it to their friends;
- At the end of the study, more than 50% of participants believed that they had reduced their energy usage as a result of using the IHD; and
- At the end of the study, more than 60% of participants believed that their household has made changes in ways that electricity is used in the home based on the information provided by the IHD.

These are strong customer experience performance benchmarks that comport with the load impact analysis showing significant monthly energy savings. The focus group findings reported later in this report also corroborate these survey results.

6.4 Individual Customer Comparison of Initial and Exit Survey Responses

In addition to examining how the overall distribution of results changed (or did not change) from the initial survey to the exit survey, it is also interesting to look for such changes on an individual customer basis. Of the 214 customers who filled out the initial survey, 169 also answered the exit survey. Many participants' answers did not change, but some did change.

When respondents reported the frequency of looking at their IHD, roughly a half (72 of 145) conveyed no change while 46% decreased their reported frequency of looking at the IHD. Of those who did not change, 77% are looking at the display more than once a day. Only 7 (5%) people reported looking at the IHD more often. Table 6-1 illustrates these changes, as well as the average number of degrees the participants' answers in that group changed.

Table 6-1: "In the past week, about how often did you look at your IHD?"

Measure	Increased	No Change	Decreased
Number	7	72	66
Percent	5%	50%	46%
Average Degree Change	1.1	0	-1.6

Both surveys also asked participants about their overall impression of the IHD, inquiring about how much they liked the Control4 IHD on a scale of 1 to 10, where 1 means they "do not like the IHD" and 10 means they "like the IHD very much." Table 6-2 shows that overall the impression went down a little. Of those 72 respondents who lowered their scores, 34 (47%) had initially given a rating of 9 or 10 while another 30 (42%) had given a 7 or 8. 30 of the 54 customers who gave the same score (56%) chose scores of 9 or 10.

**Table 6-2: What is your overall impression of your IHD?
(1 = "do not like" 10 = "like very much")**

Measure	Increased	No Change	Decreased
Number	43	54	72
Percent	25%	32%	43%
Average Degree Change	1.6	0	-1.8

The two surveys asked participants whether or not they agreed or disagreed with several statements describing how useful or easy the IHD was to use, whether the device brings to mind concerns about data privacy, and whether or not they would recommend the device to friends and neighbors. Respondents' opinions on the usefulness of the IHD have not changed very much, as seen in Table 6-3. More customers lowered their rating of the ease of use for the IHD than increased, 80 versus

44. Customers also tended to disagree more with the idea of recommending the device to friends and neighbors.

Table 6-3: Please indicate whether you agree or disagree with the following statements (1 = "strongly disagree" 10 = "strongly agree")

Question	Increase		Same	Decrease	
	N	Avg. Degree Change	N	N	Avg. Degree Change
a) Supplies information that is useful for identifying energy savings opportunities	51	2.3	62	56	-2.2
b) Is easy to navigate, read and/or understand	53	1.7	45	71	-2.5
c) Makes me worry about the privacy of my usage information	34	2.4	77	58	-2.3
d) Is something that I would recommend to my friends and neighbors	45	2.0	48	76	-2.3
e) Is easy to use	44	1.9	45	80	-2.6
f) Has made my family/household more able to control our energy use	52	2.1	42	75	-2.2
g) Has made my family/household more interested in controlling our energy use	32	1.8	63	74	-2.4

Pilot participants were also asked a series of questions regarding how they viewed certain features of the Control4 IHD that was tested in the pilot. 12 (24%) of the initial 51 customers who said they did not prefer the stand-alone energy monitor changed their answer to yes. 36 (31%) of those 118 who did prefer the stand-alone changed their minds as well. These results are summarized in Table 6-4. The columns highlighted in blue represent a change in choice. The weather function of the IHD was judged to be a generally even less important feature of the device on the exit survey. 75 (44%) people reduced their rating of the importance while only 39 (23%) people increased their rating. 55 (33%) people stayed exactly the same, with 35 (64%) of them ranking the importance at a 1.

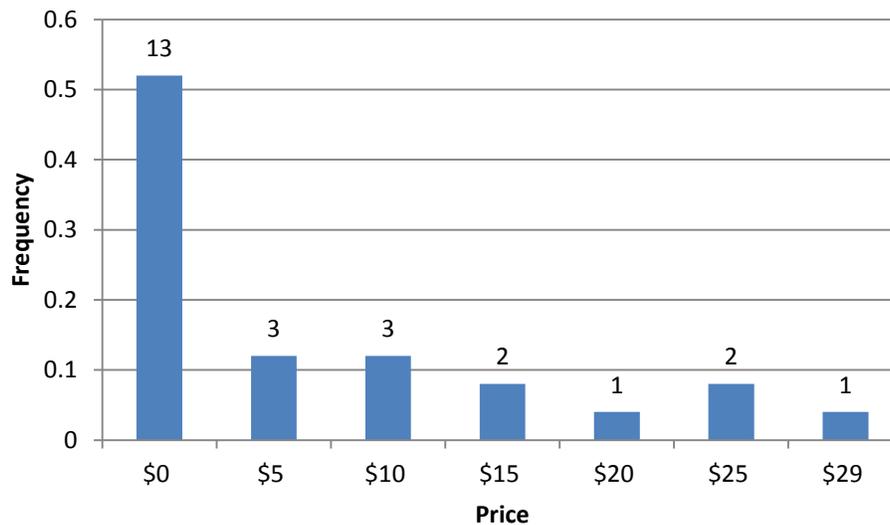
Table 6-4: "Would you prefer to see the information the IHD provides on a standalone energy monitor (such as the IHD) or through a phone app or webpage?"

Mediums	Initial Survey – Yes			Initial Survey – No		
	Total	Exit Yes	Exit No	Total	Exit Yes	Exit No
Stand-alone energy monitor	118	69%	31%	51	24%	76%
Phone app	15	60%	40%	154	12%	88%
Webpage	16	31%	69%	153	14%	86%
All of the above	38	55%	45%	131	15%	85%

Respondents were also asked how much they would pay for the Control4 device at a retail store. 57 (34%) participants reduced the amount of money they would pay an average of \$15. 50 (30%)

participants valued the device at the same price. The final 62 (37%) valued the device at a higher price, at an average of \$18 more. Figure 6-9 represents the distribution of the price respondents were willing to pay if they had initially stated \$0. Though the majority still state \$0, many have increased their opinion of the value of the device. An additional 15 customers reduced their value to \$0.

Figure 6-9: Perceived Retail Value of the IHD in Exit Survey if Initially \$0



The surveys further asked pilot participants about how they've been using the IHD in the past 30 days. There was not much change in these responses, with about an equal number of customers changing their answer to yes as to no. There were not enough customers who rated customer service on both surveys to comparatively analyze here.

Both the initial and exit surveys also inquired about participants' perception of how the IHD has impacted household electricity consumption and whether the device's presence in the home has prompted specific behavioral changes or investments. 60 (35%) of the respondents originally said they were not sure if they had reduced energy. Of those, 27 (45%) changed their answer in the exit survey to yes, they did reduce energy. 22 (37%) participants remained unsure while 11 (18%) believed they did not save energy. An additional 13 participants changed their answer to not sure. Excluding those participants, 84 (88%) customers chose the same answer while 6 (6%) customers changed their answers to yes, and an additional 6 (6%) changed to no.

The majority of customers kept the same answer when asked if they made any changes to the way they use electricity based on the IHD. 114 (67%) customers chose the same answer on both surveys. 23 (13%) participants initially stated they were unsure if they had made any changes but by the time of the exit survey, 11 (48%) changed their answer to yes, 5 (22%) changed their answer to no, and 7 (30%) remained unsure. 18 (11%) participants were unsure about changes when they filled out the exit survey.

When asked about specific changes the IHD has prompted in the household, these respondents often answered the same between the two surveys. The full results are described below in Table 6-5. The

most significant case of respondents changing their reply was in response to reprogramming their thermostat, with 72% of the original customers who said no responding with yes. The cells highlighted in blue represent a change in response.

**Table 6-5: “Please describe the changes you or others in your household have made”
(Check all that apply)**

Changes	Initial Yes			Initial No		
	Total	Exit Yes	Exit No	Total	Exit Yes	Exit No
Turned off lights not in use	80	91%	9%	6	67%	33%
Turned off office equipment	51	69%	31%	35	29%	71%
Turned off entertainment center	63	90%	10%	23	52%	48%
Installed a power strip to control vampire loads	78	100%	0%	8	75%	25%
Installed compact fluorescent lights (CFLs)	54	89%	11%	32	56%	44%
Bought an energy efficient appliance	71	97%	3%	25	44%	56%
Changed the settings on my manual thermostat to use less energy	68	88%	12%	18	39%	61%
Re-programmed my programmable thermostat to use less energy	68	88%	12%	18	72%	28%
Did fewer loads of laundry	59	86%	14%	27	37%	63%
Did fewer loads of dishes	58	91%	9%	28	54%	46%
Only used cold water when doing laundry/dishes	72	96%	4%	14	64%	36%
Other	61	79%	21%	25	36%	64%

7 Customer Focus Group Results

There are very few published accounts describing the impacts of IHDs on consumer behavior. Nevertheless, there has been no lack of speculation about how these devices might be affecting consumer behavior over the past few years. This speculation represents what might best be characterized as folk wisdom – produced by a combination of ambiguous research evidence and self-serving marketing chatter. The folk wisdom about the way consumers react to IHDs can best be summarized as follows:

- *Feedback presented through IHDs does not significantly change energy consumption* – this study presents good evidence that energy consumption was lowered by 5%;
- *They do not change energy use-related behavior* – consumers report changing a number of energy use-related behaviors including routine actions and appliance purchase decisions;
- *Consumers ignore IHDs after a short period of time* – only 14% of consumers with this device reported that their device is no longer in service after a year and nearly 80% reported that they look at it twice a week or more after six months; and
- *Consumers would rather have a portable hand-held device* – most consumers in this study said they preferred the IHD to any sort of portable device for reasons that are obvious in retrospect (i.e., the IHD is public where your iPhone is private, the IHD is always on whereas your iPhone has to be interrogated).

These findings are contradictory to the folk wisdom about the impacts of IHDs on consumers and their perceptions about them.

Survey data is of limited use for understanding exactly how consumers were using the IHDs because the answers obtained from surveys are by necessity somewhat superficial. For example, the majority of customers said they were looking at the IHD on at least a daily basis after six months of using the device. This begs several questions such as:

- What information on the IHD exactly are they looking at;
- What do they find interesting about it; and
- Are they doing anything as a result of looking at it?

These questions and other follow-on questions are essentially impossible to anticipate and incorporate into a short survey that can be administered by mail, telephone or internet. In order to fully understand how customers were using and responding to the IHD in more depth and to assess the likely response of customers to PG&E's forward going plan for supporting IHDs, FSC organized two focus groups – one with customers who said they were highly satisfied with their experience with the IHD and another group that expressed dissatisfaction. The objectives of the focus groups were to listen to and record:

- Customers' descriptions of what customers said they liked and disliked about the IHDs;
- Their current and prior levels of engagement with the device (i.e., whether they are still using it, how they are using what they are looking at, what they are doing as a result of looking at it);
- The extent to which family and friends continue to be engaged with the device;
- What customers learned from the IHD and what behavior changes came about as a result of its presence in the home; and
- The sort of HAN-related support customers expect from PG&E in the future.

Highly satisfied customers were recruited to the focus groups by inviting customers who rated the IHD as a 9 or 10 on the exit survey. Unsatisfied customers were recruited by inviting customers who rated their satisfaction with the IHD in the range of 1-6. All customers in both groups had experienced the IHD for a period of six to seven months.

The focus groups were held on the evening of June 17, 2013 at Nichols Research in Concord, California. Nine customers participated in the “satisfied” group discussions while five customers participated in the “dissatisfied” group discussions. All focus group participants live in single family homes in Moraga or Orinda. All but two participants are current or retired professionals; each focus group had one stay-at-home mom participating. Participants in each group were about evenly split between retired vs. nonretired; the number of participants with children living in the home was also evenly split. There were no participants who lived alone. One retired PG&E employee participated in the dissatisfied group discussion. The key findings of the two focus groups are summarized below.

7.1 Likes and Dislikes about the IHD

61% of customers said they were highly satisfied with the device in the exit survey. Not surprisingly, when FSC asked members of the focus group comprised of highly satisfied customers to name the things they liked and disliked about the product, most were unable to name anything about it they disliked. The chief complaints people had with the device were:

- Two customers reported they thought the display screen should be larger;
- Several expressed dissatisfaction with the fact that the device no longer displayed the prices (this complaint was raised by several customers who valued the ability of the device to display costs and prices and these were turned off at the end of the pilot a few weeks before the focus groups were held); and
- One customer said they thought the device contained too much uninteresting information or information that didn’t work (e.g., the appliance usage screens and historical screens), that the device really wasn’t very portable and that their microwave seemed to cause the device to freeze up for long periods.

On the other hand, virtually all of the consumers in the highly satisfied group named several aspects of the device they liked a lot. Almost everyone in the group said they liked the fact they could see their usage while it was occurring. They also said they liked having the ability to see how much electricity was costing in real time. They reported using these functions in a variety of ways to identify:

- How much electricity specific appliances were using;
- What it cost to operate specific appliances; and
- Whether excess usage was occurring in their home at any point in time and who was responsible for it.

In the exit survey about 13% of customers said they were dissatisfied or marginally satisfied with the product. Not surprisingly, when dissatisfied customers in the focus group were asked to name things they liked and disliked about the product these parties were able to name a number of sources of dissatisfaction. Most of the dislikes mentioned by customers centered on one or more of the following problems:

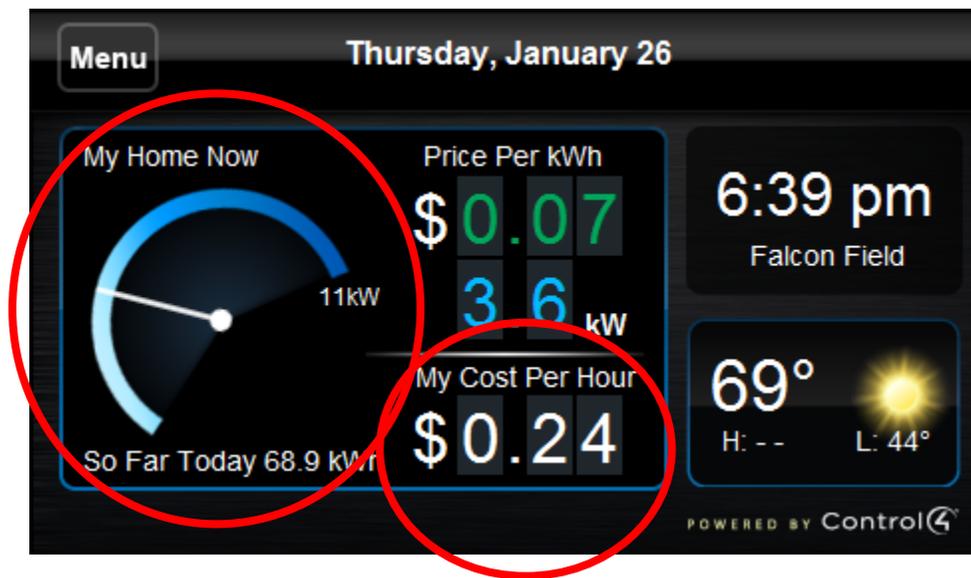
- Most of the customers in the dissatisfied group had unmet expectations regarding the information about pricing that the device would supply. In particular, they expected the device to tell them how the prices of electricity changed with the time of day – so that they could moderate their usage during high cost periods. These customers were operating under the mistaken impression that the cost of electricity varied by time of day.
- This perception was compounded by the fact that some parties viewed the pricing information that was provided (i.e., rate tiers) as useless. They said that it was interesting to know that they were going into a higher tier, but there was really nothing they could do about it, so, “So what?”
- Dissatisfied customers were seeking to use the device to identify ways of saving money. They reported that they were disappointed that the pricing information provided by the device did not supply information that was useful in that regard.
- Several of the participants mentioned technical shortcomings of the device. In particular they said the following about the device:
 - It was sluggish or slow to respond to commands;
 - They “had trouble using it” and needed better instructions;
 - They felt the date and time information was sometimes inaccurate;
 - It had an unintuitive user interface;
 - The IHD needed the password to their wireless network; and
 - The IHD displayed inaccurate weather information.

The likes mentioned by customers in the dissatisfied focus group generally paralleled those of satisfied customers. That is, they liked the delivery of real time data on their energy use; they liked knowing their costs in real time and they liked having the ability to investigate the devices that caused their electricity consumption.

7.2 How Customers Use the IHD

The Control4 device is capable of displaying electricity consumption information in a wide variety of visually attractive formats including the real time display of electricity consumption, historical displays of energy consumption, electricity consumption by end use and weather. In all, the device can display 13 different view screens. Consumers in the study reported that they concentrated almost all of their attention on the Home screen depicted in Figure 7-1 and within the Home screen they concentrated their attention on the My Home Now (the speedometer) and the My Cost per Hour quantity. It should be noted that the popular “speedometer” visualization is one among a number of in-home device display options that, until now, have not been subject to piloting and evaluation. Participants said they spent about 95% of their time looking at the Home screen when viewing the device.

Figure 7-1: Control4 Home Screen



Most of the respondents (satisfied and dissatisfied) described experiments they did in their homes using the device to discover how much electricity particular appliances were using. However, dissatisfied customers said they thought the device should be able to display end-use loads without having to experiment with them. Several customers reported that they attempted to systematically identify their baseline energy use (i.e., by observing usage when all major loads were off) and then observed how much incremental load the various appliances in their home produced when they turned them on. Those who did this were able to accurately describe the loads of their appliances and say how those loads differed by time of day and day of week. They also were able to identify the presence of baseline loads like refrigeration and vampire loads and to at least start thinking about eliminating the latter. Most customers used the device to discover and learn how the things in their home used energy.

7.3 Family and Friends Engaging With the IHD

Most consumers in both groups also reported that they located their IHDs in common areas – mostly in kitchens or living rooms – where members of the household could easily see how much energy they were using. A few located their devices in home offices. They reported that the device was a subject of conversation among household members on occasions when power consumption increased dramatically or was higher than the bill payer thought it should be. Some of the focus group members reported that the device was capable of causing friction between family members who disagreed about the importance of saving energy or lowering energy costs. One respondent even reported that they disconnected the device because it caused such severe arguments between him and his spouse about energy consumption. However, because of, or perhaps in spite of the discord that sometimes resulted from the operation of the device, most focus group participants from both the satisfied and dissatisfied groups reported that the device continued to be in operation at the time of the focus groups (30 days after the close of the pilot) and that they continued to monitor them at least daily and sometimes much more often. It is hard to escape the conclusion that the IHDs that were supplied to the customers in the study had been fully integrated into the lives of the households to which they were provided and that they were providing valuable information to customers.

7.4 Behavior Changes and Education Brought About by the IHD

Focus groups participants displayed a surprisingly accurate understanding of how much energy the appliances in their home used. Most could more or less accurately describe the loads of typical household appliances (e.g., dishwashers, clothes dryers, pool pumps, microwaves) and one respondent even accurately described a residential load shape commenting that they were surprised to learn from their IHD that their household electric load peaked in the evening between 6–10 PM rather than in the afternoon. So, it is clear that most of the parties in the focus groups (representing most of the consumers in the pilot) were highly engaged with their IHDs and used them to learn a lot about how their home used energy. But did the information from the IHD cause them to behave differently?

Most of the people in the highly satisfied group reported that they made changes to the ways they used electricity in their homes as a result of what they learned from their IHDs. They reported turning off unnecessary loads like lighting or appliances not in use and installing more energy efficient lighting where possible. Some parties reported using the device's real time display to identify when their usage was higher than they thought it should be for a given time of day (e.g., bedtime) and going around and shutting down loads until they reached their desired baseline. In addition, several of the customers in this group identified appliances they thought were using large amounts of electricity and discontinued their use. For example, two customers in the group reported that they stopped using their clothes dryer and instead dried their clothes on racks. Two others indicated that they discontinued using radiant electric floor heaters. This topic was not dealt with in any depth in the dissatisfied group, so it is difficult to say with confidence how these customers used the information they obtained from the IHDs.

It is worth noting that there were unintended consequences of presenting the pricing information on the IHDs. Several respondents stated that they learned that the price of electricity did not vary by time of day by observing the price changes on their IHDs. While customers on the whole valued the information they received about the price and cost of electricity greatly, discovering that prices did not vary by time of day produced two unintended results. First, it caused some customers to be confused and frustrated by the actual tiered pricing structure. They could not understand how to schedule their electricity consumption in relation to pricing tiers so as to save money and were thus irritated by the information they received. One customer even concluded that they should be using most of their electricity early in the month because that is when it is less expensive. Another unintended consequence of presenting the prices of electricity is that parties who reported that they previously did laundry and other discretionary actions off peak to save money stated that they stopped worrying about the time of day during which they used electricity. Several recent surveys have identified the popular misconception that electricity prices vary by time of day. It seems that providing accurate information about the price of electricity on the IHDs corrected this misconception for several of the customers in the focus groups and probably had the unintended consequence of increasing their on-peak usage. It is probable that any action that corrects this misconception will lead to some growth in on-peak electricity consumption.

7.5 Expectations for the Future of HAN

Customers were asked about several forward-looking issues. In particular, they were asked to indicate their reaction to PG&E's forward-looking policy toward IHD deployment which is essential to provide the metering infrastructure and support required to allow customers to take advantage of capabilities of SmartMeters™ to support HAN functionality, but that it was not going to provide such equipment to customers or assist them in installing and operating it. Customers who expressed an opinion on this fell into two camps:

- Most said they supported PG&E's policy because it was consistent with the way telecommunications services were supplied and because they did not want to have to pay for services that others might demand in support of HAN installations that they did not desire;
- One person – a former PG&E employee who was quite knowledgeable about regulatory affairs – said he thought that this device had the capability to cause consumers to significantly lower their energy use and he could see a reasonable basis for incorporating payment for these devices into the public service charge – just like any other energy efficiency program.

Ultimately, customers were agnostic about whether PG&E should support the development of these devices as long as they did not have to pay for what they did not want.

For about the past 24 months the industry has been moving away from standalone IHD devices in the direction of information supplied through devices on smart phone devices. A surprise finding from the exit survey was that customers stated that they preferred the standalone IHD to a smart phone app. Customers were asked during the focus group discussions whether they preferred something that displayed information on their computer, a smart phone app or on their TV, and if they preferred the stand alone IHD, why. With few exceptions, customers in the focus groups said they preferred the stand alone IHD. They offered several reasons. First, they said, the IHD is public for everyone in the household to see and discuss. This facilitates problem definition and problem solving. Next, they said that they like to use it as a surveillance mechanism and if they have to start an app to see the information they are seeking it is inconvenient. Finally, it is a conversation piece that home occupants and visitors find interesting. Several of the participants indicated that they liked the fact that the device was open and visible to household members and neighbors because it stimulated interesting conversations about energy use.

Appendix A Customer-facing Materials

This appendix contains customer-facing marketing materials.

A.1 HAN Deployment Letter



September 4, 2012

Dear James Smith:

This month, Pacific Gas and Electric Company is launching an exciting Home Area Network (HAN) trial, enabling participating customers to view near real-time electricity usage information from their SmartMeter™ on an In-home Display. The information provided on the HAN display can help you to better understand energy savings opportunities in your home, gain more control over your electricity usage, and help you to better manage your monthly electricity costs. PG&E is pleased to invite you to join this new trial program.

When you join, you will receive an In-home Display (pictured below) at no cost to you. This device, which will be professionally installed by a qualified technician and supported by PG&E's technical personnel, will:



- ✓ Help you identify times when your energy usage spikes so you can take action to lower your monthly electric costs
- ✓ Provide near real-time and cumulative electric consumption in kilowatts (kW) and kilowatt-hours (kWh)
- ✓ Make it easier to understand and adjust your electric usage patterns
- ✓ Shows your home's electric cost in dollars and cents
- ✓ Indicates when you have moved into a higher-priced electric tier, which impacts your bill

By signing up, you will be part of a small, limited duration initial trial that runs through April 30, 2013. Your participation and feedback about your experiences will help shape the future of this program for other PG&E customers in 2013. We are limiting the number of participants in this initial trial – qualified participants will be scheduled on a first come-first serve basis.

During the initial trial, PG&E will fully support you with any issues you may encounter with your device. Afterwards, the device is yours to keep, or you may choose to return it to PG&E; however, PG&E will not troubleshoot or address issues with the device after April 30th.

In the next few days, you will be contacted by one of PG&E's agents, Population Research Systems (PRS). During that call, PRS will explain more about the requirements for participation in this program, as well as the benefits of the HAN program. If you qualify, and are interested in participating, they can schedule an appointment to install the In-home Display. To learn more, please visit www.pge.com/HAN, or to inquire about participation, call PRS at 1-877-932-0614. Your reference ID is XXXXXXX.

Sincerely,

Steve Malnight
Vice President, Customer Energy Solutions

A.2 HAN Welcome Letter



Thank you for participating in Pacific Gas and Electric Company's Home Area Network (HAN) Program

Dear Valued PG&E Customer:

Welcome to PG&E's Home Area Network (HAN) Program. We are excited to provide you with a great new technology that will work with your SmartMeter™ to help you monitor your electricity usage in near real-time. With the HAN In-home Display you will see:

- The price you're paying for electricity and how that changes throughout the month
- The amount of electricity you're using at the moment; month to date; and what that's costing you in dollars and cents
- The temperature outside—if your home has a Wi-Fi connection

By participating in the HAN Program, you'll be able to:

- Determine your home's typical electricity consumption to find opportunities for adjusting your usage and avoid paying higher electricity rates
- See the difference in electricity consumption when all your lights are on and when they're off—a great reminder to turn off unneeded lights
- Observe how electricity use spikes when your washing machine is on—another reminder of how washing with full loads saves energy

These tools offer you a great way to monitor your electricity usage and be even more aware of ways to lower that usage and potentially reduce your bill.

What you'll find in this kit:

- A guide to how to use your HAN In-home Display. The guide will show you step by step what information you will have at your fingertips. (Please note that all the device functions enabled by the manufacturer are not available for this program.)
- Information about your recent billing cycle changes and an explanation of tiered pricing
- Frequently asked questions about the HAN Program and information provided on your In-home Display

And remember, during the coming months, you will be contacted twice via email or phone to participate in surveys about your experiences with the HAN Program and your In-home Display.

If you have any questions regarding the HAN Program, please call [1-877-743-4357](tel:1-877-743-4357), Monday–Friday, 7 am–7:30 pm and Saturday, 7 am–4:30 pm. Or email HelpingHAN@pge.com. For general PG&E questions, call [1-800-743-5000](tel:1-800-743-5000).

Thank you for participating in PG&E's Home Area Network (HAN) Program.

A.3 HAN Welcome Kit

Home Area Network (HAN) Program

The next step in improving your home energy management



Thank you for participating in
Pacific Gas and Electric Company's
Home Area Network (HAN) Program

Dear Valued PG&E Customer:

Welcome to PG&E's Home Area Network (HAN) Program. We are excited to provide you with a great new technology that will work with your SmartMeter™ to help you monitor your electricity usage in near real-time. With the HAN In-home Display you will see:

- The price you're paying for electricity and how that changes throughout the month
- The amount of electricity you're using at the moment, month to date, and what that's costing you in dollars and cents
- The weather outside—if your home has a Wi-Fi connection

By participating in the HAN program, you'll be able to:

- Determine your home's baseline energy consumption to find opportunities for adjusting your usage and avoid paying higher electricity rates
- See the difference in energy consumption when all your lights are on and when they're off—a great reminder to turn off unneeded lights
- Observe how energy use spikes when your washing machine is on—another reminder how washing with full loads saves energy

These tools offer you a great way to monitor your energy usage and be even more aware of ways to lower that usage and potentially reduce your bill.

What you'll find in this kit

- A guide to each of the screens that you can interact with on your device. This will show you step by step what information you will have at your fingertips. (Please note that all the device functions enabled by the manufacturer are not available for this program.)
- Information about your recent billing changes and an explanation of tiered pricing
- Frequently asked questions about the HAN Program and information provided on your In-home Display

And remember, during the coming months, you will be contacted twice via email or phone to participate in surveys regarding your experiences with the HAN program and your In-home Display.

If you have any questions regarding the HAN Program, please call [1-877-743-4357](tel:1-877-743-4357), Monday–Friday, 7:00 am–7:30 pm and Saturday, 7:00 am–4:30 pm. Or email HelpingHAN@pge.com. For general PG&E questions, call [1-800-743-5000](tel:1-800-743-5000).

Thank you for your participation in PG&E's Home Area Network (HAN) Program.



Your rates with the Home Area Network (HAN) Program

Understanding pricing to control energy use and expense

Your SmartMeter™ is the key

Now, it's easy to see how much electricity you're using in near real-time thanks to your Smart Meter™ and new In-home Display device. These



Home Area Network (HAN) Functions

How your device helps you monitor energy usage

Here's what you need to know to understand your energy consumption, make better decisions about your usage and help save money.





Thank you for participating in Pacific Gas and Electric Company's Home Area Network (HAN) Program

Dear Valued PG&E Customer:

Welcome to PG&E's Home Area Network (HAN) Program. We are excited to provide you with a great new technology that will work with your SmartMeter™ to help you monitor your electricity usage in near real-time. With the HAN In-home Display you will see:

- The price you're paying for electricity and how that changes throughout the month
- The amount of electricity you're using at the moment, month to date, and what that's costing you in dollars and cents
- The weather outside—if your home has a Wi-Fi connection

By participating in the HAN program, you'll be able to:

- Determine your home's baseline energy consumption to find opportunities for adjusting your usage and avoid paying higher electricity rates
- See the difference in energy consumption when all your lights are on and when they're off—a great reminder to turn off unneeded lights
- Observe how energy use spikes when your washing machine is on—another reminder how washing with full loads saves energy

These tools offer you a great way to monitor your energy usage and be even more aware of ways to lower that usage and potentially reduce your bill.

What you'll find in this kit:

- A guide to each of the screens that you can interact with on your device. This will show you step by step what information you will have at your fingertips. (Please note that all the device functions enabled by the manufacturer are not available for this program.)
- Information about your recent billing changes and an explanation of tiered pricing
- Frequently asked questions about the HAN Program and information provided on your In-home Display

And remember, during the coming months, you will be contacted twice via email or phone to participate in surveys regarding your experiences with the HAN program and your In-home Display.

If you have any questions regarding the HAN Program, please call **1-877-743-4357**, Monday–Friday, 7:00 am–7:30 pm and Saturday, 7:00 am–4:30 pm. Or email HelpingHAN@pge.com. For general PG&E questions, call **1-800-743-5000**.

Thank you for your participation in PG&E's Home Area Network (HAN) Program.



A.4 HAN Visual Insert

How it works

How your HAN device helps you monitor electricity use



Now you can make better energy-management decisions

Your Home Area Network (HAN) In-home Display, enabled by PG&E's SmartMeter™ technology, offers you a near real-time look at your home's electricity consumption. By staying up to date, you can decide when you need to turn off lights and devices to control and reduce your electricity use, and potentially lower your electricity bill.

Important reminders

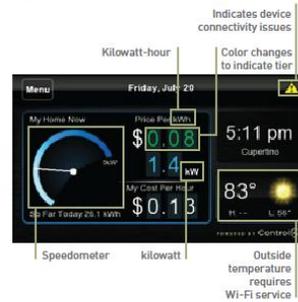
As part of the Home Area Network (HAN) Program, your PG&E SmartMeter™ provides information about your near real-time electricity usage, consumption and price. The In-home Display device manufacturer takes this information and compiles an aggregate view. This includes ongoing electricity costs (\$) and usage in kilowatt hours (kWh). The device also performs analysis of some appliances' electricity use (Electricity Use by Device). The information in this booklet is a guide to the main interfaces on your In-home Display, which will show trends in your electricity usage. However, there are some limitations.

- Your In-home Display shows only the price of electricity-use charges based on available interval data from your SmartMeter™. The price does not include gas charges, taxes, discounts, surcharges and/or fees. As a result, the price shown on your device **will not** reflect all the charges on your bill.
- The estimated consumption and cost by device displayed on the *Electricity Use by Device* screen were provided by the device manufacturer. They are estimates for a "typical" home based on the information you provided the device during the installation process. Your actual electricity consumption and cost by device may vary. PG&E's SmartMeter™ does not track your usage by device.
- Pricing and electricity usage data displayed here are for informational purposes only.

Use your HAN device to see your power now.

Home Screen

Check your electricity price per kilowatt-hour (kWh) and the number of kilowatts (kW) you are using. This will give you your per-hour electricity cost based on what is turned on in your house at that moment. You'll also see how many kWh you've used since midnight. The speedometer shows you how many kW you are using compared to your maximum 30-day value so you can gauge your electricity use at a glance.



Main Menu

Go to the *Main Menu* to get an overview of your options. Select *My Energy* to access all of your In-home Display's graphing options (information gathered over time and how it is trending). You'll also find *Messages* that PG&E may occasionally send you, and you can adjust the settings on your device. Note that you will be able to access the outside *Weather* only if Wi-Fi service is enabled.

My Energy

Access from Main Menu

Follow the graph to track your electricity use through the day and determine when it spikes—usually when more people are home, more lights are on and more appliances are in use.



Electricity Use and Costs: Daily

Access from My Energy

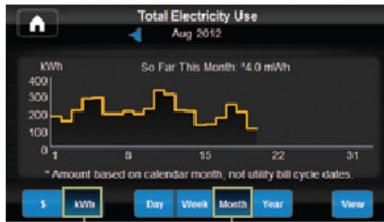
Check your usage and costs for electricity hour by hour during the calendar day. You'll see how your usage and costs trend up or down so you can better determine at what times of the day you can lower your electricity use.

Electricity Use: Weekly

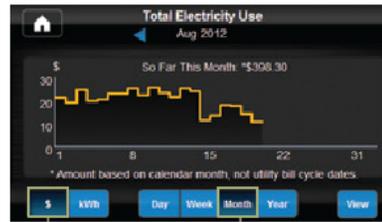
Access from My Energy

Review your electricity use for the past seven days. Emerging patterns of electricity usage may help you use less and lower your costs.





Select these to check monthly or yearly electricity use



Select these to check approximate monthly or yearly electricity costs

Electricity Use and Costs: Monthly/Yearly

Access from My Energy

Check your electricity usage and costs by the day, week, month or year. You can switch between the screens to see how your usage and costs trend up or down by each unit of time. You can also compare these estimates with previous units of time. This allows you to track patterns and recognize opportunities to use less electricity and lower your costs.

Electricity Use By Device

Access from My Energy

See an approximation of how much electricity appliances use based on an algorithm provided by the device manufacturer. Please note, this information is an approximation for a home like yours based on the information you provided at the time of installation. It should not be considered an exact reading for the appliances in your home. PG&E does not track your usage by appliance.



For more information:

HAN Program
1-877-743-4357

Monday-Friday, 7 am-7:30 pm
Saturday, 7 am-4:30 pm

HelpingHAN@pge.com
www.pge.com/HAN

General PG&E questions
1-800-743-5000

A.5 Electric Rates Insert

See your electric rates with the Home Area Network Program Understanding pricing to control electricity use and cost

Your SmartMeter™ is the key

Now it's easy to see how much electricity you're using in near real-time thanks to your Smart Meter™ and new In-home Display device. These technologies, working together, enable you to determine how to best manage your consumption and help reduce your electricity bills. To make the Home Area Network (HAN) Program possible, we've made a few changes to your billing and we're offering some tips on how to calculate your actual electricity expenses.



Your billing cycle will now start on the first of the month

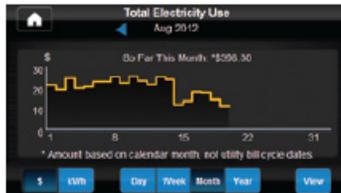
Your electric billing period has been moved to a calendar cycle, which means you'll be billed on the first of each month. Your bill due date will be around the 20th of each month. Next month, depending on when your last bill was due, you'll see either a "short" bill for less than a month's electricity use or a "long" bill for more than a month's use. Also, your bill will show your total electricity usage instead of meter reads. Please note, moving forward your gas and electric charges will still be delivered to you in one monthly statement, however the gas bill read and your electric bill read dates may be different.



Home Screen

You'll see approximate electricity costs in near real-time

Your device's Home Screen will display electricity costs by kilowatt-hour (kWh) in near real-time. As the month progresses, your cost per kWh may increase depending on your electricity usage because of tiered pricing (see other side for details). You'll be alerted that you've moved to the next tier when the color of your displayed price changes. However, the price displayed on any screen—regardless of tier—is for electricity charges only. Posted costs do not take into account gas charges, taxes, discounts, surcharges and other fees, which will appear on your bill.



Total Electricity Use screen with So Far This Month total displayed

The So Far This Month total should accurately reflect your electricity charges less taxes and fees.

Your HAN device can give you the ability to monitor your homes electricity use which can give you insights that will enable you to find ways to use less and save on your bill.



Tiered rates

Helping conserve electricity, lower bills and help the environment

California requires investor-owned utilities like PG&E to charge a higher price per unit as a customer uses more electricity during a billing period. This is done through a tiered rate structure that was designed to discourage higher electricity use and reward conservation.

The electricity you use every month is divided up into five tiers, or usage levels. As you use electricity throughout the month, you move up from one tier to the next, and the price you get charged per unit of electricity goes up in each tier.

You start off each month at Tier 1, which is your baseline quantity. This is an assigned usage level that takes into account the climate where you live, the current season and your heat source. While you're in Tier 1, your usage gets billed at the lowest rate.

Once you've used the amount of electricity allotted for Tier 1 (your baseline quantity), you move up to Tier 2. After you reach the maximum in Tier 2, you move up to Tier 3 and so on, up to Tiers 4 and 5. Tiers 1 and 2 are billed at the lowest rates, but electricity used beyond these tiers is billed at increasingly higher levels. If you can keep your electricity use in the lower tiers, you can lower your overall bill. For example, if you have an electric dryer, it could cost you more than three times as much to dry the same load of laundry when you've reached Tiers 4 and 5 than it did at Tier 1.



Why PG&E wants its customers to use less energy

Energy conservation helps make our energy grid more reliable in California and helps our customers save on their energy bills.

PG&E does not earn higher profits by selling more energy, which makes PG&E and other investor-owned utilities in California distinctly different from most other companies that make profits by selling more of a given commodity. One way PG&E makes money is through incentives earned by achieving energy efficiency goals set by our regulator, the California Public Utilities Commission.

When our customers conserve energy it's good for them and California. Learn more at www.pge.com/rates

A.6 HAN Frequently Asked Questions

Home Area Network Program FAQs

Helping you make the most of saving electricity

Following, you'll find some of the most frequently asked questions (FAQs) customers have asked PG&E about the Home Area Network (HAN) Program. The answers will help you make the most of your program participation. For a more detailed list of FAQs, visit www.pge.com/HAN.

Why do I need a SmartMeter™ to use my Home Area Network In-home Display?

Your SmartMeter™ plays a critical role by gathering your electricity use and pricing information, and then sending it via radio signal to your In-home Display. Your installed device depends on that information to show you how much electricity you're using and at what cost.

Am I seeing up-to-the-minute electricity consumption on my display?

The information you see is "near real-time." There's a 15- to 20-second delay in communicating your actual electricity use to your In-home Display. The difference is very small and won't affect how you control your electricity use.

Is my bill guaranteed to go down because of my participation with the HAN Program?

Participation in the HAN program offers a tool to help you understand and monitor your electricity usage but does not guarantee that you will experience lower bills. Lowering your energy bill depends on the behavior changes you and your household take to save on energy.

My In-home Display screen isn't showing me usage or pricing information at the moment. What's happening?

Occasionally, a device will lose connectivity to the meter. The device will attempt to reconnect for 15 minutes but until it reconnects, the price will be displayed as \$0 and current consumption as 0 kWh. If the connection is reestablished, you will see your electricity consumption information as you normally do. If, after 15 minutes, the device is unable to reconnect, you will see an *Unable to Connect* message. Click OK to acknowledge the message. Please try the following activities before calling for technical assistance:

- If the device screen is blank, ensure that the device is plugged in or check that the device's screen saver is not enabled by going to *Main Menu* → *Select Settings* → *Select Display* to adjust the screen saver settings.
- If the device is on but the home screen has no data, and the device has been moved from where it was originally installed, move the device back to its original location. If that does not help, try moving the device to a location closer to the meter. The device will attempt to reconnect to the meter automatically.

If your problem persists, call PG&E for technical assistance at **1-877-743-4357** Monday–Friday, 7 am–7:30 pm and Saturday, 7 am–4:30 pm.

What should I do if my In-home Display screen freezes?

If your In-home Display screen freezes, please try replacing the batteries. This can be done following this sequence:

1. **Unplug EC-100 from outlet**
2. **Take the two screws out of the bottom of EC-100**
3. **Remove batteries**
4. **Replace batteries**
5. **Plug EC-100 into outlet**

If your problem persists, call PG&E for technical assistance at **1-877-743-4357** Monday–Friday, 7 am–7:30 pm and Saturday, 7 am–4:30 pm.

Does any loss of connectivity affect the pricing information I'll be receiving?

When the connection is reestablished, you'll see the most accurate price of the kWh displayed. However, if you're looking at the running total for the month the assumption made by the device about the price of electricity may be inaccurate for the time the device was disconnected.



Why isn't my pricing aligned with what I see in My Energy on pge.com or on my bill?

The price displayed only captures the actual cost of electricity at that moment. Keep in mind that the price displayed is only for electricity use. It does not take into account your gas charges, taxes, fees or other surcharges that are factored into your monthly bill.

Can PG&E see my individual appliance- or device-level information when I set up or use my display device?

No, we do not obtain information about your individual appliance usage. PG&E's SmartMeter™ only provides information about your entire home-electricity demand and consumption. The information provided on the "Use by Device" screen is based on a typical home like yours using an algorithm provided by the device manufacturer. It is only an approximation based on the information you provided at the time of installation and should not be considered an exact reading for the appliances in your home.

What's the difference between a kilowatt (kW) and a kilowatt-hour (kWh)?

A kW is a unit of power—in other words, the rate at which energy is used or generated. A kWh is a unit of energy equivalent to 1,000 watt hours, and it's a common unit of measure utilities use for billing electric energy.

As an analogy, if you were to fill a bucket with water from a hose, the rate at which the water flows from the hose into the bucket would represent a kW (power), while the total amount of water in the bucket when finished would represent the kWh (energy).

To estimate how much energy an appliance uses each day—and what that appliance may cost to operate each month—follow these simple steps:

- Find the appliance's rated wattage (as listed on its nameplate) and then divide that number by 1,000 to calculate the kW.
- Multiply the kW by the estimated number of hours per day the appliance operates to get kWh per day.
- To estimate monthly usage, multiply the daily kWh by the number of days in the month.
- To estimate the monthly cost of operating an appliance, multiply the "monthly" kWh usage by the average rate you pay (see last month's bill to determine this).

Can I add additional Control4 devices to my In-home Display?

Not at this time, but the device manufacturer may enable this functionality in future In-home Displays.

I've been told that my device may not work after April 30, 2013. Why is that?

April 30, 2013, marks the official end of this first phase of the HAN Program. After that, PG&E may upgrade its systems to support newer generations of In-home Display technologies which may affect the functionality of your In-home Display. The device is yours to keep or you may choose to return it to PG&E, however PG&E will not troubleshoot or replace device specific issues after April 30th. We'll let you know before these upgrades take place.

What will happen to my personal information on the device if I recycle it at the end of the program?

To erase your personal data information from the device you should follow this sequence:

1. Go to **Menu**
2. Select the **Settings** option
3. Push the **Reset** button called **Clear Data**

This will erase the Wi-Fi and all personal data but it won't clear all persistent data for electricity use—your five-year history.

Someone I know would like to participate in the HAN Program. How can they sign up and get their In-home Display?

Participation in the HAN Program is currently limited to certain areas in PG&E's territory. That's why you were invited to join. After this first stage of the program is complete, PG&E will introduce it to our entire service territory.

Is the In-home Display device certified by the Federal Communications Commission (FCC)?

Yes. This equipment has been tested and found to comply with the limits for a Class B and Class C digital device, pursuant to Part 15 of the FCC Rules. For more information about device certification, please see the Regulatory Compliance section of the **EC-100 Energy Controller Setup Guide**.

Whom can I contact with questions about my device?

- For specific HAN-related questions, call **1-877-743-4357** Monday–Friday, 7:00 am–7:30 pm and Saturday, 7:00 am–4:30 pm. Or email HelpingHAN@pge.com.
- For general PG&E questions, call **1-800-743-5000**.

Appendix B Regression Specifications

Panel regression of average daily usage:

$$DailyLoad_{i,t} = a + b \cdot treatment_i \cdot period_t + \sum_{t=1}^N d_t \cdot date_t + \sum_{i=1}^M e_i + \varepsilon_{i,t}$$

Variable	Description
$DailyLoad_{i,t}$	Total daily kWh per customer
a	Estimated constant
b	Estimated parameter coefficient
$treatment_i$	Dummy variable indicating treatment group individuals
$period_t$	Dummy variable indicating the post-treatment period. Value is missing for days during treatment
d_t	Estimated parameter coefficient
$date_t$	Dummy variable for each date
N	The number of days included in the analysis dataset (9/1/2011-4/30/2013)
e_i	Fixed effects for each customer
M	The number of customers included in the analysis dataset (347 in Control, 347 in Treatment)
$\varepsilon_{i,t}$	The error term, assumed to be a mean zero and uncorrelated with any of the independent variables

ARIMA regression of percent difference between treatment and control daily loads, modeling an AR(1) error process:

$$Percent\ Difference_t = a + b \cdot period_t + \varepsilon_t$$

Variable	Description
$Percent\ Difference_t$	Percent difference between control and treatment daily loads.
a	Estimated constant
b	Estimated parameter coefficient
$period_t$	Dummy variable indicating the post-treatment period. Value is missing for days during treatment
ε_t	The error term, assumed to be a mean zero and uncorrelated with any of the independent variables

ARIMA regression of percent difference between treatment and control daily loads with explanatory variables, modeling an AR(1) error process:

$$\text{Percent Difference}_t = a + b \cdot \text{period}_t + \sum_{i=1}^{12} c_i \cdot \text{month}_i + \sum_{j=1}^7 d_j \cdot \text{day of week}_j + \varepsilon_t$$

Variable	Description
<i>Percent Difference</i> _t	Percent difference between control and treatment daily loads.
<i>a</i>	Estimated constant
<i>b</i>	Estimated parameter coefficient
<i>period</i> _t	Dummy variable indicating the post-treatment period. Value is missing for days during treatment.
<i>c</i> _i	Estimated parameter coefficient
<i>month</i> _i	Dummy variable for each month in the year
<i>d</i> _j	Estimated parameter coefficient
<i>day of week</i> _j	Dummy variable for each day of the week
<i>ε</i> _t	The error term, assumed to be a mean zero and uncorrelated with any of the independent variables

Appendix C List of Contract Center & Customer Service Operations Improvements

Since the focus group was held with Contact Center Operations (CCO) and Customer Service Offices (CSO) staff in July, a number of HAN program process improvements have been implemented to address the concerns and issues raised about customer service.

A selected list of CCO and CSO improvements pertaining to the HAN program follows, in addition to their implementation dates, all of which occurred in 2013.

C.1 Process Documentation and Access to Protocols

Revamped and updated HAN GenRef documentation, implemented July 8 through September 1, creating all HAN processes as its own specialty team with a variety of new articles, covering:

- Customer eligibility;
- Validated devices: including links to vendor websites with general device-specific information and troubleshooting tips;
- Glossary of terms;
- Troubleshooting steps;
- Pairing a device process;
- Un-pairing a device process; and
- HCM (Silver Spring) access: link & access instructions.

HAN weekly email communication, implemented July 29: Established an ongoing weekly email communication to CCO and CSO to advise agents of current program developments and to provide important program reminders.

HAN customer contact documentation, implemented July 16: Formalized customer notes on accounts and created templates for agents to use (to ensure consistency of notes left on customer accounts). This has improved communications between both groups handling different parts of the process and has ensured that proper notes were left on customer accounts during multiple hand-off points between various departments. A glossary of terms explaining internal and industry terminology has been documented and provided to representatives in their knowledge base, GenRef. Extensive troubleshooting steps and options have been documented and published in GenRef, to empower representatives to provide escalated support.

HAN device loaner program, implemented June 27: Loaned devices to Fresno Contact Center & CSO HAN agents for 6 weeks, then loaned devices to the Sacramento Contact Center HAN agents after transition of support from Fresno to Sacramento. The loaner program provides hands-on customer experience to agents and is ongoing.

Reporting, implemented July 1: Established more than seven daily and weekly automated reports to provide customer service metrics on call & email service levels and support.

Customer Service, implemented July 23 through August 2: Transitioned customer service support from Fresno to Sacramento (increasing the number of trained agents from 40 to more than 70).

Call Reviews, implemented August 27: CCO/CSO Project Manager audited HAN calls and provided direct-agent feedback regarding improvement opportunities. Quality Assurance (QA) analysts were also trained on proper handling of HAN calls, so that feedback can be provided to agents, as calls are encountered during normal QA evaluations.

Updated Call Routing Prioritization, implemented July 29: Call routing at the Sacramento Contact Center was updated to ensure that HAN calls are handled at top priority in order to better manage customer service levels.

Updated HAN training materials, implemented July 1 through July 16: Updated HAN training materials with current program information.

C.2 New Training and Support Provided to CCO

Customer Service Representative (CSR) training, implemented July 23 through August 5: Three-hour instructor-led training on handling HAN questions, troubleshooting and pairing HAN devices. Training designed to ensure all agents are current on the HAN program and processes.

Senior Service Representative (SSR) training, implemented July 11 through August 5 and August 14 through August 21: Three-hour CSR instructor-led training, plus additional two-hour CSO training covering eligibility and registration process. SSRs were also granted access to all necessary applications.

Supervisor and manager support, implemented July 19: Engaged CCO supervisors to ensure they are an additional channel for communicating HAN information with agents and exercised this channel on multiple occasions to communicate reminders (e.g., Silver Spring access and proper account notation). A monthly check-in call for CCO manager and HAN team to ensure agents have all their issues or needs addressed.

C.3 Refresher Training and New Support Provided to CSO

CSR training, implemented August 21: Two-hour instructor-led web training provided a refresher on handling eligibility & registration processes via email. Training designed to ensure all agents are current on the HAN program and processes.

Supervisor and manager support, implemented August 14: Engaged CSO supervisors to ensure they are an additional channel for communicating HAN information with agents and exercised this channel on multiple occasions to communicate reminders (i.e., maintaining service levels).

Instant messaging (IM), implemented August 23: Established use of internal instant messaging tool within CSO to establish a direct line of communication between the CCO/CSO Project Manager and CSO agents and to build the learning curve (allowing them to directly reach out with questions while handling HAN work)