Analysis of Green Mountain Power Critical Peak Events During the Summer/Fall of 2012

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Executive Summary

This report summarizes results from year one of a two-year Consumer Behavior Study (CBS) executed by Green Mountain Power as a component of the eEnergy Vermont project. The purpose of this study is to understand and compare two different types of pricing structures, Critical Peak Pricing (CPP) and Critical Peak Rebate (CPR; also known as the Peak Time Rebate), both of which are intended to provide incentive for residential electricity customers to reduce their demand during peak hours. In addition the study seeks to identify the additional value of In-Home Display technology in reducing monthly electric energy consumption as well as demand reduction during peak hours.

Definitions

Critical Peak Pricing (CPP): During a few peak hours electricity prices increase substantially (in this case to $0.60/kWh) in proportion to the cost of transmission and generation capacity payments.

Critical Peak Rebate (CPR): During peak hours customers earn rebates by reducing their electricity usage below a baseline level. Note that this rate is also known (at GMP) as Peak Time Rebate, PTR.

In Home Display (IHD): A small device that wirelessly communicates with a smart meter and provides the customer with real-time information

During the fall of 2012, Green Mountain Power called 4 critical peak event days (September 14, 21, 25, and October 5, 2012), in which customers in the Rutland, VT area were notified the day before of a peak event during the hours of 1 to 6 pm. Temperatures on these days were seasonably mild (68-77°F), with appropriately moderate levels of demand. Given this fact, we expect that peak-hour responses will be larger during declared peak-time events in 2013, which GMP plans to call on hot summer days.

Despite the moderate temperatures, the analysis of customer-level electricity consumption show that customers in both the CPR and CPP rate groups measurably reduced electricity consumption during declared peak-time events. Table E-1 shows a summary of estimated average customer responses and associated impacts on customer bills over the course of the four critical peak events called in 2012. The data indicate that customers on CPR reduced their average hourly loads by 0.042 to 0.048 kW (5.4 percent to 5.7 percent relative to a control group that was not notified of peak events and was not placed on any special rate) during the critical peak event hours. Customers on CPP exhibited larger average hourly load reductions of 0.051 to 0.073 kW (11.0 percent to 14.3 percent relative to the control group) over the course of the four events. Customers equipped with In-Home Displays generally exhibited smaller reductions during peak events, relative to CPP customers without the additional information technology. Monetary savings to customers on CPR and CPP averaged between $0.20 and $0.42 per customer per event, suggesting that average savings over the course of 2012 peak events ranged from $0.80 to $1.68. We estimated that customers on the CPP experienced larger monetary savings than customers on the CPR rate.

Following the completion of the first set of declared critical peak events, GMP surveyed participants in the CBS program to assess their level of satisfaction with the program and customers' perceived benefits. Analysis of the customer survey data shows that participants were moderately satisfied with the program, though

the variance among customers was very high, making it difficult to identify statistically significant differences in overall satisfaction between customers on different rate structures. However, the survey data do clearly show that a number of customers were not successful in activating their IHDs, or did not receive notification of the peak events, which likely limited their response during event days.

Table E-1: Summary of results from four peak events in 2012

Rate	Technology	Event savings (kW)	Event savings (% of control group peak-event kW)	Bill savings ($ per customer per event)	Satisfaction (1-5)
Flat (with notification)	--	0.018	2.10%	$0.13	4.0
CPR	--	0.045	5.40%	$0.20	3.5
CPR	IHD	0.045	5.70%	$0.19	3.6
CPP	--	0.116	14.30%	$0.42	3.8
CPP	IHD	0.088	11.10%	$0.34	3.7

1. Project overview, research questions and summary of findings

This report summarizes results from the first year of a two-year Consumer Behavior Study (CBS) conducted by Green Mountain Power. This study is a component of the eEnergy Vermont Smart Grid Investment Grant and GMP's Smart Power program. The study tests a combination of peak-time rate structures and information technology that jointly leverage smart-grid infrastructure investments within GMP's service territory. The general focus of the study is to identify the best combination of financial incentives and technology to enable peak-time demand response by residential customers. The analysis in this report is based on smart meter data collected from March/April of 2012 (when Advanced Metering Infrastructure was deployed) until December 2012, in addition to data from two surveys, one before and after the first-year treatment.

Using customer-level electric usage data available from spring to winter of 2012 (when advanced metering infrastructure was rolled out in the GMP territory), the discussion in this report addresses the following research questions.

1. What is the impact of time-varying electric rates (Critical Peak Pricing and Peak-Time Rebates) on residential average hourly kW usage before, during and immediately after the declaration of a peak-time event?
2. What is the impact of information technology (the In-Home Device or IHD) on residential average hourly kW usage during declared peak-time events, when coupled with a time-varying electric rate?
3. What is the impact of peak-event notification (without a time-differentiated rate and without IHDs) on customer-level average hourly kW usage before, during and immediately after the declaration of a peak-time event?
4. What are the financial impacts of critical-peak rate reductions on residential electric bills?
5. Does the presence of the IHD induce changes in total monthly electricity consumption?
6. How satisfied are customers with the various rate and information options made available to them under the experiment?
7. What actions do customers report taking in response to notification of critical peak events?

This report provides analysis with respect to each of these research questions, based on data collected from four critical peak events called in September and October of 2012. Temperature conditions during these four events were relatively moderate (temperatures in the 60s and 70s; cooler than what would be expected in Vermont during the summer months). The magnitude of demand reductions that we observe (5 percent to 14 percent, relative to customers that did not receive notifications of peak-time events and remained on GMP's flat residential rate; and relative to days with similar weather conditions where peak-time events were not declared), as well as the types of responses that customers reported (few customers reported adjusting air conditioners or thermostats, for example) suggest that

weather conditions were a substantial factor in the observed outcomes. We would thus expect larger demand reductions from customers on the rate and information treatments when peak-time events are called on warmer summer days in 2013.

In summary, our analysis suggests the following conclusions with respect to each of the seven research questions:

1. *The impact of time-varying electric rates on response to declared critical peak events (Research Question 1)*: We found that customers on CPP and CPR rates did reduce average hourly kW demand by statistically significant amounts during the four declared critical peak events in 2012. Average hourly per-customer reductions in peak-hour consumption ranged from 11-14% for the CPP groups, and 5-6% for the CPR groups, when compared to the control group that was not notified of events. We qualitatively observed a "pre-emptive" reduction in consumption for some rate and information treatment groups beginning two to six hours before the start of critical peak events.
2. *The impact of the In-Home Display on response to declared critical peak events (Research Question 2)*: Customers who were given an IHD did not exhibit larger hourly kW demand reductions during declared critical peak events. Hourly kW responses for the CPR group were about equal between customers with and without the IHD. Customers in the CPP group with the IHD exhibited smaller average hourly kW responses, by around 0.03 kW, than CPP customers without the IHD.
3. *The impact of peak-time notification on response to declared critical peak events (Research Question 3)*: Customers who received notifications of peak-time events but remained on the standard GMP flat residential rate and were not given IHDs did reduce average hourly kW consumption during declared peak periods, but these reductions were two to five times smaller than reductions from customers with time-varying rates and/or IHDs.
4. *Impacts on customer bills (Research Question 4)*: Customer savings during declared peak-time events were between 12 to 42 cents per customer, per event. The CPP groups exhibited the largest magnitude of monetary savings, roughly twice that of the CPR groups. Customers who remained on the flat rate but were notified of peak events exhibited the smallest savings.
5. *Impacts of IHDs on monthly energy consumption (Research Question 5)*: Customers with IHDs were observed to reduce total monthly kWh usage by approximately 28 kWh per customer per month, or about 4 percent of average monthly kWh usage for customers that did not have IHDs. Based on the Rate 1 energy charge in the GMP territory, this level of monthly energy savings suggests a $50 per-customer annual reduction in customer bills.
6. *Customer satisfaction with the program (Research Question 6)*: Customers reported a moderate level of satisfaction with their assigned rate and information treatments. Customers who were moderately or extremely satisfied reported that their level of satisfaction was driven by the opportunity to save money on their monthly bill or being reminded (through the peak-time notifications) of opportunities to conserve energy. Customers who were dissatisfied with the program generally reported not seeing any

noticeable savings on their monthly bill or reported confusion over how various elements of the program were supposed to work (for example, what they should do when notified of a peak-time event). A large percentage (35% to more than 50%) of customers on the information treatments (with the IHD) who were dissatisfied with the program reported that the IHD contributed in some way to their dissatisfaction. A smaller proportion of customers with IHDs who were satisfied with the program reported that the IHD contributed in some way to their level of satisfaction.

7. *Customer response to declared peak events (Research Question 7)*: More than half of customers on CPR and CPP reported taking at least one action in response to the declaration of a peak event in 2012. Turning off lights or delaying household activities (cooking and laundry) were cited the most often by customers as specific actions taken. Less than 30 percent of customers with air conditioning reported turning down air conditioning in response to peak events. This may be due to the moderate temperatures prevailing during the four events in 2012.

This report is organized along the lines of the seven research questions. Section 2 provides some background information on the treatments examined in this study and the randomization and recruitment process. Section 3 describes the interval meter and survey data used in our analysis. Section 4 describes how customers on time-varying electric rates and those equipped with IHDs responded to declared peak-time events during September and October 2012. Section 5 discusses the estimated monetary savings associated with peak-time demand reductions. Section 6 assesses the impacts of the IHD on monthly energy consumption. Sections 7 and 8 discusses our analysis of a customer-participant survey conducted in December 2012 in which customers were asked to assess their satisfaction with the program and were asked some questions about specific actions taken in response to critical peak events, and Section 9 provides some conclusions. Section 10 contains a supplemental data appendix with more detailed information on customer load shapes during each of the four events; differences between treatment groups and the no-notification control group during each of the four events; and detailed output from the regression models.

2. Study design, randomization and recruitment

The GMP Consumer Behavior Study is designed as a randomized control trial (RCT) featuring seven treatment groups and two control groups (each of which serves a different purpose as discussed below). The study is being carried out over the summers of 2012 and 2013. The treatments include two different critical peak rate structures (CPR and CPP); informational treatments (In-Home Displays provided to customers in relevant groups); and a simple notification treatment where customers are informed of declared critical peak events but are not given the IHD or placed on a time-differentiated rate. Note that all of the participants in this study were previously on a flat, non-dynamic rate structure (as opposed to a daily time-of-use rate); this study focuses only on the impact of critical peak price

differentiation. The study did not include non-critical peak rate changes, as would be included in a time of use study. At this time GMP is particularly focused on evaluating critical-peak rate treatments.

All customers except those in the two control groups were given the option to receive notification of peak events by e-mail, text and phone call. We note that all customers in IHD-enabled treatment groups received the same IHD. The seven treatments used in this study are as follows. Note that Table 2.1 summarizes the rate treatments used.

1. **Critical Peak Price (CPP):** During declared critical peak events, the energy charge for customers on the CPP rate rises to $0.60 per kWh. During non-critical peak times the energy charge for customers on the CPP rate is $0.144/kWh, slightly below the default flat rate of $0.148/kWh for residential customers in the GMP territory. (This default rate is referred to as "Rate 1").
2. **Critical Peak Price + In-Home Device (CPP+IHD):** The energy charge is the same as the CPP group but this customer group is given an IHD in addition to the time-differentiated rate. The IHD provides users with near-real-time feedback on household energy usage and can receive peak-time notifications from GMP.
3. **Critical Peak Rebate (CPR):** Customers on this rate treatment receive a rebate of $0.60/kWh for measured energy reductions during declared critical peak events. Energy reductions for rebate determination purposes are calculated using the PJM Customer Baseline methodology.
4. **Critical Peak Rebate + IHD (CPR+IHD):** The rate structure is the same as the CPR group but this customer group is given an IHD in addition to the time-differentiated rate. The IHD provides users with near-real-time feedback on household energy usage and can receive peak-time notifications from GMP.
5. **CPR to CPP:** Customers in this group are placed on CPR for the first year of the study and are then recruited to move to the CPP rate in year two. The purpose of this treatment group is to examine whether customer acceptance of Critical Peak Pricing can be increased if customers are first placed on CPR and then asked to transition (compared with customers placed on CPP straightaway). Customers in this group did not know at the time of enrollment or during the first year of the study that they would be recruited to transition to CPP in year two. Thus, we group this set of CPR customers with the regular CPR group when performing our load impacts analysis for year one of the study.
6. **CPR to CPP + IHD:** Customers in this group are placed on CPR for the first year of the study and are then recruited to move to the CPP rate in year two. These customers are also given IHDs.
7. **Flat rate + Notification:** Customers in this group remain on Rate 1 (flat rate pricing) but are given notification of peak-time events. (Note that in

the Consumer Behavior Study Plan, this group is referred to as control group, C1).

Table 2.1. Summary of rate treatments used in this study

	Base rate (all hours, other than critical peak)	Critical peak rate (1pm-6pm on critical peak days)
Flat rate (Rate 1)	$0.148/kWh	$0.148/kWh
Critical Peak Rebate	$0.148/kWh	$0.148/kWh – ($0.60/kWh reduction from baseline)
Critical Peak Pricing	$0.144/kWh	$0.60/kWh

The prices used for the rate treatments (shown in Table 2.1) were calculated by GMP as follows. Based on historical costs of state and regional transmission services and capacity costs, GMP estimated that the market value of a peak-hour kW reduction in New England was $30.00 per kW of reduction. In this study, a customer is being asked to save power for 10 events, 5 hours during each event. If a customer saved 1 kW during each of the event hours they would save 50 kWh. A 1 kW reduction during one of those hours would save GMP $30.00. Thus the average cost of a critical peak kWh is:

$$\frac{\$30/kW}{50hr} = \$0.60/kWh$$

This calculation was applied to both the CPP and the CPR rate treatments. Note that the CPP rate, as described here, is based only on marginal capacity costs and does not include an additional energy cost.

There are two control groups in this study. The first control group consists of customers on Rate 1 who are aware of the study and their participation but not given any notification by GMP of declared peak-time events. For this reason we refer to this group as the "No-notification control." The second control group was never contacted by GMP with regards to the study. The purpose of this control group is to assess whether there are Hawthorne-type effects present in the study (i.e., whether simply being aware of the study has some impact on behavior). We do not address the Hawthorne-effect research question in this interim report but we will address it in the final report, to be completed in 2014 following the end of the study timeline. A third control group, consisting of customers on Rate 1 who were contacted by GMP and surveyed (thus being made aware of the study) but who were not placed on any rate or information treatment and did not receive notifications, was originally planned for this study but was ultimately dropped from consideration.

The **target population** for this study is residential customers in the vicinity of Rutland, VT, who currently pay their own electric bills and who are year-round Vermont residents. Note that Rutland, VT has a somewhat lower than average income, relative to other portions of the Green Mountain Power service territory.

2.1 Power calculations and randomization

Power analysis was performed to determine appropriate sample sizes to attain a minimum detectable effect size of 5% of average customer-level monthly kWh

consumption, and 10% of average hourly kW demand, following the declaration of a critical peak event. The sampling has been designed to measure these minimum detectable effects with a Type I error probability of 10% and a Type II error probability of 20%.

The costs of administering the experiment vary widely by treatment group. We use an optimal allocation of study participants to control and treatment groups, as per equation (1):

$$\frac{P}{1-P} = \sqrt{\frac{C(Control)}{C(Treatment)}} \qquad (1)$$

where *P* is the proportion of subjects in the treatment group, *C(Control)* is the cost of including a participant in the control group and *C(Treatment)* is the cost of including a participant in the treatment group, above and beyond the costs of inclusion in the control group. Table 2.2, below, shows how estimated costs at the time of the power analysis and allocation of study participants differs by treatment group.

Table 2.2: Treatment Cost and Optimal Proportion in the Treatment Group

Group	Participant Cost	Optimal Proportion
Control Group (unsurveyed)	$10	N/A (Varies by treatment)
Control Group (surveyed)	$50	31%
Rate treatment, without IHD	$50	31%
Rate treatment, with IHD	$500	12%

Note that in Table 2.2, the high estimated cost of the IHDs affects the proportion of participants in treatment groups featuring IHDs. The cost of including customers in specific rate treatments is assumed to be negligible. The cost differential in the surveyed control group and the non-IHD rate treatment group can be attributed to the cost of surveying participants. The costs included in Table 2.2 represent the best estimates of GMP at the time that randomization and recruitment was undertaken.

Oversampling rates were determined based on conservative assumptions provided by GMP personnel to help in sampling planning. Table 2.3 shows the assumed *acceptance* rates; the oversampling rate is thus equal to one minus the acceptance rate. Note that the actual acceptance rates were quite a bit higher than those indicated in Table 2.3 (see Section 2.4). Most customers were recruited through phone surveys. A relatively small fraction of those who completed the phone survey decided to opt out of the study (see Table 2.5).

Customer-level data on monthly kWh consumption were gathered for 2007 through 2010, for GMP Rate 1 residential customers only. We note here that since the CBS was rolled out in conjunction with the installation of smart meters

throughout the GMP territory, we do not have pre-treatment interval meter data for residential Rate 1 customers; the best pre-treatment data available was monthly kWh consumption. The mean and standard deviation of monthly kWh Rate 1 residential consumption was calculated to be 550 kWh per customer and 526 per customer, respectively.

Table 2.3: Anticipated Acceptance and Oversampling Rates
(from the Consumer Behavior Study Plan)

Variable	Acceptance Rate	Oversampling Rate
Surveys	85%	15%
CPP (Opt-in)	15%	85%
CPR (Opt-out)	80%	20%
Persistence (non-attrition)	80%	20%
IHD	60%	40%

Based on these data, we calculated sample sizes required to achieve the aforementioned levels of statistical significance and power. A table with the treatment and control groups, and the required sample sizes, is shown in Table 2.4. A total of 3,735 customers would be involved in some aspect of the study. Given the assumptions about acceptance rates (in Table 2.3), 12,867 customers would need to be randomized prior to being contacted for eligibility determination and recruitment into the study.

Table 2.4: Required Sample Sizes for the GMP Study

Group	Year 1	Year 2	IHD	Notification	Sample Size
1	CPR	CPR		X	390
2	CPR	CPR	X	X	195
3	CPP	CPP		X	390
4	CPP	CPP	X	X	195
5	CPR	CPP		X	390
6	CPR	CPP	X	X	195
7	Flat	Flat		X	390
C1	Flat	Flat		X	390
C2	Flat	Flat			1200
Totals					3735

2.2 Eligibility determination

Eligibility for this study was determined in two stages.

In the first stage, an eligibility screen was conducted by GMP, based on information in their Customer Information System (CIS) database. Customers were deemed to be ineligible if they met any of the following characteristics:

a. Customers located outside the vicinity of Rutland, VT;
b. Customers were not on Rate 1;
c. Customers did not have consistent monthly kWh data for 12 months;
d. Customers had average monthly bills less than 50kWh and or greater than 10,000kWh;
e. Customers would be unlikely to have smart meters by the summer of 2012.

Based on these criteria, 19,936 potentially qualified customers were identified in late 2011. 1200 of these customers were assigned to the no-survey control group, leaving 18,736 customers.

In the second stage, Metrix Matrix, a market-research firm retained by GMP, contacted customers primarily by telephone, but also by mail, to determine final eligibility for this study. The following criteria were used in the recruitment surveys to determine final eligibility.

- The customer lives in or near Rutland County (confirmation of CIS data);
- The customer's primary residence charged for electricity using "Rate 1" (flat rate pricing);
- The customer lives in a single-family dwelling;
- The customer's residence is used either year-round or during the summer (the intent is to exclude from eligibility customers who are not in their homes over the summer);
- The customer intends to remain at the specified address for the two years covering the study.

Additional details of the recruitment process are provided in Section 2.3 and Appendix 2.

2.3 Recruitment process and pilot implementation details

The recruitment process began in late 2011, when GMP identified 19,936 individuals who were pre-qualified to participate in this study (see Figure 2.1). Upon identifying the qualifying customers, GMP assigned 1200 to the the un-surveyed control group (Group C2); these customers were not contacted at any point during this study. Contact information for the remaining 18,736 customers was given to Metrix Matrix, a market research company, who implemented the remaining steps of the recruitment process. Metrix Matrix found that 2,191 of the 18,736 did not have up-to-date account information, leaving 16,545 pre-screened customers. These customers were, at this point, randomly assigned to the nine treatment and control groups. Of the 16,545 customers, 2,187 did not have valid phone numbers listed, and were thus marked for mail/web recruitment. The remaining 14,358 were marked for telephone recruitment.

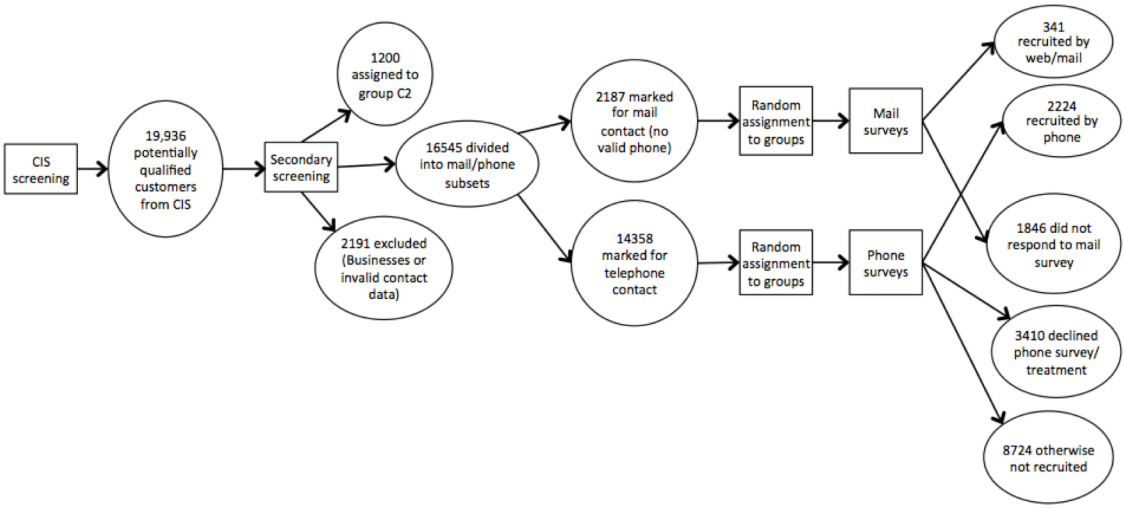

Figure 2.1 – Overview illustration of the recruitment process. See Figures 2.2, 2.3 for details of phone and mail recruitment.

The 2187 customers marked for mail recruitment were randomly divided among the 8 remaining groups and sent postcards (see Appendix 2) on Feb. 13, 2012 notifying them of their selection for the study. On Feb. 20, customers in these groups were sent a recruitment letter (see Appendix 2) and a paper version of the survey. Figure 2.2 illustrates the mail recruitment process.

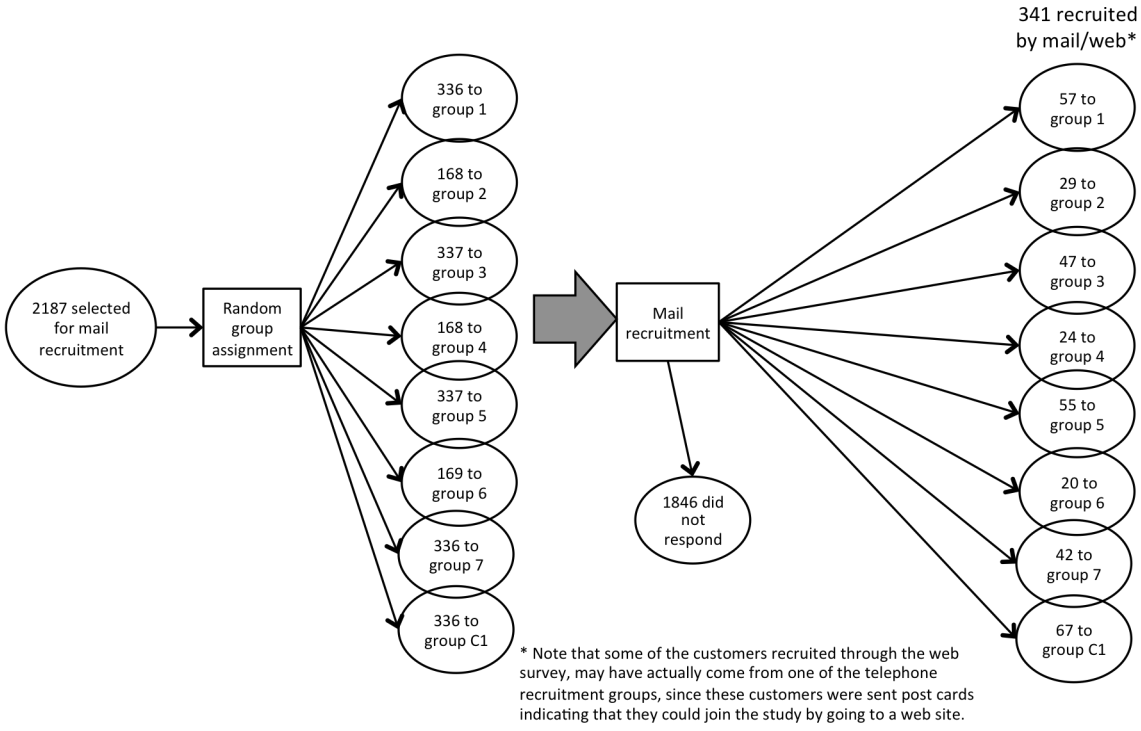

Figure 2.2. Illustration of the mail/web recruitment process

The 14,358 customers marked for telephone recruitment were first randomly assigned to one of the 8 remaining treatment or control groups. After being assigned to groups, customers were sent post cards and then contacted by telephone in five waves from February to April, 2012 (see Appendix 2). About one week after receiving post cards, customers were contacted by telephone using the script given in Appendix 2. In short, the script asked several pre-screening questions, introduced the customer to their treatment group, and then proceeded to ask the remaining demographic questions.

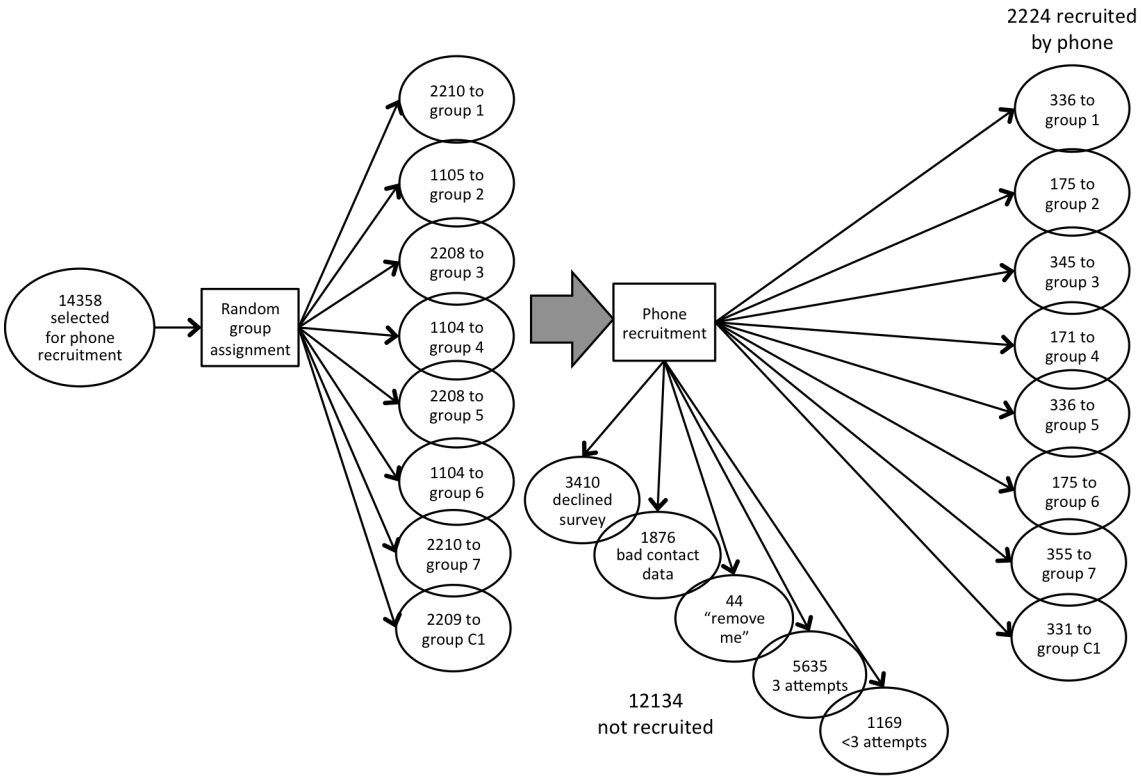

Figure 2.3. Illustration of the Telephone Recruitment Process

By the end of April 2012, the required number of customers had been recruited into their respective groups. Also by early April almost all customers had Smart Meters installed, making it possible to begin gathering interval data. Customers in the CPR groups were transitioned to their new rate in April of 2012. Due to implementation challenges, customers in the CPP rate were not transferred to their new rate until August of 2012. Figure 2.4 provides a timeline of the pilot implementation.

In-home displays were mailed to customers receiving IHDs as part of their treatment during the second two weeks of August 2012. It is important to note that GMP did not explicitly install IHDs for customers, making it difficult to verify exactly which customers used the devices, although some indication of this is available in the interim survey data.

Since advanced metering systems had not been rolled out in the GMP territory prior to the beginning of the study, we have only a limited quantity of pre-treatment

interval meter data to use in our load impact analysis. On the other hand, the data are sufficient to identify impacts on hourly average kW consumption during event periods relative to non-event periods.

2.4 Customer recruitment results

Table 2.5 provides a numerical summary of the recruitment process results. Largely because telephone surveys were the primary mechanism for recruitment, the actual acceptance rates were higher than the anticipated rates reported in Table 2.3. The acceptance rates reported here largely reflect the willingness of participants to proceed with the survey process, rather than reflecting interest or non-interest in the actual rate treatment.

About 16 percent of customers who were initially assigned to one of the groups dropped out of the study after their new rates began during the summer of 2012. Table 2.5 shows this in the "Post Recruitment Loss" column. There are several reasons for this loss. Some customers moved, resulting in their account closing. Some customers opted out of having a smart meter in their home (the Vermont Legislature passed a law allowing anyone to opt out of using a smart meter, without penalty). Some customers decided that they were no longer interested to participate in the study after learning more about their rate. The dropout rates were somewhat higher (6-10 percent above the no-survey control group) in the CPP groups. The research team will work with GMP to look at these dropout rates and reasons more closely in our final analysis report.

Table 2.5. Numerical summary of the recruitment process.

Group	Intial Assignment	Selected for phone	Selected for mail	Contacted by phone	Declined phone survey	Recruited	Treatment acceptance rate	Active in December	Post recruitment loss rate
CPR	2546	2210	336	753	417	393	36.1%	334	15.0%
CPR+IHD	1273	1105	168	413	238	204	35.1%	178	12.7%
CPP	2545	2208	337	839	494	392	33.3%	307	21.7%
CPP+IHD	1272	1104	168	410	239	195	33.7%	146	25.1%
CPR-CPP	2545	2208	337	779	443	391	35.0%	327	16.4%
CPR-CPP+IHD	1273	1104	169	413	238	195	33.5%	162	16.9%
Notification	2546	2210	336	722	391	397	37.5%	353	11.1%
C1	2545	2209	336	790	435	398	35.3%	336	15.6%
C2	1200					1200		1014	15.5%
Total	17745	14358	2187	5119	2895	3765	51.5%	3157	16.1%
Bad contact data	2197								
Total	19942								

Note that the acceptance rates shown above combine the phone and mail group, since both groups received information about their treatment at the beginning of the survey.

2.5 In home display and technology implementation

Green Mountain Power mailed in-home displays to customers in groups 2, 4 and 6 during August of 2012. The IHD technology chosen was the Tendril Insight IHD. Appendix 4 describes this technology in additional detail. The IHD was used to provided the following information to customers:

- Current household power usage in kW or dollars per hour

- Notification of critical peak events
- Notification of each customer's baseline power level

Appendix 4 includes a description of the In Home Display technology, and Appendix 5 includes detailed information from GMP about their AMI technology implementation process, as well as an evaluation of this process.

3. Data collection and descriptive statistics

Figure 3.1 shows a timeline of the first year of the GMP consumer behavior study. Participants in the study were contacted, recruited and assigned to treatment or control groups beginning in the fall of 2011, with interval meter installations beginning soon thereafter. By the end of March 2012 (the beginning of our interval meter data set) most participants had interval meters installed. Customers in the CPR group were transitioned to their new rate in March 2012, while customers in the CPP group were transitioned to their new rate in August 2012. In-home displays were mailed to customers receiving IHDs as part of their treatment during second two weeks of August 2012. It is important to note that GMP did not explicitly install IHDs for customers. Thus, GMP was not able to track whether customers had received their IHD as intended; or whether customers who did receive the IHD were able to install and use the IHD successfully. In our load impact analysis, we include all customers that were supposed to get the IHD in the IHD-enabled treatment groups but we cannot identify specific customers that either failed to receive the IHD or were not able to use the IHD as intended.

Since advanced metering systems had not been rolled out in the GMP territory prior to the beginning of the study, we have only a limited quantity of pre-treatment interval meter data to use in our load impact analysis. On the other hand, the data are sufficient to identify impacts on hourly average kW consumption during event periods relative to non-event periods.

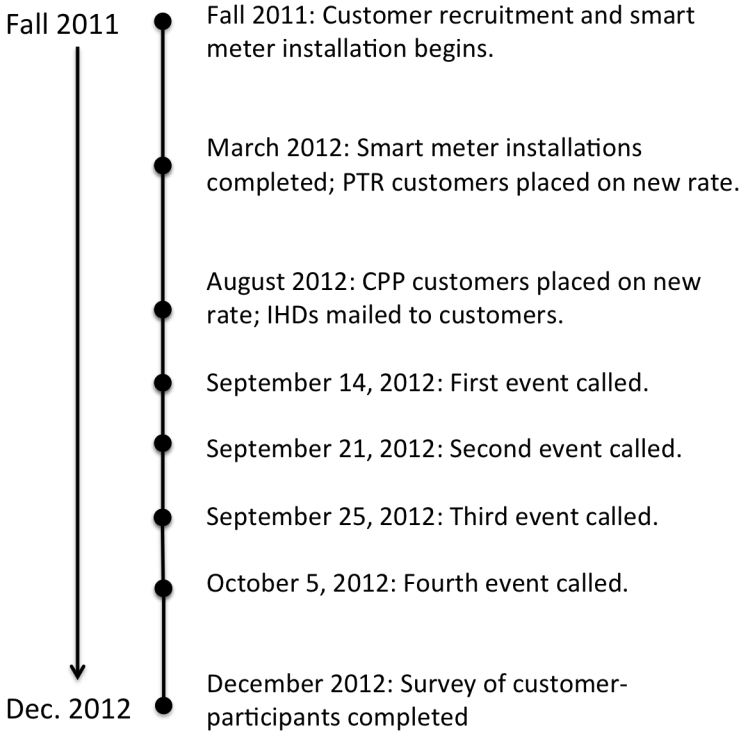

Figure 3.1. Timeline for recruitment and year 1 of the GMP Consumer Behavior Study.

3.1 Event days

The preliminary analysis in this report is based on 15-minute interval data collected from GMP for all customers who were informed of their treatment and control groups. Customers that declined to participate after being informed of their treatment group; customers that decided to stop participating after being placed on their treatment; and customers that remained on their treatments are all included in our analysis data set. The data set covers the period from March 2012 to December 2012. During this period four critical peak events were called: September 14, 21, 25, and October 5, 2012. All customers in groups 1-6, and C3 (see Table 3.2) were notified by e-mail, text message, and/or automatic phone calls by 6 pm the day before each critical peak event, and critical peak events lasted from 1 pm to 6 pm on the event day. The four event days were seasonably mild, with mean temperatures of 68-77°F (see Table 3.1). Events were not called earlier in the summer due to overall eEnergy Vermont project delays.

Table 3.1. Average Temperatures During Event Hours

Event Date	Average Temperature During Event Hours (°F)
9/14/12	76.8°
9/21/12	68.2°
9/25/12	65.0°
10/5/12	69.3°

After collecting interval data for March through December of 2012, 15-minute kWh data were summed over each one-hour period in order to produce hourly data for each one-hour time period. Hours with missing data were not included in the data analysis. A very small fraction (<0.1%) of the data were marked as estimated in the database. These estimated readings were not excluded from our analysis; we assumed that the estimations were not poor enough to bias our results.

3.2 Descriptive statistics

Our interval meter data set includes 17,386,003 hourly observations, divided among six customer groups as shown in the panels of Table 3.2. Customers in our dataset had an average load (over all groups) of 0.82 kWh/h (or average kW), with a standard deviation (over all samples) of 0.88 kW. Note that the large standard deviation reflects the large diversity of users in the dataset. Table 3.2 also reflects customer counts after attrition (i.e., the table includes only those customers who remained in the pilot study throughout 2012).

Table 3.2. Descriptive statistics, and summary of treatments, for the 2012 CPP/CPR treatments. Mean and Standard Deviation (SD) are for hourly average kW.

(a) All hours

Group	*Number of Customers*	*All Observation*		
		No. Obs (millions)	*Mean*	*SD*
CPR	809	5.61	0.84	0.91
CPR + IHD	332	2.32	0.79	0.85
CPP	445	3.02	0.81	0.85
CPP + IHD	167	1.16	0.79	0.86
CTRL	354	2.50	0.81	0.87
CTRL - N	400	2.78	0.83	0.91
Total	*2507*	*17.39*	*0.82*	*0.88*

(b) Weekday hours

Group	*Number of Customers*	*Weekday*		
		No. Obs (millions)	*Mean*	*SD*
CPR	809	4.01	0.83	0.89
CPR + IHD	332	1.66	0.78	0.83
CPP	445	2.16	0.80	0.84
CPP + IHD	167	0.83	0.78	0.85
CTRL	354	1.79	0.80	0.85
CTRL - N	400	1.99	0.82	0.85
Total	*2507*	*12.44*	*0.81*	*0.86*

(c) Peak event hours

Group	*Number of Customers*	*Critical Peak event hours*		
		No. Obs (Thousands)	*Mean*	*SD*
CPR	809	16.02	0.69	0.76
CPR + IHD	332	6.64	0.65	0.75
CPP	445	8.80	0.66	0.71
CPP + IHD	167	3.31	0.61	0.67
CTRL	354	7.06	0.72	0.78
CTRL - N	400	8.00	0.72	0.74
Total	*2507*	*49.8*	*0.68*	*0.74*

Note: CTRL represents customers that remained on the flat rate but received peak-event notification; CTRL-N represents the no-notification customer group.

3.3 Average daily pattern and differences among the control groups

The descriptive statistics above show that there are small differences in the mean consumption among the various treatment and control groups. In order to

estimate the extent to which the groups are representative of one another, we performed the following analyses.

First we plotted the mean weekday and weekend load, for each group, in order to test for qualitative differences between the various groups. Figures 3.2 and 3.3 show the results. Both figures indicate, as does Table 3.2, that there are small differences in the mean load for the various treatment groups. The CPR group in particular has a noticeably higher average load than what was observed in the other groups. It is possible (though difficult to confirm) that this could be an effect of the rate design; customers could be using more in order to achieve a greater reduction during critical peak hours. On the other hand, the graphs clearly show that the general load patterns among the groups are very similar.

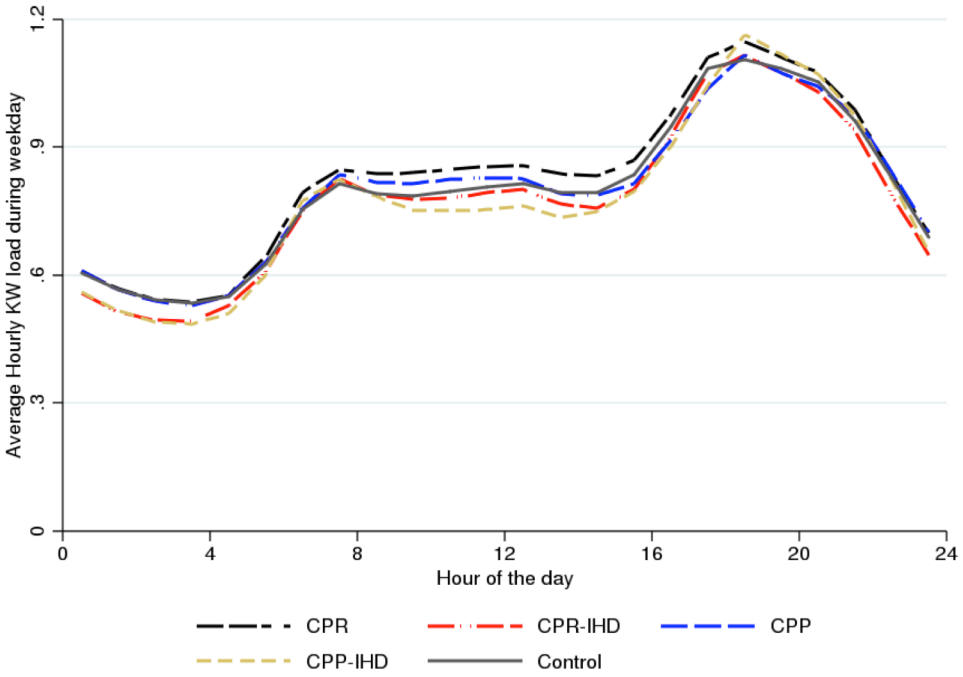

Figure 3.2. Mean weekday load pattern for the treatment and control groups.

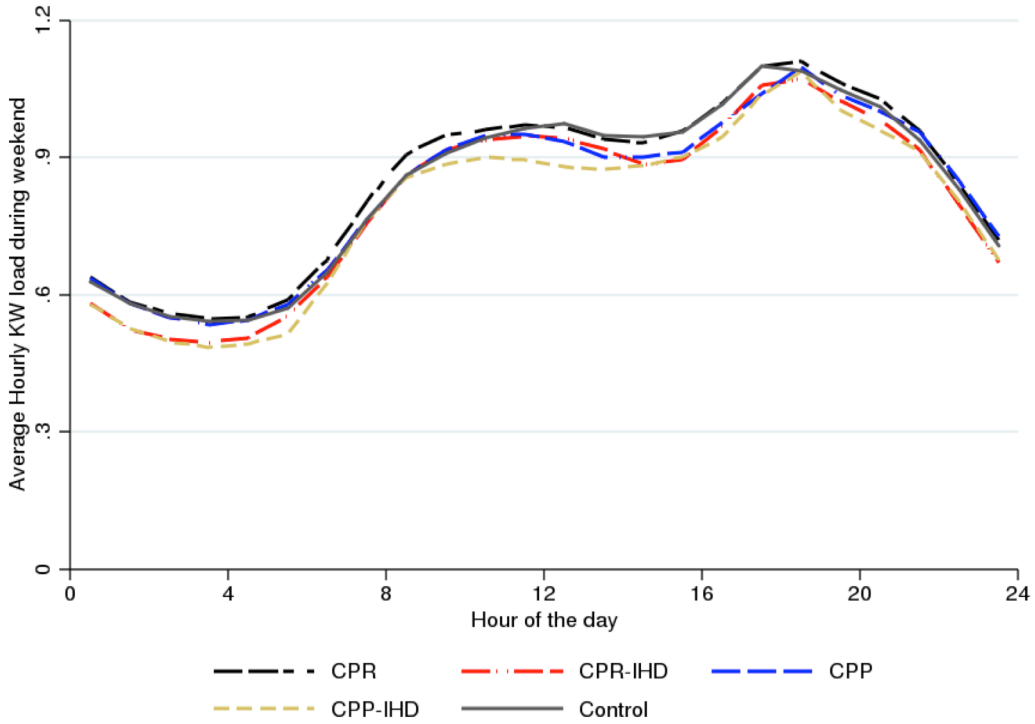

Figure 3.3. Mean weekend load pattern for the treatment and control groups.

Secondly, we tested to see if the observed differences were statistically significant. Ideally this test would occur using data from the period before customers were notified of their treatment. However, recruitment occurred before AMI installation was complete, which means that no interval meter data are available for the pre-recruitment period. Therefore, we tested for differences between each treatment group and the no-notification control group (C1) using data from the period April – June 2012, which was well before any event notifications occurred, and before IHDs were sent to customers. To do so we performed a paired t-test on the hourly data, essentially testing whether the hourly differences between the treatment and control groups were significantly different than zero.

The results, shown in Table 3.3, indicate that there are small, but statistically significant, differences between the average loads in the treatment and control groups during the period April-June 2012.

In order to control for these small differences our analysis includes two types of adjustments. First, the regression includes a fixed-effect parameter for each group, which adjusts for differences in the group means. Second, the randomized encouragement design (RED) analysis controls for differences between groups of customers who did or did not opt in/out to participation in the study.

Table 3.3. Comparison of mean loads for the period April – June 2012

Group	Mean	Difference	t-statistic	p-value
C1	0.7296	na	na	na
CPR	0.7568	-0.0272	-22.08	<0.001
CPR+IHD	0.7229	0.0067	4.76	<0.001
CPP	0.7247	0.0049	3.72	<0.001
CPP+IHD	0.7349	-0.0053	-3.02	<0.01
Notif.	0.7678	-0.0382	-24.80	<0.001

4. Research Questions 1 - 3: Impact of time-differentiated electric rates and information technology

This section presents several results that together address Research Questions 1 through 3, which focus on rate and technology treatments as well as notification of peak-time events, Section 4.1 describes customer responses graphically. Section 4.2 provides a simple comparison of mean consumption during the critical peak hours, and Section 4.3 describe results from regression analysis, which provides a more detailed look at the impact of the rate and information treatments during each event.

4.1 Customer response before, during and after critical peak events

In order to visualize customer loads during the hours before during and after the critical peak events, we plotted hourly average kW consumption for each of the rate and information treatment groups. Figure 4.1 shows these load profiles, averaged over all four event horizons, for all treatment groups without the IHD and the no-notification control group (simply denoted "control" in the figure). Figure 4.2 shows the hourly kW differences between the treatment and no-notification control group . Figures 4.1 and 4.2 were constructed using hourly averaging of actual 15-minute interval meter data at the customer level (in other words, the figures represent actual load shapes and not modeled load shapes).

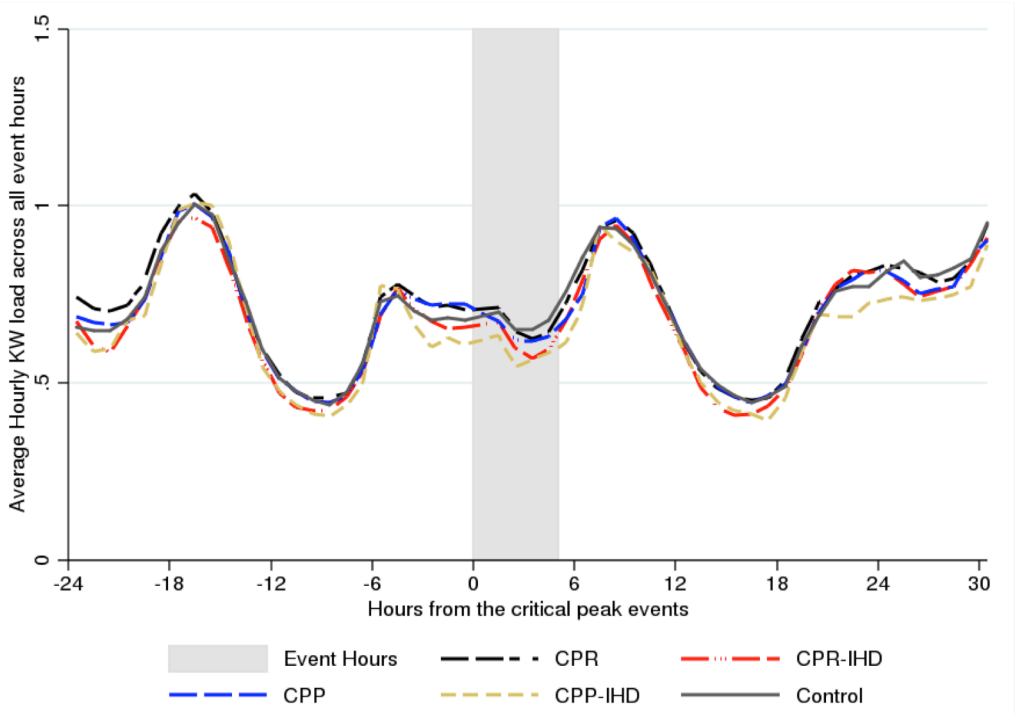

Figure 4.1. Average hourly kW consumption across all four 2012 critical peak events for all rate and information treatment groups, and the no-notification control group.

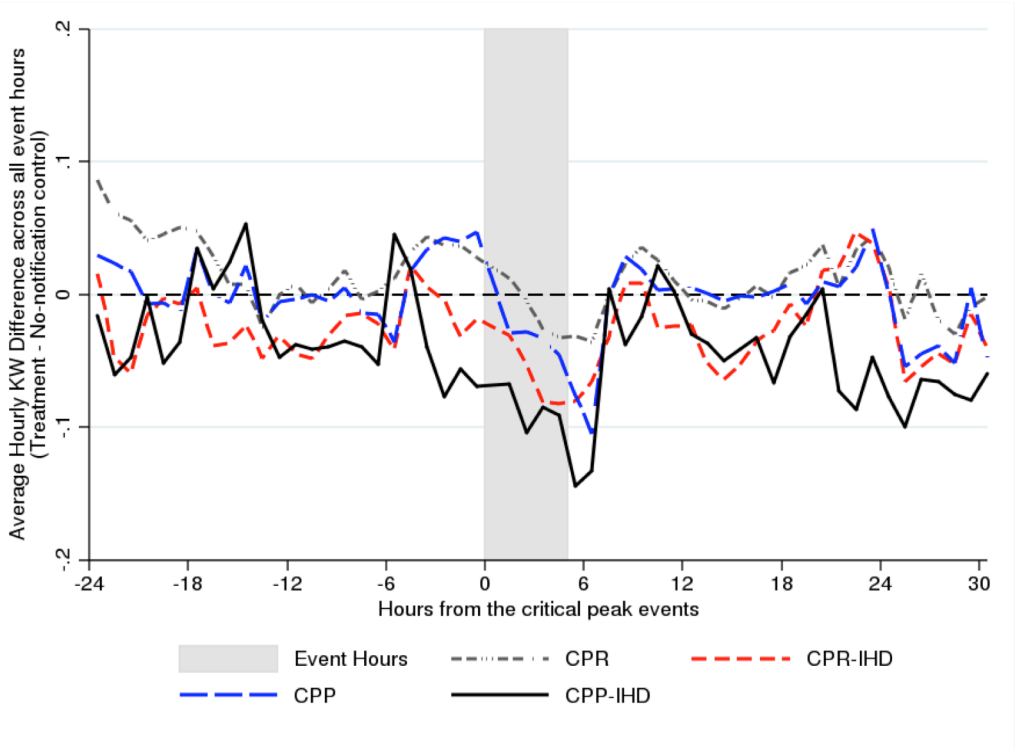

Figure 4.2. Average hourly kW differences (treatment minus control) across all four event horizons for all rate and information treatment groups, and the no-notification control group.

Figures 4.1 and 4.2 suggest that customers in rate and technology treatment groups are responding during declared critical peak events. Customers also appear to have undertaken pre-emptive measures to reduce electricity consumption (both in magnitude and relative to the no-notification control group) between two and six hours prior to the onset of critical peak events. Of these groups, customers on IHD treatments generally started this pre-emptive consumption response earlier than customers on the CPP rate without the IHD. All customer groups increased usage following the end of critical peak events (i.e., starting at 6:00 pm or shortly thereafter), and most customers appear to have returned to their normal consumption patterns the day after the critical peak event.

4.2 Load impact analysis

We estimate the impact of rate and information treatments (research questions 1 through 3 from Section 1) through a difference-in-difference type of regression model. This analysis procedure decomposes differences in observed electricity consumption between treatment and control groups into: (i) differences that would be observed during a non-event period; and (ii) differences specifically during critical peak events.

Although the GMP Consumer Behavior Study was structured as a RCT, we need to incorporate customers who declined to participate or dropped out in our

analysis. To do this, we analyze the results as if they were generated through a "randomized encouragement" study design (RED), in which participants are actively encouraged to adopt a particular treatment. In our analysis, all customers who were recruited into a particular treatment are treated as if they were "encouraged" to adopt the treatment. Since the vast majority of customers who exited the study did so during the initial survey contact (before actually being put on their rate and/or information treatment) we group those customers together with the few customers who dropped out after actually being put on their rate and/or information treatment. We note that drop-outs (as opposed to customers declining to participate) came from the CPP groups; customers could effectively drop-out of the CPR treatment by simply ignoring the notifications. Given our data we are not able to identify specific customers who have dropped out of the CPR treatment.

The RED analysis proceeds in two stages. A first-stage regression predicts the proportion of customers in each treatment group who adopted the treatment. The second-stage regression is a difference-in-difference regression as discussed above. The two-stage regression procedure is shown in equation (2).

$$T_{ij} \times DE = a_i + b_1(T_{Ej} \times DE) + b_2 DE + e_{it} \qquad (2)$$

$$\begin{aligned} y_{it} = {} & \beta_i + \sum_j \beta_j DT_{ji} + \sum_k \beta_k^{DB} DB_{ki} + \sum_k \beta_k^{DE} DE_{ki} + \sum_k \beta_k^{DA} DA_{ki} \\ & + \sum_j \sum_k \beta_{jk}^{DE(k)} T*_{ij}\, DE*_{kt} + \sum_j \sum_k \beta_{jk}^{DB(k)} T_{ij} DB_{kt} + \beta_t^{HI} HI_t \\ & + \beta_t^{CD} CD_t + \beta_t^{CCD} CCD_t + \varepsilon_{it} \end{aligned}$$

where *i*, *j*, *k*, and *t* are indices for household, treatment group, event number, and hour number respectively. The first stage of equation (2) is estimated separately for each treatment group. T_{ij} is an indicator variable for those customers who agreed to take up treatment *j*, while T_{Ej} is an indicator variable for those customers who were encouraged to take up treatment *j* (i.e., those customers randomized into treatment group *j* prior to recruitment). Note that customers who were not randomized into treatment group *j* cannot take up treatment *j*; thus by design the rate of customer acceptance of treatment *j* by customers that were not encouraged is zero. *DE* is an indicator variable for those hours when a critical peak event had been called. Since encouragement to accept rate and information treatments happened at the recruitment stage rather than prior to individual peak events, the set of customers in the encouraged group (T_{Ej}) and the set of customers in the acceptance group (T_{ij}) is identical for all four critical peak events. The term $T*_{ij}\, DE*_{kt}$ represents the predicted values from the first-stage regression. DB_{kt} and DA_{kt} are indicator variables for the six-hour period leading up to the start of an event; and the 24-hour period following the conclusion of the event, respectively. The weather variables included in this second regression model are the heat index at hour *t* (HI_t), the

number of cooling degree-hours during hour t (CD_t), and the cumulative number of cooling-degree hours during a single day as of hour t (CCD_t). ε_{it} is the error term (unexplained variance) for customer i at time t. Each β is an estimated model parameter.

The intercept variable β_i essentially gives us the mean load in kW for the no-notification control group (C2). The Hawthorne control group, which was not contacted by GMP in relation to the study, is not included in the regression analysis. The treatment parameter estimates β_j give the mean difference in load between group j and group C2 (the fixed-effect of treatment j). The parameter β_k is the average impact of event k on all groups, essentially indicating how loads differed during event hours, on average. Finally, $\beta_{jk}^{DE(k)}$ and $\beta_{jk}^{DB(k)}$ give the estimated impact of treatment j during event k and before event k, after controlling for the other factors. These β_{jk} are the primary variables of interest in this analysis.

Equation (2) was estimated separately for each critical peak event, and included all interval meter data available through the end of 2012. We also implemented a version of equation (2) that did not exclude an explicit weather variable, but instead limited the analysis for each event to days where temperatures were similar to the average temperature during the event period. We defined "similar" using criteria of +/- 5 degrees and +/- 10 degrees. Either way, our results were virtually identical to the results of the model presented in equation (2). We also estimated a version of equation (2) using customer-level fixed effects and got virtually identical estimates of the β_{jk} parameters. Robust standard errors were calculated utilizing clustering at the customer level.

4.2.1 Regression results

Table 4.1 summarizes the results from the regression model in equation (2). The non-informed control group will be excluded from future regressions, so parameter estimates for this group are not shown in Table 4.1. In summary, we find that most of the rate and technology treatment groups reduced their consumption significantly during the first event, as indicated by the fact that most of the "Group-Event" interactions (the β_{jk} variables) for the rate and technology treatments (groups 1 through 6) are statistically significant. The reductions during this event ranged from 0.06 kW (CPR group) to 0.132 kW (CPP group).

Perhaps due to cooler weather, we observe that responses among the CPR groups during the second, third and fourth critical peak events (on September 21, 25 and October 5) were not statistically significant. Customers on CPP rates (both with and without the IHD) exhibited reductions that were consistently statistically significant.

Table 4.1. Regression model results

			Group-Event Interaction Effects			
Group	Average Intercept	Average Group effect	14-Sep	21-Sep	25-Sep	5-Oct
CPR		0.01	-0.061*	-0.040	-0.030	-0.050
CPR+IHD		-0.04	-0.100***	-0.040	0.010	-0.050
CPP		-0.02	-0.132**	-0.103*	-0.111**	-0.118**
CPP+IHD		-0.04	-0.119***	-0.082**	-0.078**	-0.073*
Flat Rate + Notification		0.00	0.000	-0.020**	-0.020	-0.030**
No-Notification	0.83					
		During-event effects	-0.027***	-0.140**	-0.119***	-0.120***
		After-event effects	-0.035***	-0.064***	-0.028***	0.017***
		Before-event effects	-0.037*	-0.061**	-0.050**	-0.047**

* indicates significance at the α=0.1 level, **at the α=0.05 level, and *** at the α=0.01 level. Average event responses represent a simple mean of the 4 group-event interaction coefficients; significance was not computed for these estimates.

4.2.2 Load impact analysis

Our load impact analysis based on the regression data starts by computing the average load reduction for each treatment group over the four critical peak events, relative to the no-notification control group. This amounts to taking the average of the four group-event interaction estimates from Table 4.1. Based on this comparison, we calculated load impact measures over the four critical peak events called in 2012.

Figure 4.6 shows the average per-customer hourly kW reduction for each treatment group, based on the estimates of the regression model, plus a 95% confidence interval for each estimate, based on the standard errors of the parameter estimates (these standard errors did not vary substantially between the parameter estimates for the four regressions; the standard errors themselves can be seen in the appendix to this document). Average hourly kW savings for customers on time-differentiated rate and information treatments during critical peak events (relative to the no-notification control group) are 5.4 to 5.7 percent for customers on CPR treatments and 11 to 14.3 percent for customers on CPP treatments, compared to average hourly kW usage by the no-notification control group during times when a critical peak events had not been declared. The two CPP groups exhibited the largest declines in average hourly kW consumption. Average hourly kW savings for the group that received notifications but was not placed on any time-differentiated rate and did not receive the IHD were estimated to be substantially smaller, perhaps a 2 percent savings.

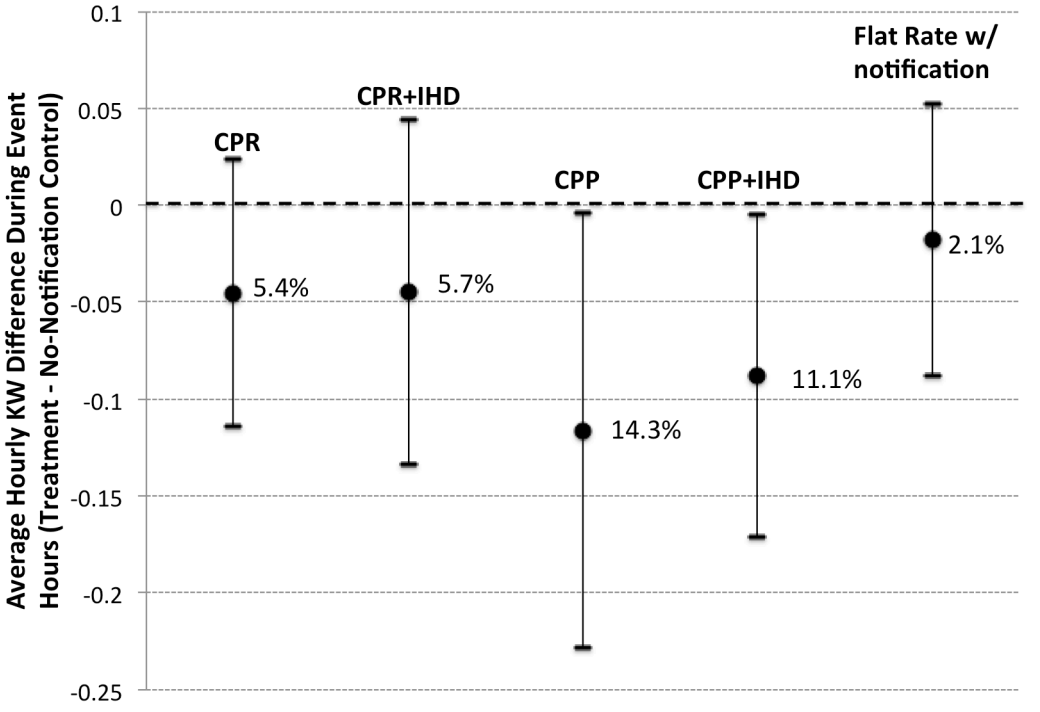

Figure 4.6. Estimated peak-hour reductions for each rate and information treatment group. The markers indicate average estimated reduction (in kW and percentage terms) while the lines above and below the markers indicate a 95% confidence interval.

5. Research Question 4: Reduction in customer bills

Using our estimates of kW reductions during critical peak events (Section 4), and information on the CPP and CPR rates, we can estimate the monetary savings to customers resulting from peak reductions. This is relatively straightforward for the CPP groups as well as the Rate 1 control group (with event notification). To calculate monetary savings for the CPR group, we must assume that GMP will credit each CPR customer based on the difference between that customer's usage during critical peak events and average usage by the no-notification control group during critical peak events. In reality, GMP will calculate peak-time rebates using a customer-specific baseline formula (based on a moving average, like the customer baseline used in PJM's demand response programs). There may be differences between the baseline formula that will determine peak-time rebates and average usage by the no-notification control group. We were unable to recover the baseline estimates calculated by GMP for use in this report.

Based on the regression model from Section 4, the declaration of a critical peak event induced some reductions in consumption during the hours leading up to the event. In equation (2) we defined the variable DB_t as an indicator variable for the six hours prior to the start of each peak event (i.e., 7:00 am to 1:00 pm on event days). Table 4.1 suggests that the average hourly kW reduction during the six hours leading up to a peak event was statistically significant for each of the four events.

Group-specific reductions, as shown in the detail regression results in the Appendix (Table A1) were statistically significant less frequently. In general, the estimated group-specific pre-event reduction was larger for the CPP groups than the CPR groups.

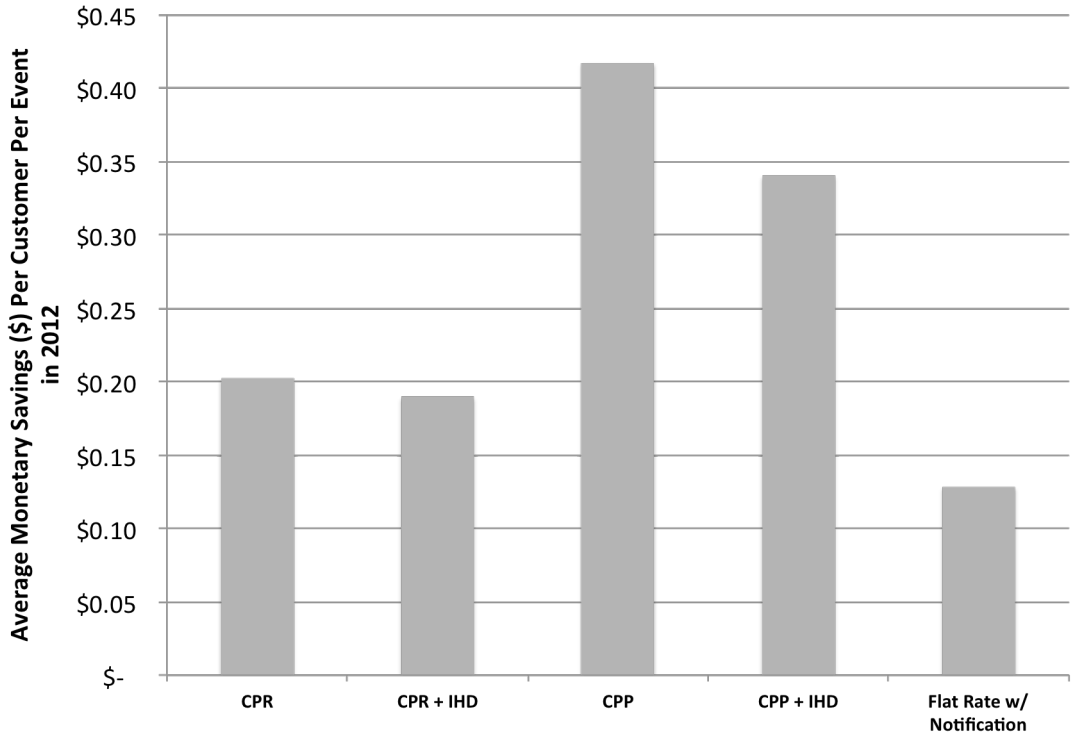

Figure 4.7. Estimated dollar savings per customer, per event for critical peak events in 2012.

For each customer, we calculated the average per-event monetary savings by multiplying the calculated average hourly kW reduction (relative to the no-notification control group) by the duration of each event (six hours) and the relevant rate for each treatment group. We then added the value of any savings during the six hours prior to the start of each critical peak event for the CPR, CPP and CPP+IHD groups. We note that these calculations effectively utilize consumption by the no-notification control group as the baseline for determining kW reductions and associated monetary savings. These savings are expressed mathematically in equation (3).

$$S_{CPP,k} = \underbrace{\left(6 \times \beta_k^{DB(k)} \times \$0.144\right)}_{pre-event} + \underbrace{\left(6 \times \beta_k^{DE(k)} \times \$0.60\right)}_{during-event}$$

(3)

$$S_{PTR,k} = \underbrace{\left(6 \times \beta_k^{DB(k)} \times \$0.148\right)}_{pre-event} + \underbrace{\left(6 \times \beta_k^{DE(k)} \times \$0.60\right)}_{during-event},$$

Figure 4.7 shows the average monetary savings per customer (per-event). The largest per-customer savings was again observed in the CPP group (around $0.42 per event, or nearly $1.68 over four events), followed by the CPP+IHD group, whose savings were around 10 percent smaller ($0.32 per event). The CPR and CPR+IHD groups exhibited nearly identical savings on a per-customer, per-event basis. The during-event savings dominate the bill impacts, since the incremental benefit of a one kW reduction is several times larger during the event, compared to the pre-event hours.

Note that since bills are analyzed for September and October (when load profiles are relatively flat), it is possible that CPP bill savings would occur even in the absence of any load shifting.

6. Research Question 5: Conservation effects of IHDs

In this section we assess whether the presence of the IHD, which gives consumers continuous feedback on electricity usage (as long as the customer is paying attention to the IHD), has the effect of lowering electricity usage during periods other than declared critical peaks.

Our analysis compares monthly energy usage (monthly kWh) for customers with and without IHDs, during the periods before and after the IHDs were installed. We first construct a monthly kWh variable for each customer by summing the observed hourly average kW readings for each customer over the course of a month. The pre-IHD period is defined as March 2012 through July 2012, while the IHD period is defined as August 2012 through December 2012. Since customers received their IHDs over the course of the month of August, this definition is perhaps blunt. Since the IHDs were not installed by GMP, however, we have no way of pinpointing a specific date that an individual customer started using their IHD.

We run a differences-in-differences type of panel regression using all customer data (including those who declined to participate) over the period March through December 2012. The two relevant differences in this analysis are: (i) monthly kWh usage by customers with and without IHDs; and (ii) monthly kWh usage before and after IHDs were mailed to customers in the relevant treatment groups. The specific equation that we estimate is shown in equation (4):

$$(4) \qquad Y_{jt} = \beta_0 + \beta_1 W_t + \delta IHD_j + \varepsilon_{jt}.$$

In equation (4), Y_{jt} measures monthly kWh consumption by customer j during month t; W_t is a measure of weather conditions during month t; and IHD_j is an indicator variable identifying those customers with an IHD. ε_{jt} is the error term. The weather variable we use is the total number of cooling-degree days during each month.

Table 6.1: Regression Parameters from Equation (4)

Variable	Parameter
Constant	777.379***
Monthly Cooling Degree Days	12.766***
IHD Indicator	-28.069**

* indicates significance at the α=0.1 level, **at the α=0.05 level, and *** at the α=0.01 level.

Table 6.1 shows the estimated regression parameters. All three coefficients are statistically significant at the 5 percent level. The regression indicates that on average, customers with IHDs have monthly energy (kWh) usage that is 28 kWh below the average usage for customers without IHDs. A 95 percent confidence interval for this estimate would be a monthly reduction of 4 kWh to 53 kWh, relative to customers with IHDs. This amounts to a 4 percent average reduction in monthly kWh relative to non-IHD customers. If we evaluate these estimated savings at the Rate 1 energy charge of $0.148 per kWh, we get a 95 percent confidence interval for monthly savings among IHD customers of $0.55 to $7.75 per IHD-enabled customer per month.

These results suggest that the value of the IHD to GMP customers is likely not in reducing demand during declared critical peak times, but in giving customers continuous feedback on their household electricity usage. This increased feedback coupled with the conservation and economic motivations of some segments of GMP's customer base (see Section 7) appears to have played a role in reducing overall monthly energy demand. At the average savings level of $4.15 per customer per month, the average IHD-equipped customer would save nearly $50 per year on their electric bill. As discussed further in Section 8, many customers were unsure of how to install the IHD or how to interpret the numbers that appeared on the screen (or how those numbers might suggest behavioral changes). It is possible that with some customer education, the IHD or another real-time feedback mechanism could become more useful in inducing energy-saving behavioral changes.

7. Research Questions 6 and 7: Customer satisfaction and reported actions during declared peak events

In late 2012, GMP commissioned Metrix Matrix to conduct a survey of customers participating in the study. (Metrix Matrix was also involved in the customer qualification and recruitment process, so customers were used to hearing from them; see Appendix 3 for the text of the questions used). This section addresses research question 7: whether customers appear to have higher, or lower, satisfaction in the different rate and information treatments; and the degree to which customers recalled taking specific actions to reduce electricity usage following notifications of peak events.

Customer response rates for the survey are shown in Figure 7.1, and were fairly similar among treatment groups, with 50 percent to 60 percent of customers in each group responding to the survey.

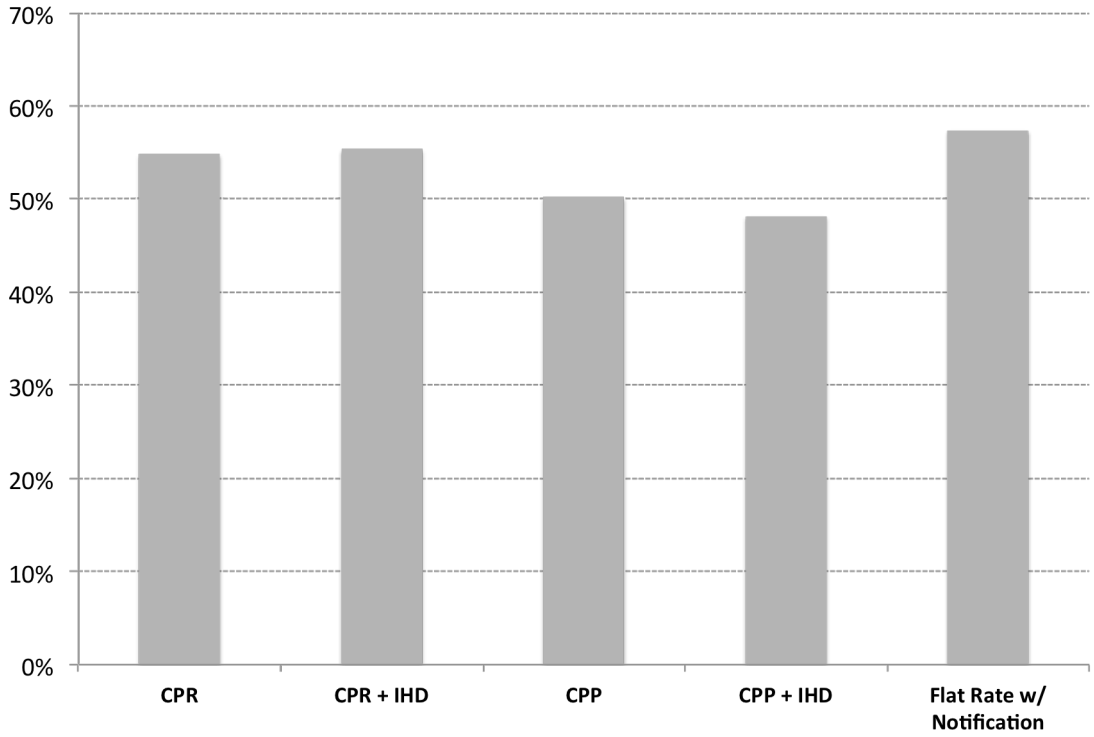

Figure 7.1. Response rates to the interim survey conducted by Metrix Matrix in December 2012.

The interim survey asked customers to assess their level of satisfaction with the program; to provide some specific reasons for their level of satisfaction; and to make recollections about specific actions taken during declared peak events in September and October 2012. The survey results should be taken in light of the fact that customers were asked their opinions and to recall specific actions taken two or three months prior to the survey being conducted. Respondents may have imperfect memories or may not give thoughtful answers. This is illustrated in Figure 10, which shows customer responses to the question of how many peak days they recall being notified about during 2012. While it is understandable that some customers may recall being notified about fewer than four events (due to travel or some other reason), a substantial number of customers reported being notified that there were ten or eleven peak days declared in 2012. In this case, the variance in response may be due to imperfect recollection by customers, or customers may have recalled the number of times that they received individual notifications (some customers reported being notified multiple times about each event) rather than the number of declared peak days.

While the survey responses must be viewed in the context of customers being asked to recall specific things about the peak-time events declared in 2012, survey responses may have some value in assessing not only the program's effectiveness but what customers view as the strong and weak points of the program.

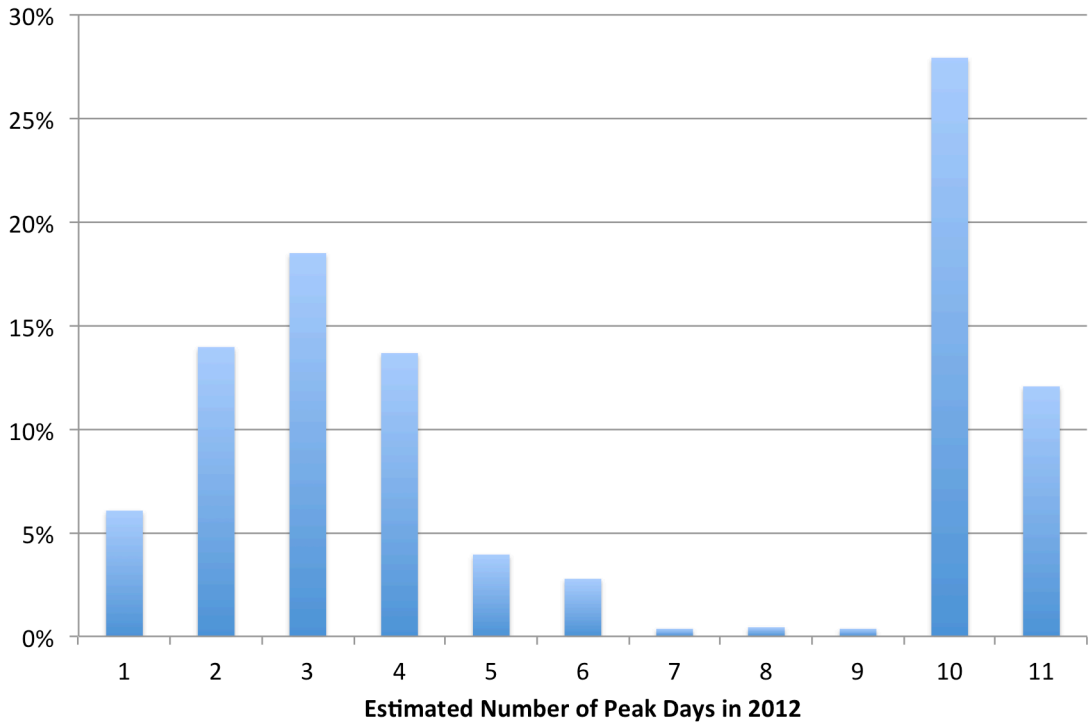

Figure 7.2. Customer recollections of the number of declared peak days in 2012.

7.1 Overall customer satisfaction

Customers were asked to rate their satisfaction with the program in one of six categories:

- Extremely satisfied
- Moderately satisfied
- Neutral
- Moderately satisfied
- Extremely unsatisfied
- Don't know or no response

In the analysis in this section, we have excluded customers that did not express an opinion as to their satisfaction with the program. Of the 1,104 responses received during the interim survey, 113 (or around 10 percent) reported having no opinion as to their satisfaction with the program.

Figure 7.3 shows the average level of reported customer satisfaction for the rate and information treatment groups, along with the group of customers that were notified about peak events but remained on a flat electric rate. Figure 11 also shows the standard deviation in reported customer satisfaction levels. Customers in every treatment group, on average, reported a moderate level of satisfaction with the program. While average satisfaction levels were quite similar between treatment groups, the highest level of average satisfaction was reported by customers that received notifications but were not on a time-differentiated rate. Variation in satisfaction rankings among customers within each treatment group was substantial (as shown by the long standard deviation bars above and below each average point

in Figure 7.3), so we cannot say that customers in one treatment group were significantly more or less satisfied than customers in another treatment group.

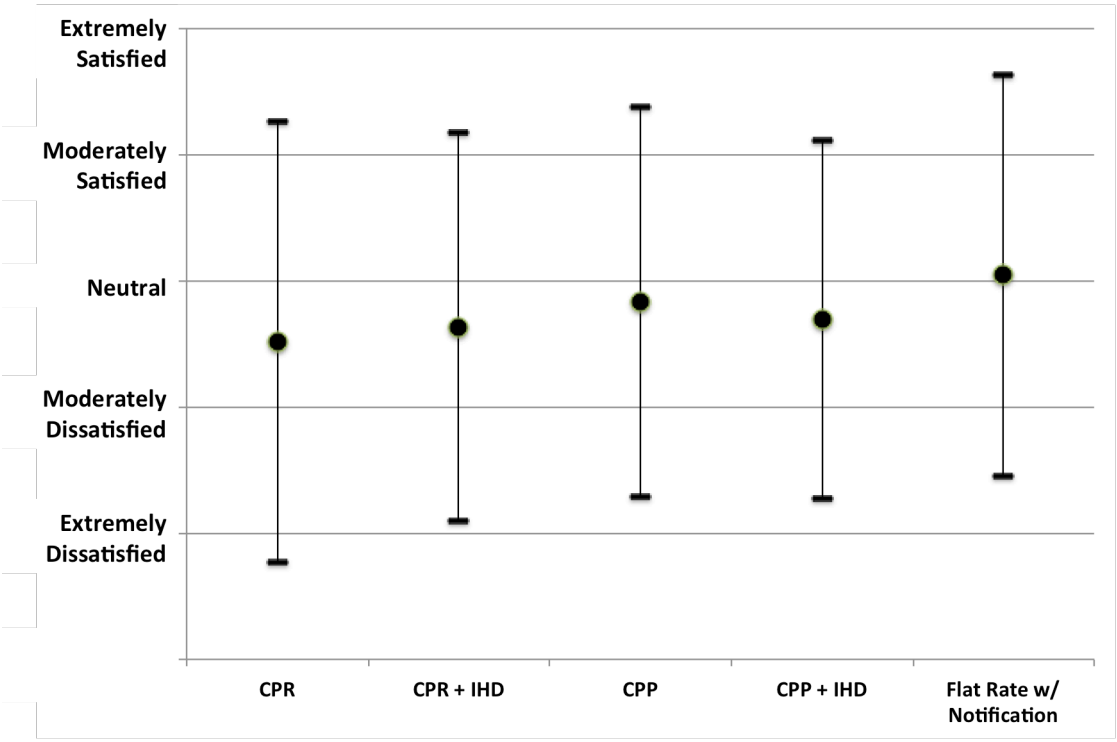

Figure 7.3. Average and standard deviation of customer satisfaction rankings by treatment group.

7.2 Specific actions taken following the declaration of peak events

Customers were also asked to recall specific actions taken to lower electricity consumption during declared critical peak event days. Customers were first asked if they recalled taking any specific action during any of the declared peak days in 2012. Figure 7.4 shows the results by treatment group. With the exception of the group that received notifications but was not on a time differentiated rate and did not receive an IHD, more than 50 percent of respondents in each group said that they recalled taking specific actions in response to peak-day declarations.

Customers placed on the CPR treatment were also asked specifically whether they had checked their bill to determine the size of their rebate in September and October. 583 customers in total responded to this survey question; 197 of the respondents had also been given the IHD while 386 of the respondents had not been given the IHD. 29 percent of respondents who had been given the IHD (57 out of 197) answered that they recalled looking at their bill to determine the size of their rebate. An equal percentage of respondents without the IHD (29 percent of non-IHD respondents or 112 of 386 customers) answered that they recalled looking at their bill to determine the size of their rebate.

Those customers who recalled taking at least one specific action during the four declared peak days in 2012 were then asked what specific action they recalled taking. Customers were asked whether they had taken any of the following actions:

- Changed the settings on their thermostat
- Turned off lights
- Changed timers on thermostats or other household appliances
- Delayed doing laundry
- Delayed cooking
- Adjusted air conditioning
- Took some other action not in the above list

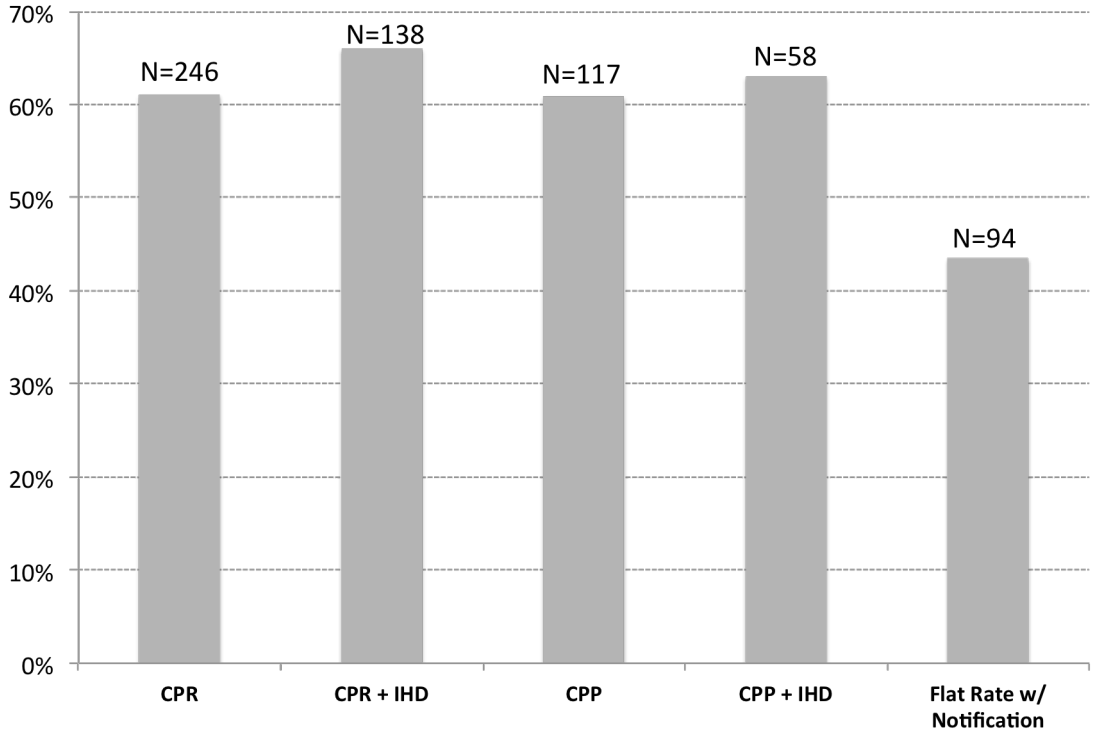

Figure 7.4. Proportion of customers in each group who reported taking specific action during at least one of the declared critical peak days in 2012.

Figures 7.5 and 7.6 show the number and proportion of customers in each group who reported taking each of the above actions during at least one of the declared peak events in 2012. Figures 7.7 through 7.11 show these numbers and proportions in more detail for each reported action taken. Proportions are taken as percentages of customers in each treatment group that responded to questions specific about each action. Referring to Figure 7.6, for example, when asked whether they specifically had changed thermostat settings in response to a declared peak-time event, around 3% of respondents to this question in the CPR group reported having done so, 4% of respondents to this question in the CPP group reported having done so, and so forth. Many customers indicated that they had taken more than one specific action, so the percentages for each treatment group do not necessarily add up to 100%. A small number of customers who indicated taking specific actions did answer "no" or "I don't know" to the question of whether they recalled taking any

action in response to declared peak-time events, or refused to answer that particular question. Similarly, some customers were willing to answer the question of whether they recalled taking any action in response to declared peak-time events but refused to answer questions asking them to recall specific actions they had taken (or answered "I don't know" when asked about all specific actions). Figures 7.7 through 7.13 show the proportion of respondents answering affirmatively to each question (on the vertical axis of each figure), along with the number of respondents in each treatment group answering affirmatively (located above each column).

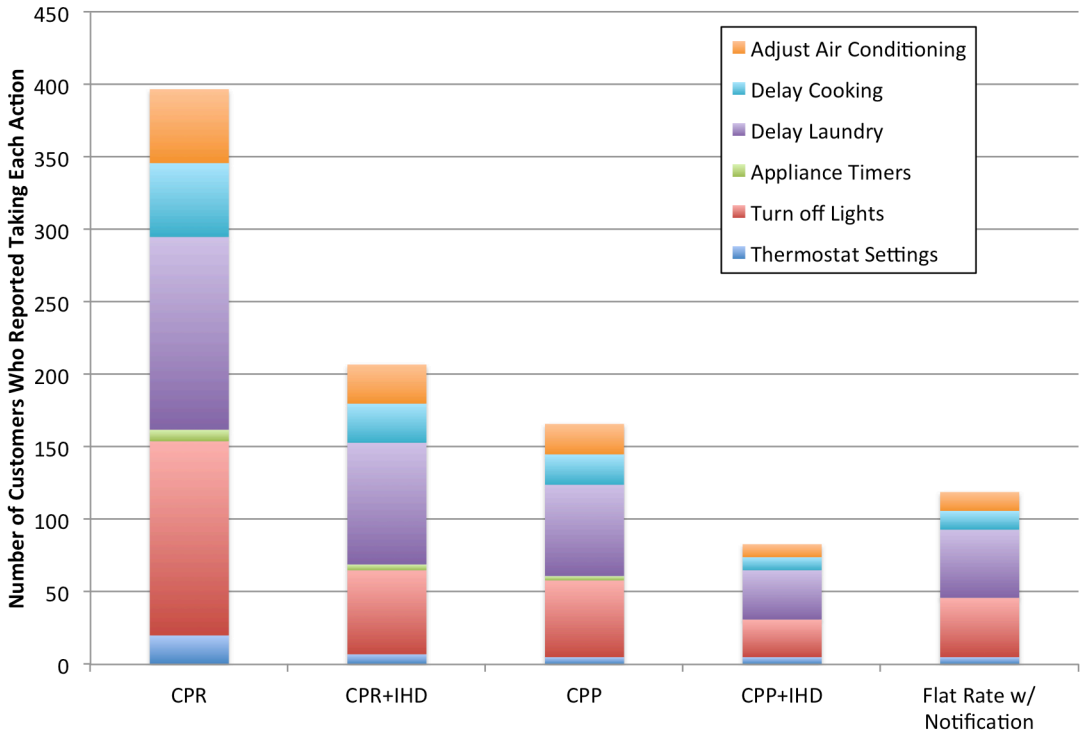

Figure 7.5. Summary of the number of customers in each treatment group who reported taking specific actions during at least one of the declared critical peak days in 2012.

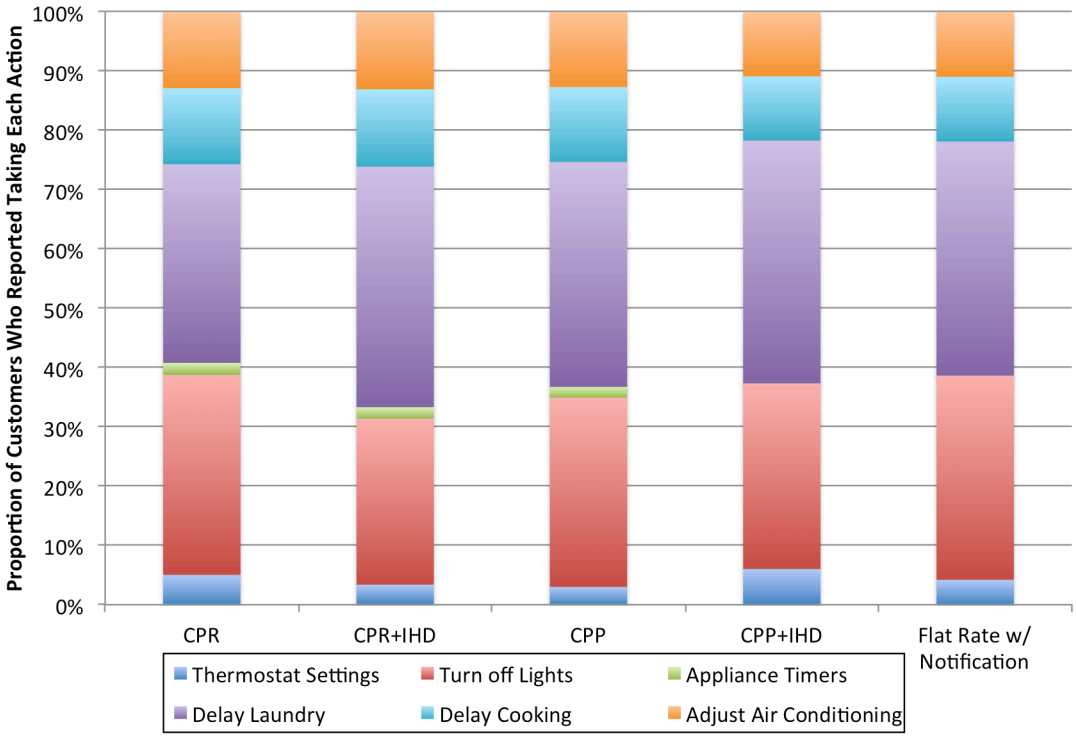

Figure 7.6. Summary of the proportion of customers in each treatment group who reported taking specific actions during at least one of the declared critical peak days in 2012.

Based on the survey results as shown in Figures 7.5 through 7.13, more than half of customers on rate and information (IHD) treatments recalled taking some specific action in response to the declaration of a peak-time event. The most common actions reported by customers were turning off lights, delaying laundry and delaying cooking. Fewer customers with air conditioning reported adjusting air conditioning in response to peak-time declarations, but this low response can likely be attributed to the mild temperature conditions prevailing during the times when peak events were called in 2012.

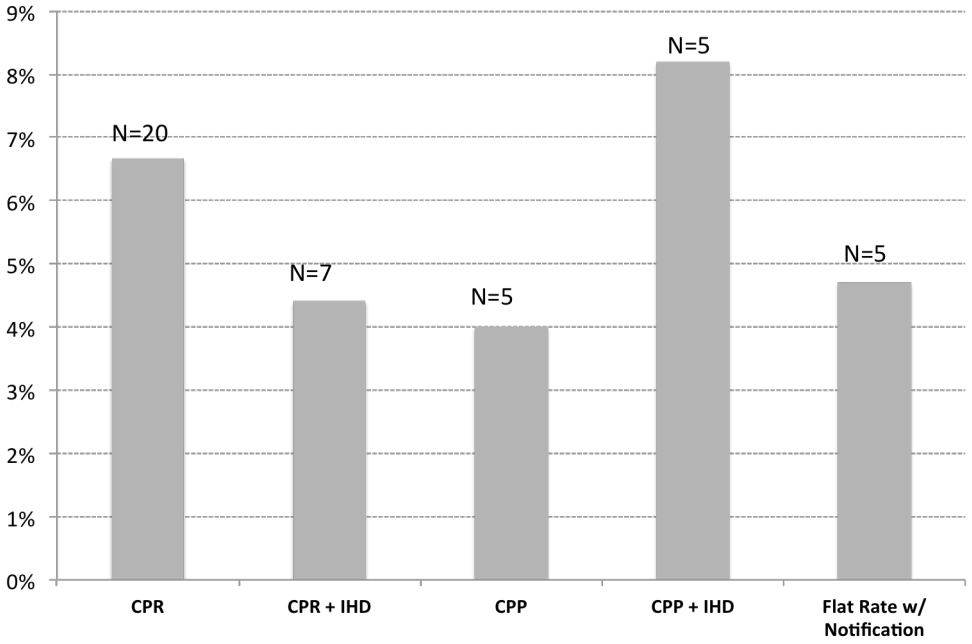

Figure 7.7. Proportion of customers in each group who reported changing thermostat settings during at least one of the declared critical peak days in 2012.

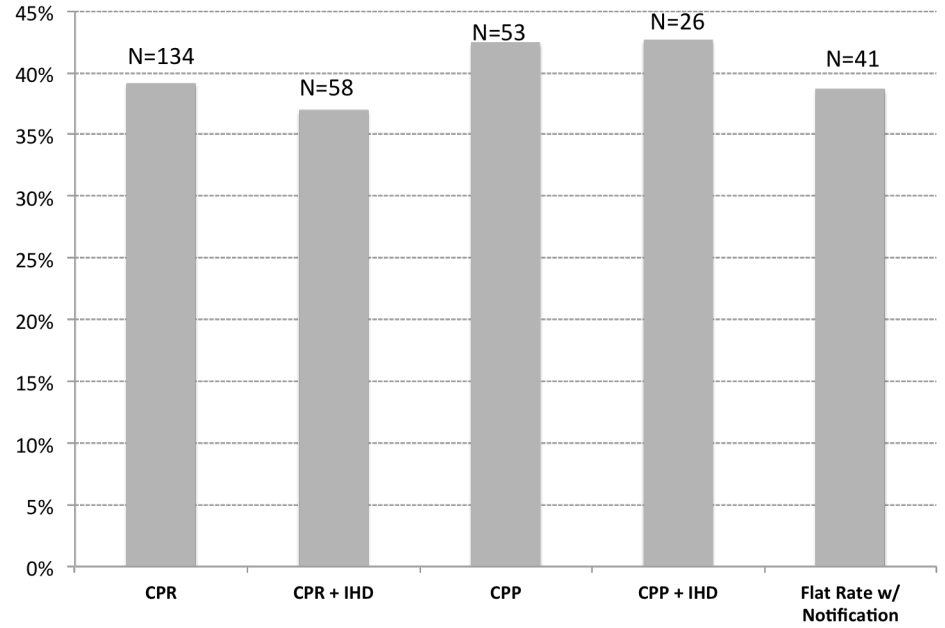

Figure 7.8. Proportion of customers in each group who reported turning off lights during at least one of the declared critical peak days in 2012.

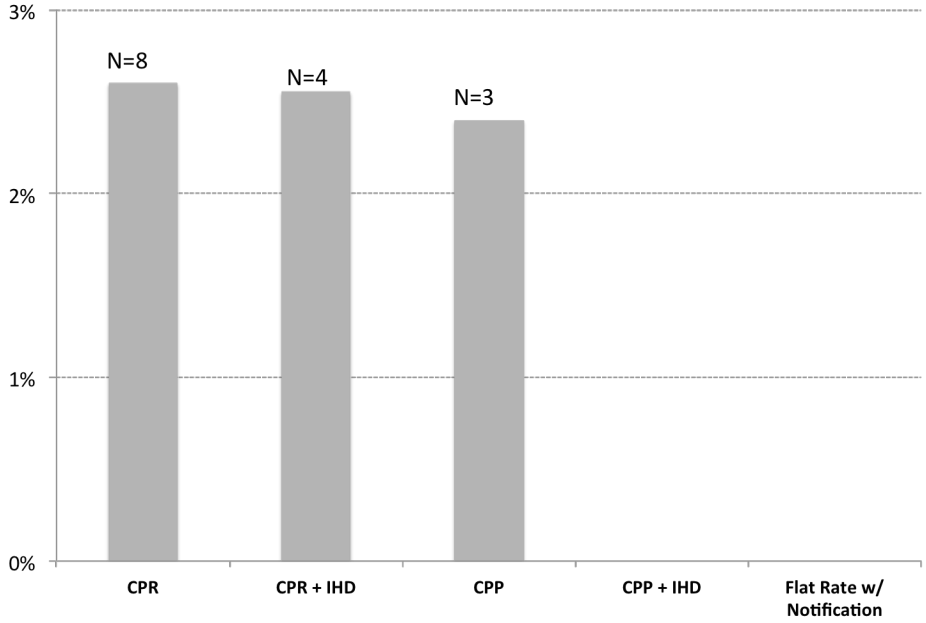

Figure 7.9. Proportion of customers in each group who reported changing timers on appliances during at least one of the declared critical peak days in 2012.

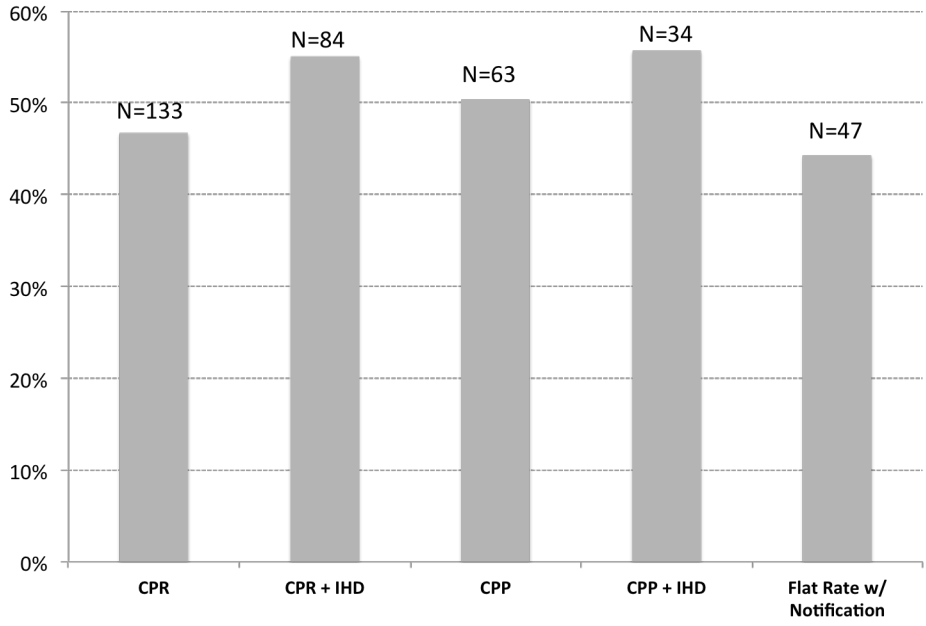

Figure 7.10. Proportion of customers in each group who reported delaying laundry during at least one of the declared critical peak days in 2012.

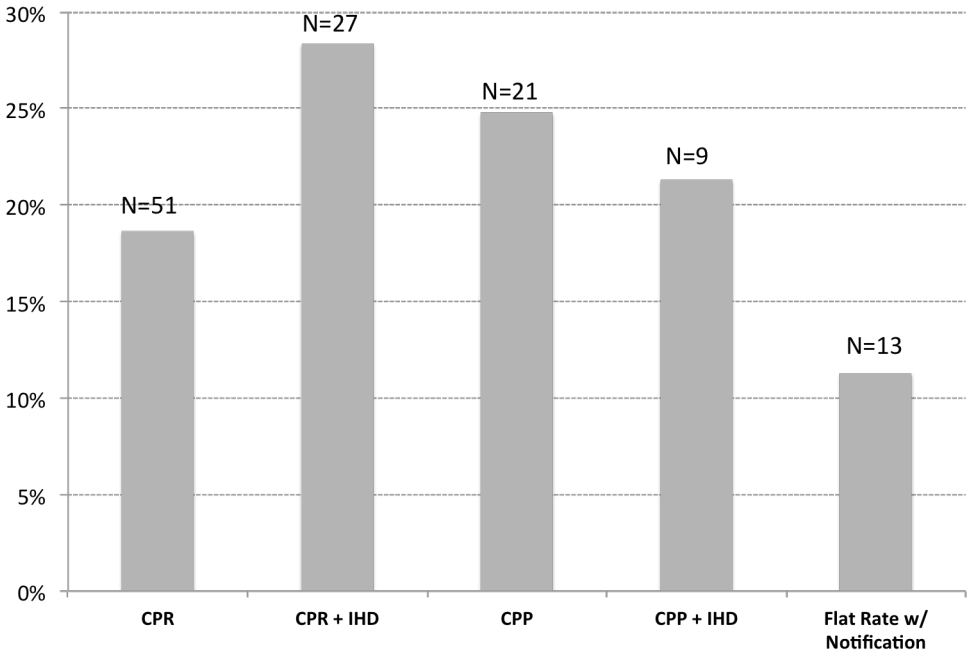

Figure 7.11. Proportion of customers in each group who reported delaying cooking during at least one of the declared critical peak days in 2012.

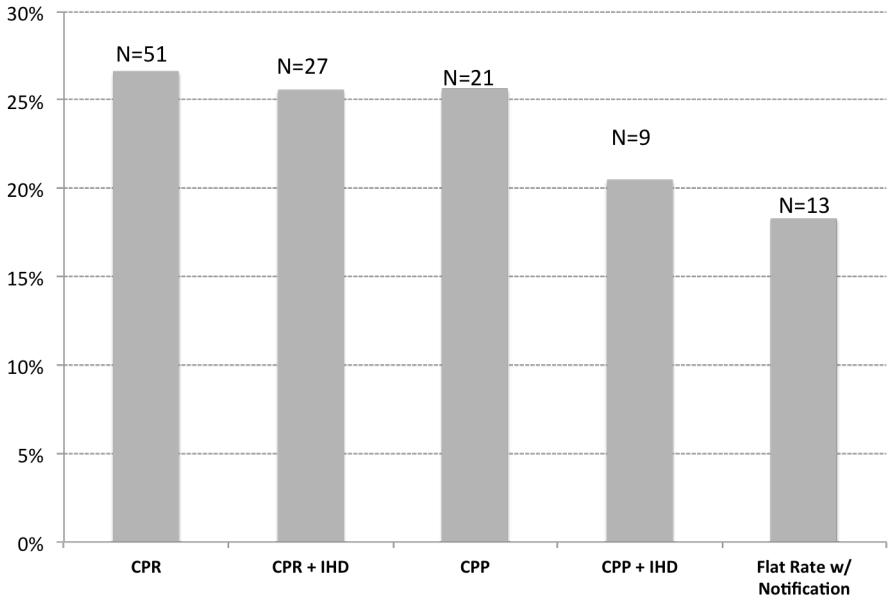

Figure 7.12. Proportion of customers *with air conditioning* in each group who reported adjusting settings on air conditioners during at least one of the declared critical peak days in 2012.

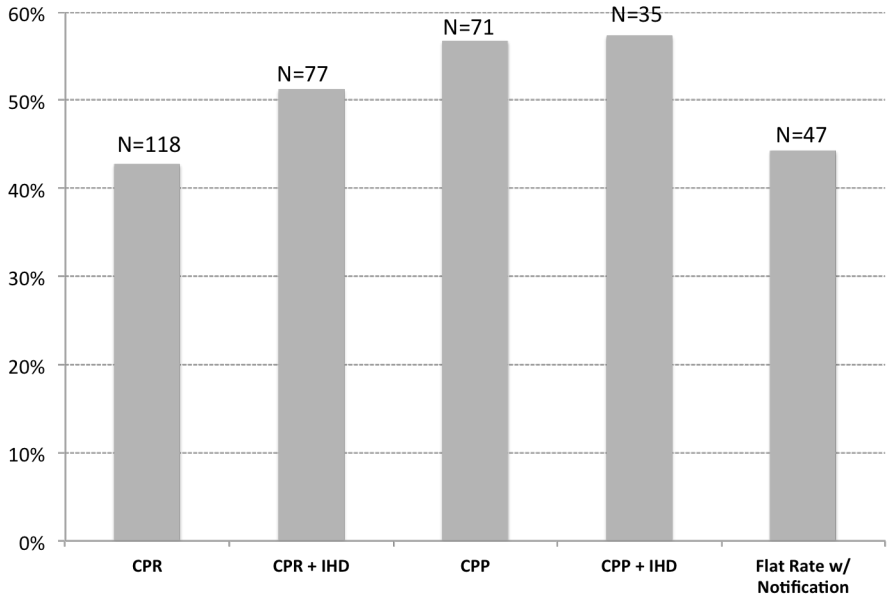

Figure 7.13. Proportion of customers in each group who reported taking some other action during at least one of the declared critical peak days in 2012.

7.3 Qualitative assessments of program satisfaction

As part of the interim survey, customers were given the opportunity to provide qualitative reasons as to their level of satisfaction. These responses were recorded verbatim. We have gone through the individual qualitative responses and categorized them. While this analysis is inherently subjective, most customers offered reasonably easily-identifiable reasons for their level of satisfaction (even if the reason given was "I don't know"). This section shows our analysis of these qualitative results. In general, customers who were either dissatisfied with the program or who felt neutral about the program gave qualitative responses that were similar in nature. For example, virtually no customer reported dissatisfaction because he or she saved a lot of money on their monthly energy bill. Customers who were satisfied with the program also gave qualitative responses that were similar in nature, though a small number of customers gave the program a high satisfaction rating and were then critical of some aspects of the program's structure or outcomes when asked to provide qualitative feedback.

7.3.1 Assessment of customers who were neutral or dissatisfied with the program

For customers who reported being neutral towards the program; or who reported a moderate or extreme level of dissatisfaction, we categorized their qualitative responses into seven classifications:

1. Dissatisfied with or did not understand their new rate
2. Dissatisfied with or did not understand the IHD (calculated as a percentage of respondents in one of the three technology treatments)
3. No change in bill or increase in bill

4. Did not receive notifications or did not understand what to do after notifications were received
5. Dislike smart meters or dislike GMP more generally
6. Unspecified reasons (were not paying attention to the rate, technology or notifications; or did not recall being part of the study)
7. Other reasons (generally having nothing to do with the study itself)

Figures 7.14 through 7.16 show the distribution of each of these seven types of responses for customers who ranked their level of satisfaction as "neutral," "moderately dissatisfied" or "extremely dissatisfied." The most often-cited reasons for dissatisfaction or a neutral feeling towards the program (apart from a number of customers who answered "I don't know" as to why they felt neutral about the program) were that customers perceived that they were not saving enough money to make the program worthwhile; they did not understand how to install or utilize the IHD; or they did not receive notifications or did not understand what they should do following the notifications being sent out. A small number of customers reported being notified excessively during the period leading up to at least one of the four events.

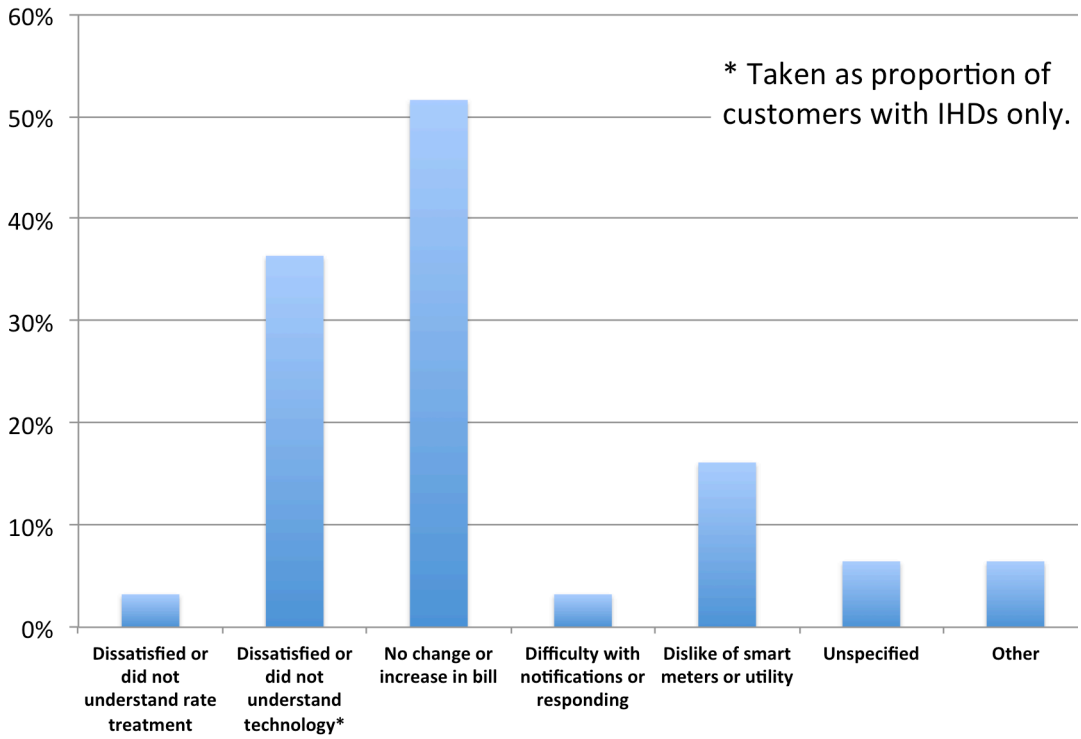

Figure 7.14. Qualitative Responses of Customers Ranking "Extremely Unsatisfied" (31 total; 11 with IHD).

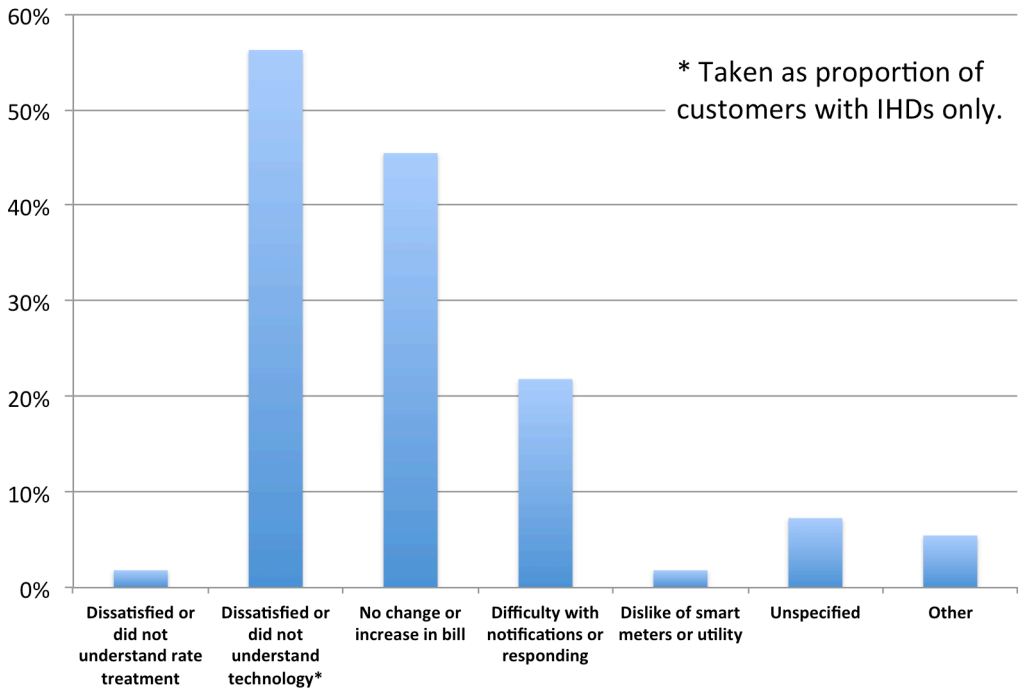

Figure 7.15. Qualitative Responses of Customers Ranking "Moderately Unsatisfied" (55 total; 16 with IHD).

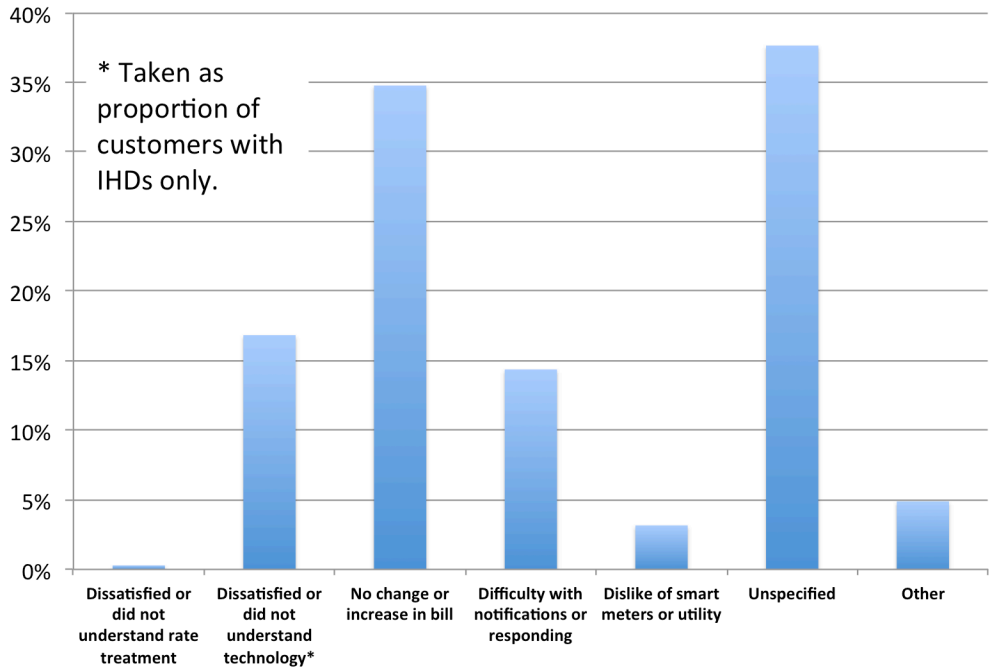

Figure 7.16. Qualitative Responses of Customers Ranking "Neutral" (348 total; 101 with IHD).

7.3.2 Assessment of customers who were satisfied with the program

For customers who reported being moderately or extremely satisfied with the program, we categorized their qualitative responses into ten classifications, as shown below. We note that some customers reported being satisfied with the program but gave qualitative comments that were critical of some elements of the program or suggested some level of confusion or indifference towards the program.

1. Decline in bill or in energy usage
2. Motivated by conservation, environmental reasons, increased reliability, etc.
3. Liked the IHDs
4. Liked receiving peak-time notifications
5. Improvement in service from the utility (usually noted as faster response to outages)
6. Did not receive notifications or did not understand what to do after notifications were received
7. Difficulty with IHD or did not understand how to use the IHD
8. Unsure of any particular benefit or responded that the program worked fine without offering a specific reason
9. Active dislike of the program
10. Other reasons (generally having nothing to do with the study itself)

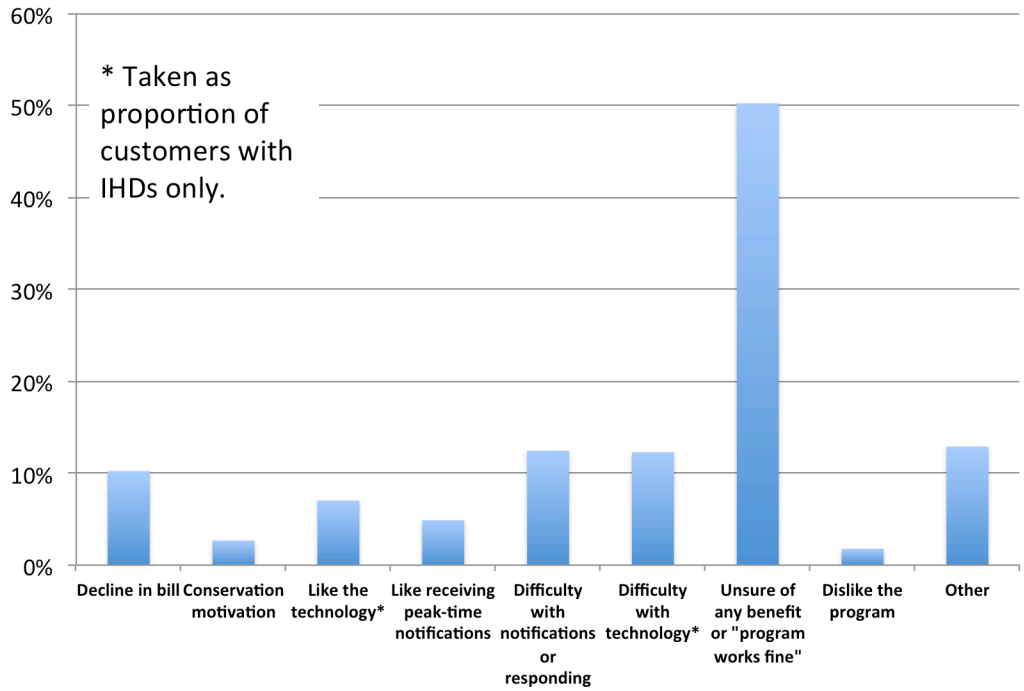

Figure 7.17. Qualitative Responses of Customers Ranking "Moderately Satisfied" (225 total; 57 with IHD).

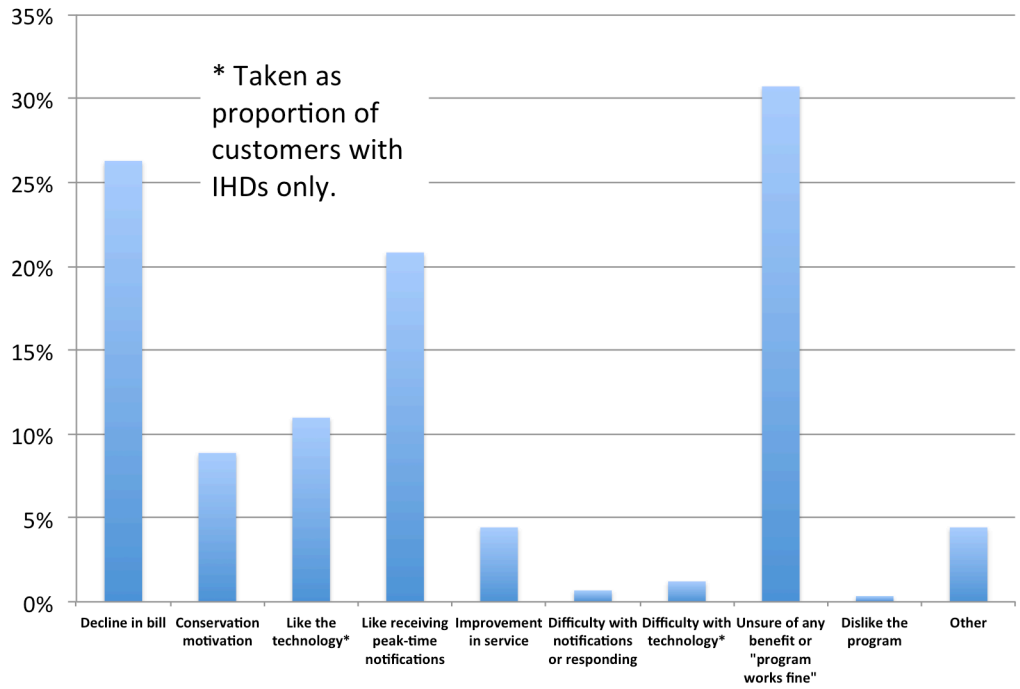

Figure 7.18. Qualitative Responses of Customers Ranking "Extremely Satisfied" (293 total; 82 with IHD).

Figures 7.17 and 7.18 show the distribution of responses. Aside from customers that did not offer a specific reason for their favorable ranking of the program (which amounted to 50 percent of respondents who were "moderately satisfied" and 30 percent who were "extremely satisfied"), those who were satisfied with the program tended to feel so because they liked saving money on their monthly electric bill and like receiving the peak-time notifications from GMP. Among customers who reported being "extremely satisfied" with the program a bit more than 10 percent singled out the IHD as a reason for their satisfaction level.

8. Conclusions

Based on this analysis of the data from critical peak events called in the Fall of 2012, we can conclude that the CPR and CPP treatments had a statistically significant impact on electric power consumption during the periods when events were called in September and October 2012. The results from several statistical tests are similar and suggest that average kW reductions during declared peak events in 2012 were between 5.4 and 5.7 percent for customers on the CPR rate (relative to the control group) and 11 to 14.3 percent for customers on the CPP rate. The larger average kW response for CPP customers, relative to CPR customers, is statistically significant. Groups with IHDs showed larger responses on average than their non-IHD counterparts, though the considerable variation in customer response levels makes it difficult to ascertain whether or not this difference could be considered statistically significant. Customers with IHDs did, however, exhibit statistically significant savings in monthly energy consumption (monthly kWh).

Our analysis of the customer survey data shows that while many customers were satisfied with their participation in the program, many also indicated that they did not notice the amount of money that they saved, did not get the notifications that they expected or felt confused as to what they were supposed to do after getting the notifications, or were not able to get the IHD technology to work. Only a minority of CPR customers (around 30 percent) reported checking their monthly electric bill to see what their rebate was, perhaps suggesting a belief that the rebates would not be large enough to take the time to understand (or to remember looking for), or that customers found information on their monthly bills to be confusing or difficult to find. While survey results are inherently subject to imperfect memories and varying levels of motivation to answer survey questions thoughtfully, some of the criticisms and concerns raised by customers could be helpful in designing and rolling out future rates and peak-time conservation programs that are aimed at leveraging investments in smart grid infrastructure.

The results in this report are not definitive (since the program has been in place, effectively, for less than one year), but the results suggest that even under moderate temperature conditions, time-differentiated rates can induce customers within the GMP service territory to reduce electricity consumption during daytime periods. Given that the summer 2013 events were called on warmer days with higher electricity demand, the size the responses observed is likely to be larger than that reported in this interim evaluation.

Appendix 1
Supplemental data

This appendix presents more detailed data and regression output than appears in the main body of the report. It is provided here primarily for those readers interested in more statistical detail.

Customer load shapes during the four 2012 events.

Figures A1 through A4 present average hourly kW during each of the four events for all treatment groups and the no-notification control group. These figures were developed based on hourly averaging of the customer-level 15-minute interval meter data.

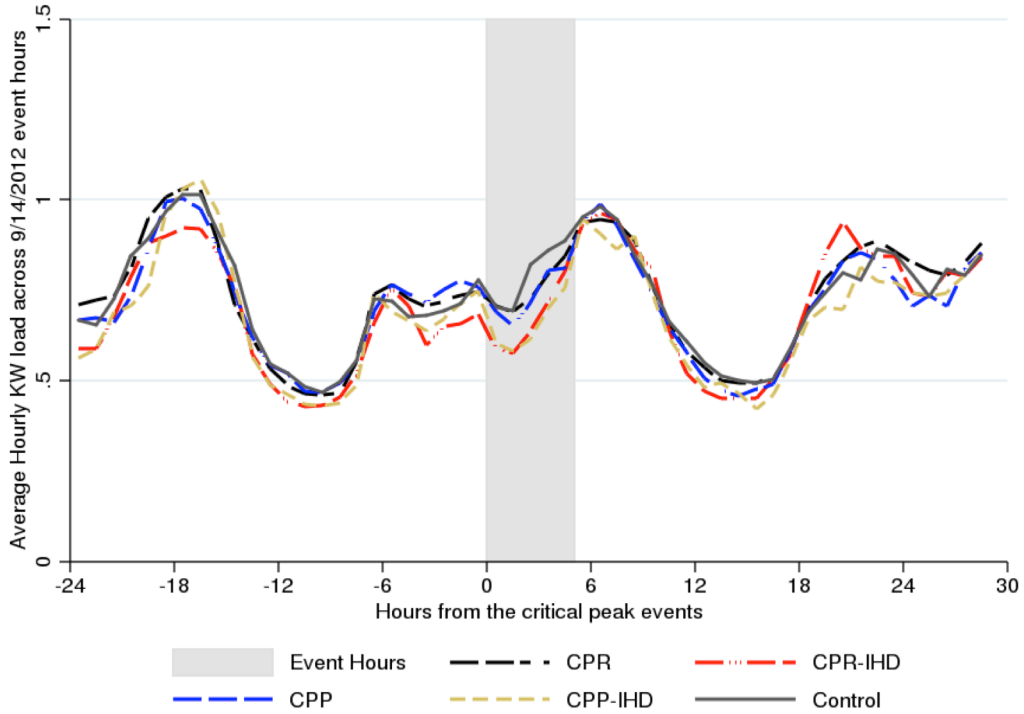

Figure A1. Average hourly kW consumption for the 9/14/2012 event for all rate

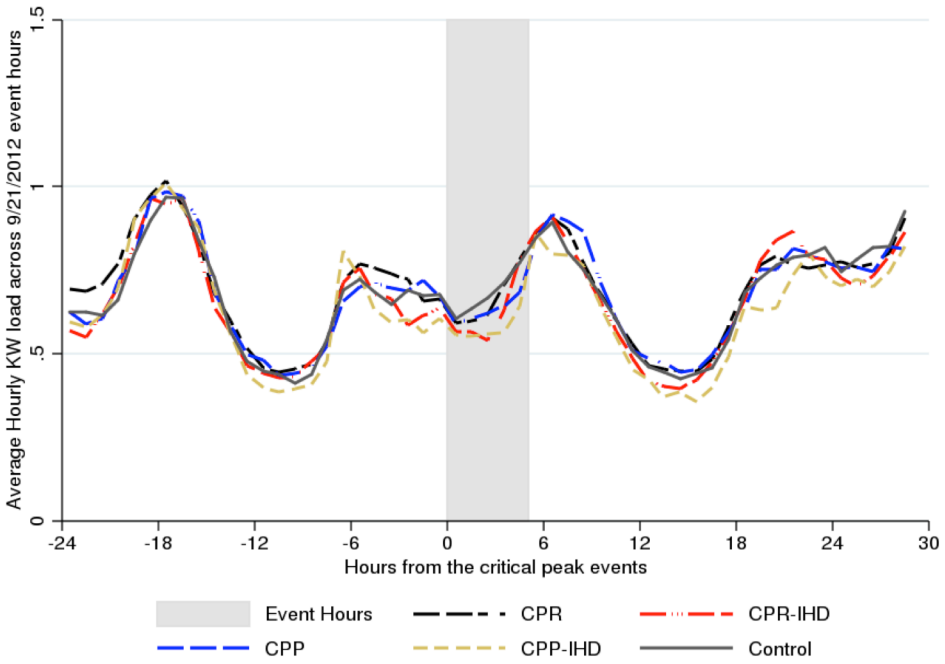

Figure A2. Average hourly kW consumption for the 9/21/2012 event for all rate and information treatment groups, and the no-notification control group.

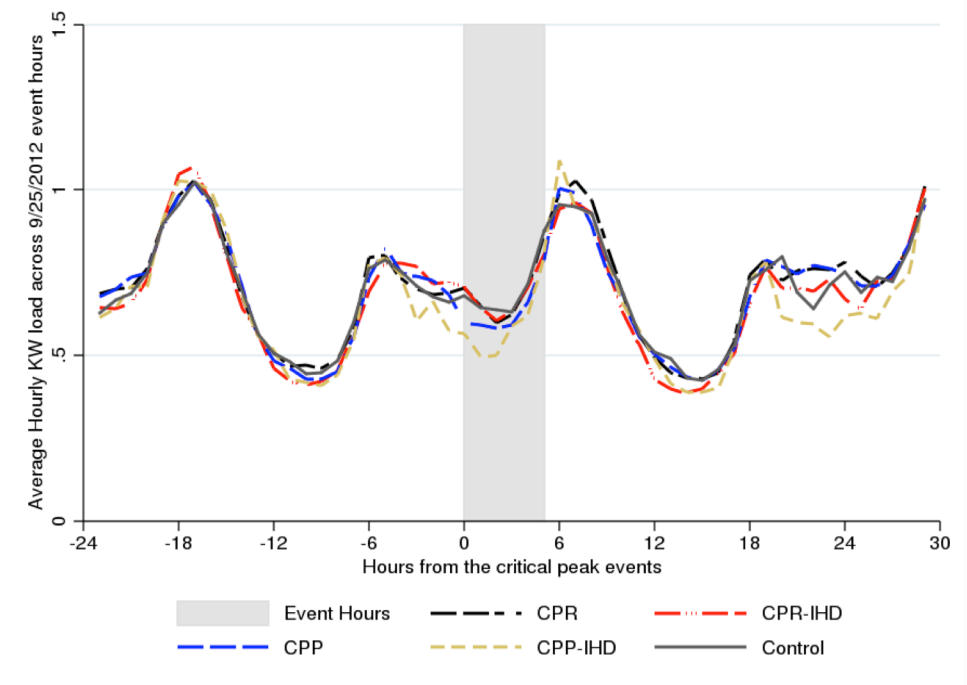

Figure A3. Average hourly kW consumption for the 9/25/2012 event for all rate

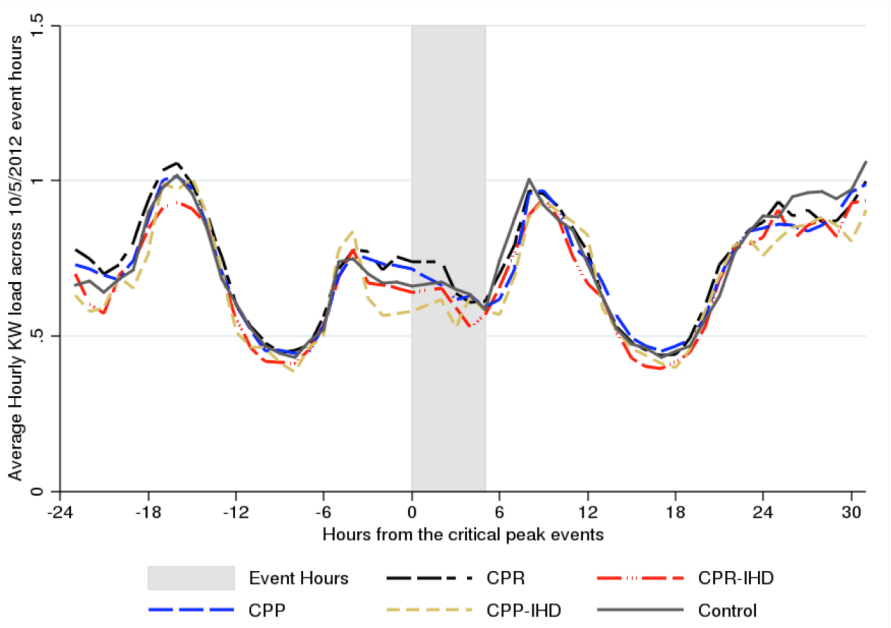

Figure A4. Average hourly kW consumption for the 10/15/2012 event for all rate and information treatment groups, and the no-notification control group.

Load impacts during the four 2012 events

This section contains graphs of the differences in hourly average kW consumption between each of the rate and information treatment groups and the no-notification control group (Figures A5 – A8).

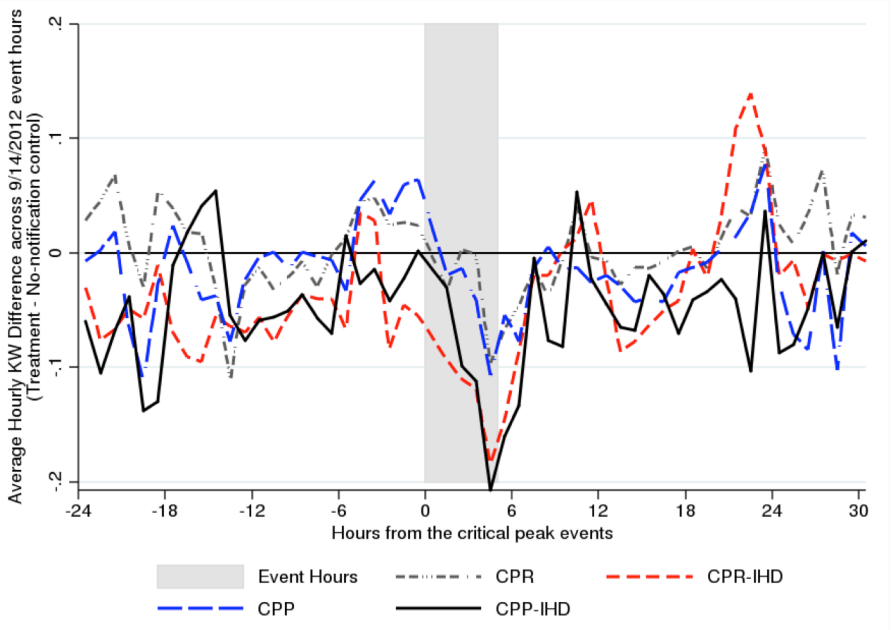

Figure A9. Average hourly kW differences between the treatment groups and the no-notification control group for the 9/14/2012 event.

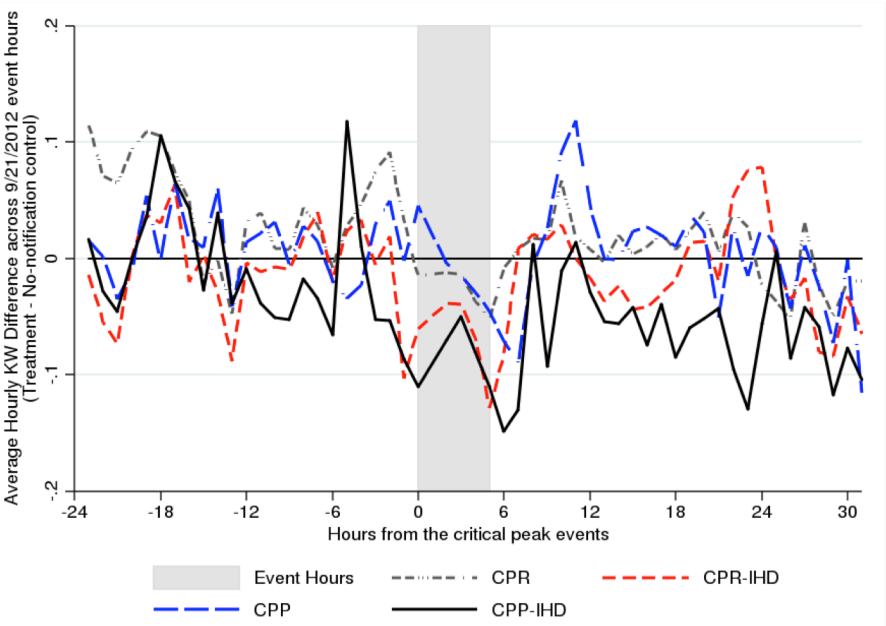

Figure A10. Average hourly kW differences between the treatment groups and the no-notification control group for the 9/21/2012 event.

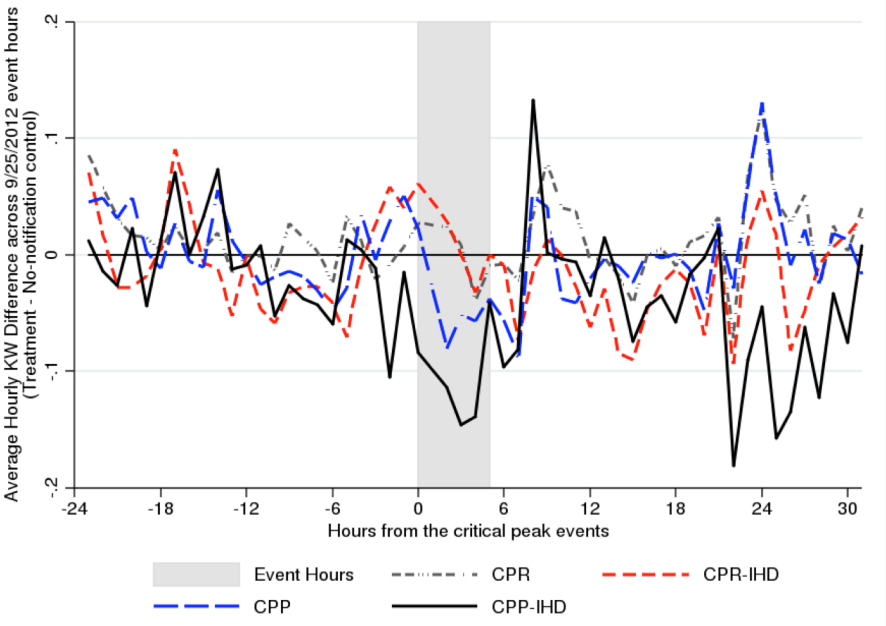

Figure A11. Average hourly kW differences between the treatment groups and the no-notification control group for the 9/25/2012 event.

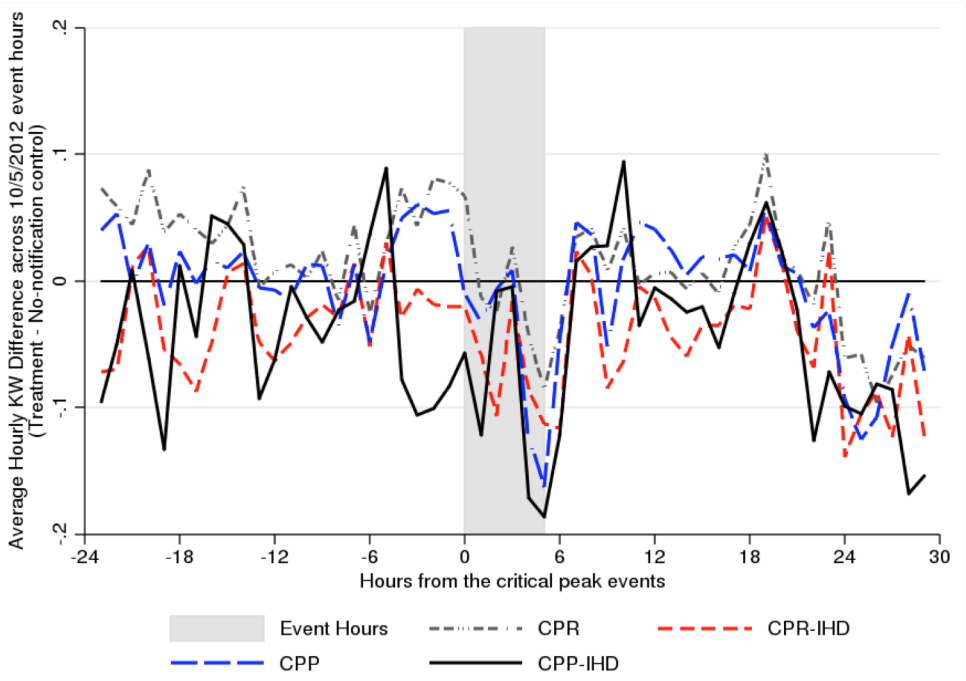

Figure A12. Average hourly kW differences between the treatment groups and the no-notification control group for the 10/5/2012 event.

Regression results: RED and RCT regression analysis on customer-level average hourly kW

We estimated versions of equation (2) using the RED method described in the text, and also using the RCT method, in which we omit the first stage of the regression and simply estimate the second-stage equation including those customers who declined to participate or decided to stop participating at some point after being placed on their rate and/or information treatments.

Table A1 shows the full regression output from the RED regression, while Table A2 shows the full regression output from an RCT version of equation (2) that was not used in the load impact analysis (the regression results are shown only for reference with the RED model). The primary differences between the RCT and RED regressions arise in the estimated group-level fixed effects. There are some minor differences in the weather parameter estimates as well but these differences are small enough that they do not show up until the fourth significant decimal place.

Table A1: RED regression output

	Independent Variables	*Parameter Estimate*
Weather Variables	Heat Index	-0.003***
		(0.000)
	Cooling Hours	0.023***
		(0.001)
	Cumulative Cooling Hours	0.001***
		(0.000)
Group-level fixed effects	CPR	0.021
		(0.026)
	CPR with IHD	-0.027
		(0.030)
	CPP	-0.018
		(0.028)
	CPP - IHD	-0.034
		(0.039)
	Flat Rate No Notification	0.001
		(0.008)
Event-level fixed effects	Critical Peak Event 1 hours	-0.192***
		(0.026)
	Critical Peak Event 2 hours	-0.089***
		(0.024)
	Critical Peak Event 3 hours	-0.009
		(0.024)
	Critical Peak Event 4 hours	-0.088***
		(0.024)
	Hours Before Event 1	-0.037*
		(0.022)
	Hours Before Event 2	-0.061**
		(0.024)
	Hours Before Event 3	-0.050**
		(0.022)
	Hours Before Event 4	-0.047**
		(0.022)
	Hours After Event 1	-0.035***
		(0.006)
	Hours After Event 2	-0.064***
		(0.005)
	Hours After Event 3	-0.028***
		(0.005)
	Hours After Event 4	0.017***
		(0.006)

Table A1 (continued)

	Independent Variables	*Parameter Estimate*
Group-level Interactions for Event 1	DE_1_group_1	-0.061*
		(0.032)
	DE_1_group_2	-0.102***
		(0.035)
	DE_1_group_3	-0.127**
		(0.059)
	DE_1_group_4	
	DE_1_group_9	-0.001
		(0.035)
Group-level Interactions for Event 2	DE_2_group_1	-0.041
		(0.029)
	DE_2_group_2	-0.036
		(0.033)
	DE_2_group_3	-0.098*
		(0.053)
	DE_2_group_4	
	DE_2_group_9	-0.021
		(0.035)
Group-level Interactions for Event 3	DE_3_group_1	-0.034
		(0.029)
	DE_3_group_2	0.004
		(0.041)
	DE_3_group_3	-0.106*
		(0.055)
	DE_3_group_4	
	DE_3_group_9	-0.014
		(0.034)

Table A1 (continued)

	Independent Variables	*Parameter Estimate*
Group-level Interactions for Event 4	DE_4_group_1	-0.049
		(0.029)
	DE_4_group_2	-0.050
		(0.034)
	DE_4_group_3	-0.113**
		(0.054)
	DE_4_group_4	
	DE_4_group_9	-0.029
		(0.033)
Group-level interactions for the period before event 1	DB_1_group_1	0.005
		(0.027)
	DB_1_group_2	-0.007
		(0.031)
	DB_1_group_3	0.051*
		(0.030)
	DB_1_group_4	0.002
		(0.039)
	DB_1_group_9	0.001
		(0.031)
Group-level interactions for the period before event 2	DB_2_group_1	0.015
		(0.029)
	DB_2_group_2	0.000
		(0.032)
	DB_2_group_3	0.023
		(0.032)
	DB_2_group_4	-0.039
		(0.040)
	DB_2_group_9	-0.014
		(0.033)

Table A1 (continued)

	Independent Variables	*Parameter Estimate*
Group-level interactions for the period before event 3	DB_3_group_1	-0.014
		(0.027)
	DB_3_group_2	0.061*
		(0.035)
	DB_3_group_3	0.016
		(0.030)
	DB_3_group_4	-0.032
		(0.039)
	DB_3_group_9	0.020
		(0.032)
Group-level interactions for the period before event 4	DB_4_group_1	0.041
		(0.028)
	DB_4_group_2	0.015
		(0.031)
	DB_4_group_3	0.044
		(0.032)
	DB_4_group_4	-0.030
		(0.035)
	DB_4_group_9	0.003
		(0.031)
	Constant	0.910***
		(0.020)
	Number of observations	14,904,158
	Adjusted R2	
	note: *** p<0.01, ** p<0.05, * p<0.1	

Table A2: RCT regression output

	Independent Variables	*Parameter Estimate*
Weather Variables	Heat Index	-0.003***
		(0.000)
	Cooling Hours	0.023***
		(0.001)
	Cumulative Cooling Hours	0.001***
		(0.000)
Group-level fixed effects	CPR	0.021***
		(0.026)
	CPR with IHD	-0.027***
		(0.030)
	CPP	-0.004***
		(0.001)
	CPP - IHD	-0.034
		(0.039)
	Flat Rate No Notification	0.021***
		(0.001)
Event-level fixed effects	Critical Peak Event 1 hours	-0.192***
		(0.026)
	Critical Peak Event 2 hours	-0.089***
		(0.024)
	Critical Peak Event 3 hours	-0.009
		(0.024)
	Critical Peak Event 4 hours	-0.088***
		(0.024)
	Hours Before Event 1	-0.037*
		(0.022)
	Hours Before Event 2	-0.061**
		(0.024)
	Hours Before Event 3	-0.050**
		(0.022)
	Hours Before Event 4	-0.047**
		(0.022)
	Hours After Event 1	-0.035***
		(0.006)
	Hours After Event 2	-0.064***
		(0.005)
	Hours After Event 3	-0.028***
		(0.005)
	Hours After Event 4	0.017***
		(0.006)

Table A2 (continued)

	Independent Variables	*Parameter Estimate*
Group-level Interactions for Event 1	DE_1_group_1	-0.061*
		(0.032)
	DE_1_group_2	-0.102***
		(0.035)
	DE_1_group_3	-0.050
		(0.034)
	DE_1_group_4	-0.119***
		(0.046)
	DE_1_group_9	-0.001
		(0.035)
Group-level Interactions for Event 2	DE_2_group_1	-0.041
		(0.029)
	DE_2_group_2	-0.036
		(0.033)
	DE_2_group_3	-0.042
		(0.030)
	DE_2_group_4	-0.082**
		(0.039)
	DE_2_group_9	-0.021
		(0.035)
Group-level Interactions for Event 3	DE_3_group_1	-0.034
		(0.029)
	DE_3_group_2	0.004
		(0.041)
	DE_3_group_3	-0.050
		(0.031)
	DE_3_group_4	-0.078**
		(0.039)
	DE_3_group_9	-0.014
		(0.034)

Table A2 (continued)

	Independent Variables	*Parameter Estimate*
Group-level Interactions for Event 4	DE_4_group_1	-0.049*
		(0.029)
	DE_4_group_2	-0.050
		(0.034)
	DE_4_group_3	-0.057*
		(0.031)
	DE_4_group_4	-0.073*
		(0.040)
	DE_4_group_9	-0.029
		(0.033)
Group-level interactions for the period before event 1	DB_1_group_1	0.005
		(0.027)
	DB_1_group_2	-0.007
		(0.031)
	DB_1_group_3	0.051*
		(0.030)
	DB_1_group_4	0.002
		(0.039)
	DB_1_group_9	0.001
		(0.031)
Group-level interactions for the period before event 2	DB_2_group_1	0.015
		(0.029)
	DB_2_group_2	0.000
		(0.032)
	DB_2_group_3	0.023
		(0.032)
	DB_2_group_4	-0.039
		(0.040)
	DB_2_group_9	-0.014
		(0.033)

Table A2 (continued)

	Independent Variables	*Parameter Estimate*
Group-level interactions for the period before event 3	DB_3_group_1	-0.014
		(0.027)
	DB_3_group_2	0.061*
		(0.035)
	DB_3_group_3	0.016
		(0.030)
	DB_3_group_4	-0.033
		(0.039)
	DB_3_group_9	0.020
		(0.032)
Group-level interactions for the period before event 4	DB_4_group_1	0.041
		(0.028)
	DB_4_group_2	0.015
		(0.031)
	DB_4_group_3	0.044
		(0.032)
	DB_4_group_4	-0.030
		(0.035)
	DB_4_group_9	0.003
		(0.031)
	Constant	0.910***
		(0.020)
	Number of observations	14,904,158
	Adjusted R2	
	note: *** p<0.01, ** p<0.05, * p<0.1	

Regression results: Monthly kWh analysis

Table A3 shows the full regression output from the monthly kWh estimation in Section 7. Figures in parentheses are standard errors for the parameter estimates.

Table A3: Monthly kWh regression output

Variable	Parameter
Constant	777.379***
	(13.667)
Monthly Cooling Degree Days	12.766***
	(0.573)
IHD Indicator	-28.069**
	(12.162)
N_obs	*22,313*
Adjusted R-squared	*0.024*

Note: Standard errors in parentheses.

Appendix 2
Recruitment Process, Survey Scripts and Timeline

This appendix includes documents related to the recruitment process and survey.

To summarize, the recruitment process proceeded as follows:

1. **Late 2011**: CVPS/GMP identified 19,936 customers from their Customer Information System (CIS) database who were potentially qualified for this study. 1200 of these were assigned to the no-survey control group.
2. **January 2012**: Metrix Matrix identified that 2191 customers had incomplete contact data, and then randomly assigned each of the remaining 16,545 customers to exactly one of the 9 treatment groups.
3. **February – April 2012**: Metrix Matrix contacted each customer (other than those in the no-survey control group), to administer the survey and tell customers about the group to which they were assigned. The script for this survey, along with the associated mailings, are included with this Appendix.
4. **April 2012**: The target numbers for the 9 treatment groups were achieved, concluding the recruitment process.
5. **August 2012:** Welcome packages (and IHD's for those groups) were mailed to customers in the appropriate groups.

Table A1 summarizes the numerical results of the recruitment process.

Table A1. Summary of the GMP CBS recruitment numbers

No. of customers	Description
19936	Potentially qualifying flat rate customers in/near Rutland VT identified
2191	Removed accounts because of being businesses or invalid contact information
1200	Customers withheld from survey group as the no-survey control group
16545	**Valid and pre-qualified customers in Rutland were randomly assigned to 8 remaining treatment groups**
2187	Customers across all 8 groups who were flagged to receive US Mail recruitment packages
14358	Remaining customers were flagged for Telephone contact
5635	Were not successfully contacted by telephone (no response after 3 attempts)
3410	Customers declined to participate in study
44	Customers asked to be removed from call list
1876	Customers with bad contact data
1169	Were contacted fewer than 3 times (treatment groups were filled)

2224	Customers recruited into the study, assigned to treatment groups by phone
196	Completed mail survey and opted in
145	Complete web survey and opted in
2565	**Customers enrolled in the study (all 9 groups) after survey completion**

Recruitment surveys were conducted in 5 waves. All but the first wave received post cards (see attached) informing the customers to expect a phone call or mail survey.

Below is a timeline of the recruitment process. At the end of the recruitment process, welcome cards were sent to all who were ultimately placed into treatment or control groups, other than the no-survey control group.

Wave 1
NO Postcard ----
Phone Calls Begin 02/06/12

Wave 2
Postcards mailed 02/13/12
Phone calls begin 02/18/12

Wave 3
Postcards mailed 02/24/12
Phone calls begin 03/02/12

Wave 4
Postcards mailed 03/09/12
Phone calls begin 03/23/12

Wave 5
Postcards mailed 03/30/12
Phone calls begin 04/07/12

Mailed survey Packages
Postcards mail 02/13/12
Mail packages sent 02/20/12

Welcome packages
Mailed 08/03/12

The following attachments are included in Appendix 2:

- 2-1: Post cards mailed to participants before surveys.

- 2-2: Phone script used for the telephone-based recruitment process. The web-based survey was nearly identical (and only used by a small number of customers).
- 2-3: Example recruitment letter. Note that most of the recruitment occurred with phone interviews, so the recruitment letters were not a key component of the process.
- 2-4: Example welcome letter, sent to confirmed participants.

CVPS SmartPower® is **recruiting study participants** in your community. You may be contacted over the **next few weeks** to see if you qualify for this important study.

CVPS SmartPower® is conducting a study to learn how to encourage customers to reduce the electricity they use, especially during periods of peak customer usage. We will also be testing various ways to notify customers of an approaching "Peak Usage Day."

What to expect: A call, email or letter with a few qualifying questions.

What action can you take: Answer the call/email or letter and enroll as a study participant, or do nothing to continue service at your existing rate.

Thank you for your help!

To enroll today, please complete the questionnaire at the website located on the back of this postcard, above your address.

Metrix Matrix, Inc.
AN APPROVED CONTRACTOR FOR:

CVPS smartPOWER

785 Elmgrove Rd., Bldg. 1
Rochester, NY 14624

Presorted
FIRST-CLASS
U.S. Postage
PAID
PostcardMania
33634

103165

To enroll now, go to
www.cvps.com/smartpower
Your enrollment code is:

<#-####>

If you have **general questions** about CVPS SmartPower®, call the CVPS Customer Information Center at **1-800-649-2877**, or check out CVPS SmartPower® on the web at

www.cvps.com/smartpower

THIS SPACE RESERVED FOR
ADDRESSING

2012 CVPS (Green Mountain Power)
SmartPower Recruitment Web Survey Script

C1 Hi, my name is [NAME] and I'm calling on behalf of CVPS. We need your help. We are conducting a study to learn how to encourage customers like yourself to reduce the electricity you use, especially during periods of peak customer usage during the summer. This study is funded in part by the US Department of Energy.

C2 For this study CVPS is looking for individuals who are responsible for paying the energy bill for their home and plan to remain in their home for at least the next two years.

B1 Would you say you qualify for this study?

Y
N
U

B2 IF B1 = N,U Is there someone else in the home who may meet those criteria? [IF YES] May I speak to that individual?

Y
N
U

C3 IF B2 = Y Hi, my name is [NAME] and I'm calling on behalf of CVPS. We need your help. We are conducting a study to learn how to encourage customers like yourself to reduce the electricity you use, especially during periods of peak customer usage during the summer. This study is funded in part by the US Department of Energy.

C4 For this study CVPS is looking for individuals who are responsible for paying the energy bill for their home and plan to remain in their home for at least the next two years.

B3 Would you say you qualify for this study?

Y
N
U

C5 If B2=N,U or
If B3=N,U Thank you for your time. [THANK AND CD RECORD]

QUALIFYING

C6 If B1=Y or B3=Y Great, as part of our SmartPower project we will test various rebate and rate adjustment programs. We will also be testing different ways to notify customers about extreme summer weather events when demand for electricity is greatest. To complete the qualification for this study I would like to confirm your address.

M1 Is your CVPS service address on [SERVICE STREET] in [SERVICE CITY]

1. Yes
2. No [THANK AND CD]
3. Unsure [THANK AND CD]

B4 If M1=1 Is this address your primary, year-round residence?

Y
N
U

B5 If B4=N,U Will you reside full-time at this address during the summer months between June 1st and August 31st?

Y
N
U

C7 If B5=N,U I'm sorry, to qualify for this particular study we require participants to reside in their home during the summer months. Thank you for your time. [CD RECORD]

2012 CVPS (Green Mountain Power)
SmartPower Recruitment Web Survey Script

INTRO TO ASSIGNED GROUP SPECIFICS

C8 If GROUP=1,5 Congratulations! You have been selected to participate in a new rebate study, which gives you the opportunity to earn rebates on your summer utility bills. The study is called a peak time rebate. Participation in this trial can only reduce your total electric bill, it cannot increase it. Throughout the summer you will be notified the day before a Peak Usage Day. This is a day when demand for electricity is especially high. If you reduce your average electricity consumption during the specified peak hours, as compared to the days before the Peak Day, your bill will be credited at a rate of **60** cents per kilowatt hour reduced.

C9 If GROUP=1,5 In the next few months, we will be sending you more information about this rebate study in the mail, as well as information about how you can opt out of this trial, should you desire to do so.

C10 If GROUP=2,6 Congratulations! You have been selected to participate in a new rebate study, which gives you the opportunity to earn rebates on your summer utility bills. The study is called a peak time rebate. As a rebate study this trial can only reduce your total electric bill, it cannot increase it. Throughout the summer you will be notified the day before a Peak Usage Day. This is a day when demand for electricity is especially high. If you reduce your average electricity consumption during the specified peak hours, as compared to the days before the Peak Day, your bill will be credited at a rate of 60 cents per kilowatt hour reduced.

C11 Always skip To help you to maximize your rebates during peak events and to monitor your electric usage at any time, CVPS will (**install/be sending you)** a free and convenient wireless in-home display.

C12 If GROUP=2,6 Over the next few months, you will be receiving more information in the mail about this rebate study as well as information about how you can opt out of this trial, should you desire to do so.

C13 If GROUP=3 Congratulations! You are eligible to participate in a new rate study, which may save you money on your utility bill. The study is called critical peak pricing. During this study your ordinary CVPS rate will be reduced approximately two and a half percent with the exception of a few hours during a few days in the summer when electric demand is greatest. You will be notified a day prior to those peak events to reduce your energy use during the peak event hours, as the rate during those hours will increase approximately 46 cents per kilowatt hour.

B6 If GROUP=3 Would you like to participate in this very important study?

1. Y
2. N
3. U

Q1 If GROUP=3 and B6=N What would you say is your main reason for not participating in this study?

C14 If GROUP=3 and B6=N In the next few months, we would like to send you additional information about this study in the mail, with instructions on how you can sign up, should you decide to do so after reviewing the details. I have your current mailing address as [MAILING STREET], [MAILING CITY], [MAILING STATE], [MAILING ZIP 5]-[MAILING ZIP 4]. Is that correct? [RECORD CHANGES TO MAILING ADDRESS IN Q6 - Q10]

2012 CVPS (Green Mountain Power)
SmartPower Recruitment Web Survey Script

C15 If GROUP=3 and B6=Y,U Over the next few months, we will be sending you additional information about your new rates in the mail, with information about how you can opt out, should you decide to do so.

C16 If GROUP=4 Congratulations! You are eligible to participate in a new rate study, which may save you money on your utility bill. The study is called critical peak pricing. During this study your ordinary CVPS rate will be reduced approximately two and a half percent with the exception of a few hours during a few days in the summer when electric demand is greatest. You will be notified a day prior to those peak events to reduce your energy use during the peak event hours, as the rate during those hours will increase approximately 46 cents per kilowatt hour.

C17 Always skip To help you maximize your savings, CVPS will (**install/send you**) a free and convenient in-home display to help you monitor your electric usage during peak events and every day.

B7 If GROUP=4 Would you like to participate in this very important study?
Y
N
U

Q2 If GROUP=4 and B7=N What would you say is your main reason for not participating in this study?

C18 If GROUP=4 and B7=N In the next few months, we would like to send you additional information about this study in the mail, with instructions on how you can sign up, should you decide to do so after reviewing the details. I have your current mailing address as **[MAILING STREET], [MAILING CITY], [MAILING STATE], [MAILING ZIP 5]-[MAILING ZIP 4].** Is that correct? [RECORD CHANGES TO MAILING ADDRESS IN Q6 - Q10]

C19 If GROUP=4 and B7=Y,U Over the next few months, we will be sending you additional information about your new rates, as well as information about how you can opt out, should you decide to do so.

C20 If GROUP=8 Congratulations! You have been selected to participate with a group of CVPS customers in a new rate study. As a participant, your electricity rate will not change, but you will be notified a few days during the summer when electricity consumption is particularly high, and encouraged to consider reducing your power consumption. If at any time you wish not to receive these notifications, you may opt out by going to the CVPS web site.

HOUSEHOLD ENERGY EFFICIENCY POLL

C21 If NOT (B7=N OR B6=N) To complete the enrollment process I will need to ask you a few short questions about your home and energy usage. May I begin?

C22 If NOT (B7=N OR B6=N) Please be aware this call may be recorded for quality purposes

M2 If NOT (B7=N OR B6=N) Do you own or rent your home?
1. Own
2. Rent
3. Other [DO NOT READ]
4. Don't Know [DO NOT READ]
5. Refused [DO NOT READ]

M3 If NOT (B7=N OR B6=N) What type of residence do you live in? Do you live in a... [READ LIST]
1. Single-family home
2. Duplex or two-family home

3. Apartment or condo with 2 to 4 units in one building
4. Apartment or condo with more than 4 units in one building
5. Townhouse or row house [IF NECESSARY: ADJACENT WALLS TO ANOTHER HOUSE]
6. Mobile home or house trailer
7. Some other type of home
8. Don't Know [DO NOT READ]
9. Refused [DO NOT READ]

M4 If NOT (B7=N OR B6=N) How many rooms are in your home? Please do not include closets, unheated storage, unheated basement, garage, or seasonal rooms. [IF ASKED OF THE INTERVIEWER: INCLUDES BATH, BEDROOMS, KITCHEN, LIVING, DINING, ETC IN HEATED LIVING SPACE]

1. 1 to 5 rooms
2. 6 to 8 rooms
3. 9 to 10 rooms
4. 11 or more rooms
5. Refused [DO NOT READ]

M5 If NOT (B7=N OR B6=N) Does your home have central air conditioning?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M6 If NOT (B7=N OR B6=N) Do you have any room air conditioners? [IF ASKED OF THE INTERVIEWER: A ROOM AIR CONDITIONER IS A SMALL UNIT THAT SITS IN YOUR WINDOW TO COOL ONE OR MORE ROOMS]

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M7 If M6=1 How many room air conditioners do you have?

1. 1
2. 2
3. 3
4. 4
5. 5 or more
6. Refused [DO NOT READ]

M8 If NOT (B7=N OR B6=N) Do you have a programmable thermostat?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M9 If M5=1 and M8=1 Is the programmable thermostat used to control your central air conditioning in the summer?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

C23 If NOT (B7=N OR B6=N) Which of the following appliances do you have in your home?

M10 If NOT (B7=N OR B6=N) Ceiling fans?
1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M11 If NOT (B7=N OR B6=N) Electric clothes dryer?
1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M12 If NOT (B7=N OR B6=N) Electric stove?
1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M13 If NOT (B7=N OR B6=N) Dehumidifier?
1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M14 If NOT (B7=N OR B6=N) Including yourself, how many adults, 18 or older, currently live in your household? [INCLUDE ADULTS WHO LIVE IN THE HOME AT LEAST 3 DAYS AND NIGHTS EACH WEEK]
1. 1
2. 2
3. 3
4. 4
5. 5 or more
6. Refused [DO NOT READ]

M15 If NOT (B7=N OR B6=N) And, how many of these adults are over 65?
1. None
2. 1
3. 2
4. 3
5. 4
6. 5 or more
7. Refused [DO NOT READ]

M16 If NOT (B7=N OR B6=N) How many children under the age of 18 live in your household at least part of the week? [INCLUDE CHILDERN WHO LIVE IN THE HOME AT LEAST 3 DAYS AND NIGHTS EACH WEEK]
1. None
2. 1
3. 2
4. 3
5. 4
6. 5 or more
7. Refused [DO NOT READ]

M17 If NOT (B7=N OR B6=N) Do you or does anyone in your household have a chronic illness or disability that requires regular medical treatment?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M18 If NOT (B7=N OR B6=N) In a typical week is there someone home on Monday to Friday sometime between 1 PM and 5 PM at least one day a week?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M19 If NOT (B7=N OR B6=N) Is there anyone in your household working full time for pay?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M20 If NOT (B7=N OR B6=N) Do you or anyone in your household have a job where you typically work at home at least one weekday per week, rather than go into an office or some other location?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M21 If NOT (B7=N OR B6=N) Do you remember receiving any information from your electric utility that told you how you could save money by changing what activity you do in your home or when you do the activity?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M22 If M21=1 Did you think the information was useful?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

M23 If M21=1 Did you do anything that was suggested within this information to help you save money?

1. Yes
2. No
3. Don't Know [DO NOT READ]
4. Refused [DO NOT READ]

C24 If GROUP NOT 7 AND NOT (B7=N OR B6=N) For this study during the summer months we will notify you of a Peak Usage Date a day before the event to allow you to adjust your energy usage. Which of the following ways would you like to be notified of these events: [CHOOSE ALL THAT APPLY]

B8 If GROUP NOT 7 AND NOT (B7=N OR B6=N) Text Message

1. Y

2. N
3. U

B9 If GROUP NOT 7 AND NOT (B7=N OR B6=N) Voice Message

1. Y
2. N
3. U

B10 If GROUP NOT 7 AND NOT (B7=N OR B6=N) Email Message

1. Y
2. N
3. U

C25 If GROUP NOT 7 AND (B8=Y OR B9=Y OR B10=Y) Please be aware that any voice, text or email notifications sent to your mobile phone or smart phone are subject to your voice and data price plan for that carrier.

Q3 If GROUP NOT 7 and B8=1 May I have your text message number? [XXX-XXX-XXXX]

Q4 If GROUP NOT 7 and B9=1 May I have your phone number for a voice call or voice mail? [XXX-XXX-XXXX]

Q5 If GROUP NOT 7 and B10=1 May I have your email address? [_____@_____.___] [REPEAT AND SPELL OUT TO CONFIRM]

C26 If GROUP NOT 7 AND (B8=Y OR B9=Y OR B10=Y) Please be aware that this contact information will only be used for the purposes of this study and will not be shared.

ADDITIONAL DEMOGRAPHIC QUESTIONS

C27 If NOT (B7=N OR B6=N) These final two questions are for categorization purposes only.

M24 If NOT (B7=N OR B6=N) In 2011, what was your total household income from all sources, before taxes? Just stop me when I get to the right category. [READ LIST]

1. Less than $10,000
2. $10,001 to $20,000
3. $20,001 to $30,000
4. $30,001 to $40,000
5. $40,001 to $75,000
6. $75,001 to $90,000
7. $90,001 to $100,000
8. $100,001 to $150,000
9. More than $150,000
10. Don't Know [DO NOT READ]
11. Refused [DO NOT READ]

M25 If NOT (B7=N OR B6=N) What is the LAST grade or class that you COMPLETED in school? [DO NOT READ LIST]

1. None, or grade 1-8
2. High School incomplete (grade 9-11)
3. High School graduate (grade 12 or GED certificate)
4. Technical, trade or vocational school AFTER high school
5. Some college, not four-year degree (includes associate degree)
6. College graduate (B.S., B.A., or other four-year degree)
7. Post-graduate or professional schooling after college (e.g., towards a Master's degree or Ph.D; law or medical school)
8. Don't Know [DO NOT READ]

9. Refused [DO NOT READ]

C28 If NOT (B7=N OR B6=N) In the next few months, we will be sending you more information about this study in the mail, as well as information about how you can opt out, should you desire to do so.

C29 If NOT (B7=N OR B6=N) I have your current mailing address as [MAILING STREET], [MAILING CITY], [MAILING STATE], [MAILING ZIP 5]-[MAILING ZIP 4]. Is that correct?

Q6 [ENTER UPDATED MAILING STREET]

Q7 [ENTER UPDATED MAILING CITY]

Q8 [ENTER UPDATED MAILING STATE]

Q9 [ENTER UPDATED MAILING ZIP 5]

Q10 [ENTER UPDATED MAILING ZIP 4]

C30 Thank you! This concludes our questions.

February 2012

Metrix Matrix
785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
City State Zip

Dear <Name>,

CVPS is conducting a study to learn how to encourage customers like yourself to reduce the electricity you use, especially during periods of peak customer usage during the summer. This study is funded in part by the US Department of Energy. As part of our CVPS SmartPower® project we will test various rebate and rate adjustment programs. We will also be testing different ways to notify customers about extreme summer weather events when demand for electricity is greatest.

You have been selected to participate in a new rebate study, which gives you the opportunity to earn rebates on your summer utility bills. As part of the study, a group of participating customers will be placed on a Peak Time Rebate (PTR) Rate. Participation in this trial can only reduce your total electric bill, it cannot increase it. Throughout the summer you will be notified the day before a Peak Usage Day. This is a day when demand for electricity is especially high. If you reduce your average electricity consumption during the specified peak hours, as compared to the days before the Peak Day, your bill will be credited at a rate of 60 cents per kilowatt hour reduced.

If you are responsible for paying the energy bill at <service street> in <service city>, plan to reside there for at least the next two years, and wish to participate in this very important study, please complete the enclosed enrollment Form and return it in the enclosed prepaid envelope.

You may also complete your enrollment by visiting our web site at **www.cvps.com/smartpower**. Click on the enrollment link found at the bottom of the web page and use the following enrollment code:

<X-NNNN>

Upon enrollment, we will send you more information about this rebate study in the mail over the next few months. If you do not wish to enroll in this study, you do not need to respond or take any action in order to continue receiving service at your current rate.

Thank you for in advance for helping CVPS SmartPower® in this very important study.

Sincerely,
Your CVPS SmartPower® Team

February 2012

Metrix Matrix
785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
City State Zip

Dear <Name>:

CVPS is conducting a study to learn how to encourage customers like yourself to reduce the electricity you use, especially during periods of peak customer usage during the summer. This study is funded in part by the US Department of Energy. As part of our CVPS SmartPower® project we will test various rebate and rate adjustment programs. We will also be testing different ways to notify customers about extreme summer weather events when demand for electricity is greatest.

You are eligible to participate in a new rate study, which may save you money on your utility bill. As part of the study, a group of participating customers will be placed on a Critical Peak Pricing (CPP) rate. During this study your ordinary CVPS rate will be reduced approximately two and a half percent with the exception of a few hours during a few days in the summer when electric demand is greatest. You will be notified a day prior to those peak events to reduce your energy use during the peak event hours, as the rate during those hours will increase by approximately 46 cents per kilowatt hour.

If you are responsible for paying the energy bill at <service street> in <service city>, plan to reside there for at least the next two years, and wish to participate in this very important study, please complete the enclosed enrollment Form and return it in the enclosed prepaid envelope.

You may also complete your enrollment by visiting our web site at **www.cvps.com/smartpower**. Click on the enrollment link found at the bottom of the web page and use the following enrollment code:

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February 2012

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Customer Name
Mail Address
City State Zip

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If you are responsible for paying the energy bill at <service street> in <service city>, plan to reside there for at least the next two years, and wish to participate in this very important study, please complete the enclosed enrollment Form and return it in the enclosed prepaid envelope.

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You have been selected to participate with a group of CVPS customers in a new rate study. As a participant, your electricity rate will not change, but you will be notified a few days during the summer when electricity consumption is particularly high, and encouraged to consider reducing your power consumption.

If you are responsible for paying the energy bill at <service street> in <service city>, plan to reside there for at least the next two years, and wish to participate in this very important study, please complete the enclosed enrollment Form and return it in the enclosed prepaid envelope.

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Sincerely,

Your CVPS SmartPower® Team

Central Vermont Public Service is now Green Mountain Power

July 2012

Metrix Matrix, Inc.
785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
City State Zip

Dear <Name>,

Thank you for agreeing to join the pilot we are conducting as part of GMP Smart Power, GMP's "smart grid" solution to modernizing and automating the electric grid.

Through this pilot you will have the opportunity to partner with GMP and other customers to reduce electricity use during peak summer periods when demand on the grid and power generators is greatest. By reducing electricity use during periods of very hot weather, we can reduce the need to purchase power from supplemental generation sources which generate the most pollution and are more costly – allowing GMP to pass along some of the savings to you.

Here's how it works. During the summer, GMP will monitor the weather and grid conditions and will notify you one day before a "peak day" is about to occur via a phone call, text message*, and/or e-mail. Customers participating in the pilot have been organized into different pilot groups. The various groups will allow us to study different ways of partnering with our customers during peak day events. You have been placed in a group whose electricity rate will not change.

Again, peak day events will be communicated one day ahead of time and will occur the following day between the hours of 1 PM and 6 PM – no more than 10 times each summer during the summers of 2012 and 2013. The first potential peak event could be called on or after August 1, 2012.

We currently have your contact information on file as:

Home Phone (voice notification): **<customer provided Home phone number>**
Cell Phone (text notification): **<customer provided Text phone number>**
Email: **<customer provided email address>**

If you would like to update your GMP contact information, please contact the GMP Customer Information Center at 800-649-2877. If you have questions about the pilot or you no longer wish to participate, please contact our Customer Information Center in Rutland at 800-649-2877, Monday-Friday between 7 AM and 7 PM or Saturday 8 AM to 4 PM.

Thank you for helping GMP Smart Power in this very important study.

Sincerely,
Your GMP Smart Power Team

*Please note that text messages may increase your cell-phone bill depending on the contract you have with your cell phone provider.

Central Vermont Public Service is now Green Mountain Power

July 2012

Metrix Matrix
785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
City State Zip

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Here's how it works. During the summer, GMP will monitor the weather and grid conditions and will notify you one day before a "peak day" is about to occur via a phone call, text message*, and/or e-mail. Customers participating in the pilot have been organized into different pilot groups. The various groups will allow us to study different ways of partnering with our customers during peak day events. You have been placed in a group that is eligible for a Peak Time Rebate. As a Peak Time Rebate customer you will receive a rebate of 60 cents/kwh** for every kwh saved compared to your normal use during the peak event time period. This pilot will give you an opportunity to earn a rebate on peak days if you take action to reduce your usage. If you choose to do nothing, the rate treatment will have no impact and you will be billed as you always have.

Again, peak day events will be communicated one day ahead of time and will occur the following day between the hours of 1 PM and 6 PM – no more than 10 times per summer during the summers of 2012 and 2013. The first potential peak event could be called on or after August 1, 2012. We currently have your contact information on file as:

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Sincerely,
Your CVPS Smart Power Team

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**A kwh or kilowatt hour is the unit of measure used for billing your electric usage.

Central Vermont Public Service is now Green Mountain Power

July 2012

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785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
City State Zip

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Here's how it works. During the summer, GMP will monitor the weather and grid conditions and will notify you one day before a "peak day" is about to occur via a phone call, text message*, and/or e-mail. The pilot group you are in will also receive an In Home Display (IHD) for notification of "peak day" events. The peak day may be displayed on the screen of the IHD.

Customers participating in the pilot have been organized into different pilot groups. The various groups will allow us to study different ways of partnering with our customers during peak day events. You have been placed in a group that is eligible for a Peak Time Rebate. As a Peak Time Rebate customer you will receive a rebate of 60 cents/kwh** for every kwh saved compared to your normal use during the peak event time period. This pilot will give you an opportunity to earn a rebate on peak days if you take action to reduce your usage. If you choose to do nothing, the rate treatment will have no impact and you will be billed as you always have. As a participant in this pilot group you will also receive an In Home Display as an additional notification device. You will receive the IHD in the mail within the next two weeks with instructions on how to use it as well as a phone number to call for help.

Again, peak day events will be communicated one day ahead of time and will occur the following day between the hours of 1 PM and 6 PM – no more than 10 times each summer during the summers of 2012 and 2013. The first potential peak event could be called on or after August 1, 2012. We currently have your contact information on file as:

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GREEN MOUNTAIN POWER

Central Vermont Public Service is now Green Mountain Power

July 2012

Metrix Matrix
785 Elmgrove Rd.
Rochester, NY 14624

Customer Name
Mail Address
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Here's how it works. During the summer, GMP will monitor the weather and grid conditions and will notify you one day before a "peak day" is about to occur via a phone call, text message*, and/or e-mail.
Customers participating in the pilot have been organized into different pilot groups. The various groups will allow us to study different ways of partnering with our customers during peak day events. You have been placed in a group that will receive a Critical Peak Price. As a Critical Peak Price customer you will receive a roughly 2 ½% discount on all kwh** used year round with the exception of kwh used during the called peak event time period which will be charged a premium of 60 cents/kwh for every kwh of use. This pilot hopes to motivate you to use less energy on peak days by charging a higher rate on these days which could result in a higher bill if you do not take action. If you do take action during peak events, you should see little change in your summer bills and continue to be rewarded throughout the year with a 2 ½% discount on all other electricity used.

Again, peak day events will be communicated one day ahead of time and will occur the following day between the hours of 1 PM and 6 PM – no more than 10 times each summer during the summers of 2012 and 2013. The first potential peak event could be called on or after August 1, 2012. Since you are in a pilot group that has a pricing change, you will notice your new pricing structure on your next bill.

We currently have your contact information on file as:

Home Phone (voice notification): **<customer provided Home phone number>**
Cell Phone (text notification): **<customer provided Text phone number>**
Email: **<customer provided email address>**

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Home Phone (voice notification): **<customer provided Home phone number>**
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Email: **<customer provided email address>**

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Sincerely,
Your GMP Smart Power Team

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Appendix 3
Interim survey

As with the recruitment survey, the interim survey was administered by Metrix Matrix, primarily by telephone. The survey was administered during October-December of 2012.

This appendix includes the mail version of the Interim survey. Three phone attempts were made to reach all participants in all groups, other than the no-survey control group.

SURVEY INSTRUCTIONS

- **Please fill out this short survey to help GMP understand how satisfied you are with the pilot program to-date, what measures you took to reduce your energy consumption, and to verify your continued participation.**
- **You are sometimes told to skip over some questions in the survey. When this happens you will see an arrow with a note that tells you what question to answer next, like this:**

  ➔ If you selected Yes, please continue to Question #1

1. Are you:

   ☐ Male

   ☐ Female

2. Is your GMP service address on
   [SERVICE STREET]
   in
   [SERVICE CITY] **?**

   ☐ Yes

   ☐ No

3. Has this been your primary full-time address for the past 4 months?

   ☐ Yes

   ☐ No

   ☐ Don't Know

4. Are you aware of being enrolled in this pilot program?

   ☐ Yes

   ☐ No

   ☐ Don't Know

➔ If you selected No or Don't Know, please continue to Question #10

5. Overall, how satisfied are you with this pilot program so far?

   ☐ Very Satisfied

   ☐ Somewhat Satisfied

   ☐ Neutral

   ☐ Somewhat Dissatisfied

   ☐ Very Dissatisfied

   ☐ Don't Know

6. What is your primary reason for your rating?

7. Did you receive information in the mail about this pilot program after enrollment?

   ☐ Yes

   ☐ No

   ☐ Don't Know

8. Have you checked for your rebate on your electric bill?

   ☐ Yes

   ☐ No

   ☐ Don't Know

9. Are the rebate(s) worth the extra effort to keep your electricity usage down during peak days?

   ☐ Yes

   ☐ No

   ☐ Don't Know

10. Did you receive information in the mail about reducing your electric usage when notified by Green Mountain Power?

    ☐ Yes

    ☐ No

    ☐ Don't Know

➔ If you selected No or Don't Know, please continue to Question #12

11. Was this information helpful in understanding the GMP pilot program to reduce electric usage during peak times?

- ☐ Yes
- ☐ No
- ☐ Don't Know

12. In the past 4 months Green Mountain Power identified a number of peak days. How many peak days do you recall being notified about in the past 4 months?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ None
- ☐ Don't Know

➔ If you selected None or Don't Know, please go to Question #20

13. Which method of notification did you find most helpful? (Please choose one.)

- ☐ Telephone
- ☐ Text Message
- ☐ Email
- ☐ In-home Display
- ☐ Other

14. If you selected Other, please note what other method did you most prefer?

15. Did you, or anyone in your household, take any action to reduce your power consumption following the notification of a peak day?

- ☐ Yes
- ☐ No
- ☐ Don't Know

➔ If you selected No or Don't Know, please continue to Question #18

16. What action or actions did you take to reduce your power consumption? Please select all that apply.

- ☐ Changed thermostat
- ☐ Changed timers
- ☐ Turned off lights
- ☐ Changed the time you did Laundry
- ☐ Changed the time you did Cooking/Baking
- ☐ Adjusted AC
- ☐ Other
- ☐ Don't Know

17. If you selected Other, what other action or actions did you take?

18. Please rate your satisfaction with the notification process prior to a peak day.

- ☐ Very Satisfied
- ☐ Somewhat Satisfied
- ☐ Neutral
- ☐ Somewhat Dissatisfied
- ☐ Very Dissatisfied

19. Do you have any suggestions to improve the notification process?

21. If No, please tell us your main reason for not converting to the new rate plan.

20. You are eligible to convert to a lower rate that is 2.5% less than your current rate except for a few hours during the summer which we call peak hours. During these hours, your rate will increase approximately 46 cents per kilowatt hour.

The idea is to encourage customers to work together to reduce electricity consumption during peak hours. As before, you will be notified the day prior to the peak days as well as the peak hours.

Would you like to convert to this new rate plan?

- ☐ Yes
- ☐ No
- ☐ Don't Know

We will send you additional information about the rate plan in the mail, with instructions on how you can sign up or opt out, should you decide to do so.

THANK YOU

for participating in this very important pilot program.

Appendix 3
In Home Display information

Three of the treatment groups in this study received In-Home Display (IHD) units. The in-home display technology used in this study was the Tendril Insight In-Home-Display, Model IHD-5-002-103.

For customers on the Peak-Time Rebate (Critical Peak Rebate) rate structure, the IHD was programmed to display the customer's "baseline" load level.

Attached is a brochure describing the technology.

TENDRIL™

Insight

In-Home Display

Give customers insight into energy consumption. Help customers understand, manage and control their household energy consumption with the Tendril Insight™ in-home display.

The Tendril Insight is an in-home display that communicates with networked smart devices including thermostats, electricity meters, and outlets. With the Tendril Insight, consumers can track kilowatts and cost-per-hour of their energy as they use it for up to the minute bill tracking. Customers enjoy more choices around energy consumption and can also actively participate in Energy Efficiency, Load Control and Demand Response programs. With the Tendril Insight, energy service providers can help customers save money and reduce their environmental impact, while reducing customer service incidents and improving overall load balancing and Demand Response capabilities. For an enhanced homeowner experience the Tendril Insight can be used in conjunction with the Tendril Energize™ application suite.

Provide in-home energy usage at a glance. The Tendril Insight displays a variety of screens that show consumers their monthly consumption and the associated cost, month-to-date estimated bill, utility electricity pricing and Load Control event messages. Users can also set personal alerts to manage energy usage more efficiently, and control their energy costs. Concurrently, providers can send messages about price changes as well as rebate opportunities for participation in Demand Response events, such as switching thermostats and appliances to more environmentally-friendly settings during peak demand.

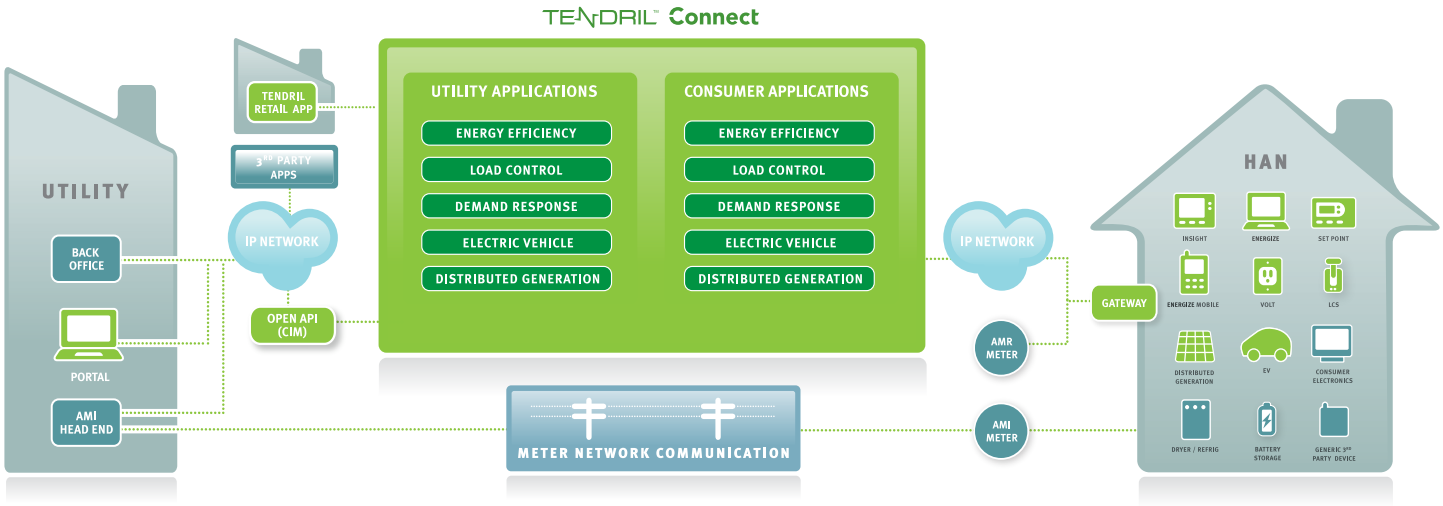
Manage change with a flexible standards-based approach. The Tendril Insight is ZigBee® Smart Energy 1.0 certified and an integral part of an effective Home Area Network (HAN). A ZigBee-based HAN gives consumers the freedom to choose from a variety of interoperable energy management solutions and to take advantage of automation and real-time information for better energy management.

Overview

- Displays current household energy use in both kilowatts and dollars-per-hour
- Displays current day accumulated energy usage and compares cost with previous day's cost
- Offers up-to-date monthly billing information and an estimated end of month bill
- Displays price of electricity in real time
- Allows consumers to be alerted with a variety of audio and visual alerts when their energy use or cost exceeds specified targets
- Allows text messaging and notification of Load Control events from energy service provider to consumers
- Provides wireless software updates of the latest features and functions

Key Features

- Consumer-friendly package
- Durable plastic housing
- Wall powered via 120VAC power adapter, with 6' cord
- Wall mountable or use the retractable stand for placing at upright viewing angle (e.g., on counter) or laying flat
- Rubber pads at base to provide stability and avoid slippage on hard surfaces
- Colored LED lights indicate various conditions for user and customer support
- Over-the-Air (OTA) enabled firmware update support
- Colored backlight for alerts
- Custom branding available
- Embedded Tendril Profile provides extended Smart Energy functionality and remote diagnostics



Tendril Connect™ is the proven energy management platform that enables unprecedented insight, choice, and control. This open standards-based, end-to-end technology enables energy service providers and their customers the ability to deploy and take advantage of tomorrow's Smart Energy solutions, today. Energy service providers and their consumers are empowered with data and analytics about energy consumption, helping to drive down costs, lower environmental impact and realize operational efficiencies.

Integrate now and in the future. The Tendril Insight is open standards-based, enabling it to integrate with today's AMI and AMR meters. Over-the-air updates enable enhancements to deployed device firmware and software.

This flexible, standards-based approach also enables Tendril solutions to comply with and adapt to changing regulatory, consumer and technological needs, as well as future Smart Energy certified hardware, such as WiFi™ and HomePlug® products. With ZigBee-certified Tendril solutions, providers can implement energy management and efficiency programs more easily and securely, and consumers can reduce energy costs and their impact on the environment.

The big advantage. Now energy service providers can meet consumer demand and prepare for regulatory mandates by offering customers a truly integrated experience. The Tendril Connect™ platform, along with Tendril in-home products, makes it easy. No matter the network architecture or metering infrastructure, Tendril offers a solution that gives energy service providers the security and control they need, while delivering the interaction customers expect.

About Tendril. Tendril provides the cloud platform for the energy industry, delivering end-to-end consumer engagement products, applications and services powered by Tendril Connect™—an open, secure and scalable platform that takes the complexity out of the Energy Internet and creates a dialogue between energy service providers and their customers. Delivering consumer engagement software, in-home products and applications as well as easy to integrate utility solutions such as Demand Response and Energy Efficiency, Tendril offers unparalleled insight into energy decisions, making the Energy Marketplace a reality.

Insight Technical Specifications

- 128 x 240 pixel monochrome display with 9.2 x 5.3 centimeter viewing area
- Backlight with ambient light sensing and Red-Green-Blue color options
- Large fonts with home screen viewable from 8+ feet
- ZigBee®/802.15.4 Radio with Tendril additional functionality
- 2.400 - 2.483 GHz, unlicensed ISM band
- Atmel AVR Control Processor operating at 3.6864 MHz with 256KB Flash and 8KB RAM
- 1MB external serial flash EEPROM
- 100mW power-amp output
- -94dBm receiver sensitivity
- Internal power consumption 0.9W to 2.25W (depending on operational state)
- Elliptic Curve Cryptography (ECC) enabled, or Pre-configured Key enabled, for AMI and AMR configurations
- Over-the-air (OTA) embedded software updates

Requirements

- Tendril Connect platform
- AMI Smart Meter
- AMR Meter

Standards

- ZigBee SE certified
- FCC certified
- UL certified

Availability

The Tendril Insight is available today

For more information contact a Tendril representative today. Call 720-921-2100 or visit www.tendrilinc.com.

Tendril
2560 55th Street
Boulder, CO 80301

TENDRIL™

Appendix 5
Green Mountain Power AMI Technical Architecture and Implementation Process Evaluation

Technical Architecture

The Green Mountain Power Consumer Behavior Study relies on infrastructure that includes the following components:

Advanced Metering Infrastructure (AMI) – GMP selected Elster's EnergyAxis AMI solution. The Elster architecture uses a 900 MHz wireless mesh network. Data collection devices called Gatekeepers aggregate usage data from meters on a schedule. The usage information is then collected from the gatekeepers by the head end system – a server-based application that manages the AMI network and data, and facilitates the communication of information such as real-time pricing signals and event notifications. GMP's system is configured to collect consumption data in 15-minute intervals. All meters are equipped with home area network (HAN) infrastucture that uses Zigbee compliant communications and supports SEP 1.1. The AMI network allows the utility to broadcast information such as peak alerts to in home displays (IHDs). The AMI and integrated systems were set up to bill from the 15-minute interval data for all customers.

Meter Data Management System (MDMS) – MDMS functionality is provided by Siemens/eMeter's EnergyIP platform. It aggregates usage data from the AMI system, provides validation, estimation and editing capabilities, and makes consumption data and billing determinants available to the customer information system (CIS) so that it can render bills, and for presentation to the customer via a secure web portal.

Demand Response Management System (DRMS) – To support the need to manage demand response events in support of the goals of the CBS, GMP implemented the Siemens DRMS. The DRMS supports customer enrollment and facilitates the processing and communication of DR events. When an event is called, this system establishes baselines, calculates billing determinates on actual verifiable load shed relative to the baselines after DR events, and initiates e-mail event notifications. The DRMS also has the ability to craft the DR event notification for communication to the AMI head end system that then sends it out to IHDs.

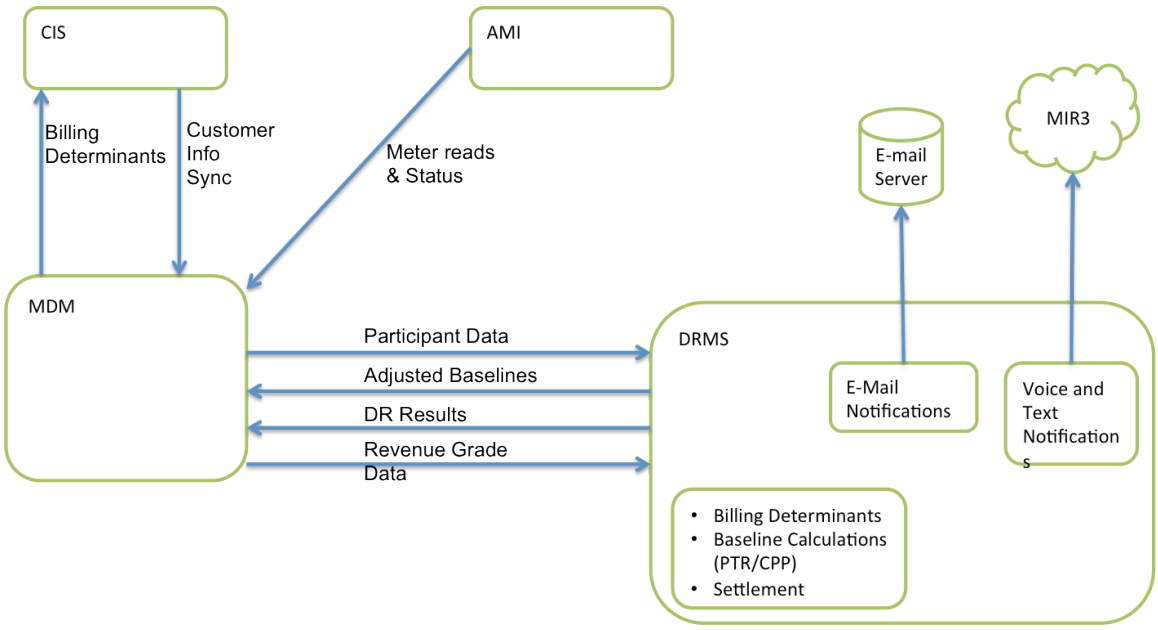
MIR3 – This is a cloud-based communication service that specializes in emergency and mass communication via various media. For purposes of this pilot, the service is used to communicate DR events to participants via text and recorded voice messages. http://www.mir3.com/

In Home Displays (IHD) – Green Mountain Power selected the Tendril Insight IHD for the Study. These are Zigbee compliant devices that include an LCD display that shows real-time usage data from the meter, displays text for events initiated by GMP, and can (but as configured for this study, does not) display pricing information. http://www.tendrilinc.com/wp-content/uploads/2012/01/Insight_01122012.pdf

Customer Information System (CIS) – The CIS system stores customer account information, tracks events and change relative to accounts and renders bills for all customers. The CIS system receives billing determinants from the MDMS through a batch interface so that bills can be generated.

System Integration

The diagram below shows the flow of information between systems that support the Study:



AMI – IHD – The IHD communicates with the customer meter. When an event is called, the content to be displayed on the IHD (typically a message notifying customers of the event's details) is manually entered on the AMI head end system, which then pushes it out to all target displays.

AMI – MDMS – The AMI head end system gathers load profile and register readings from all meters and feeds this information to the MDMS on a periodic basis.

CIS – MDMS –CIS provides customer identification and rate information to the MDMS so that it can generate billing determinants. The MDMS matches customer

rates to the corresponding usage data gathered from the AMI head end system, and generates the billing determinants, which the CIS system uses to render bills.

DRMS – MDMS – The DRMS receives information from the MDMS indicating which customers are participating in which treatment groups, along with their interval usage data. The DRMS compares customer energy usage patterns to baseline calculations, determines any appropriate credits for the customer, and transfers the adjusted baselines and determinants back to the MDMS.

DRMS – E-mail Server – The DRMS is leveraged to generate customer e-mail notifications when events are called. For customers that are flagged to receive event notifications via e-mail the DRMS sends the notifications to the appropriate distribution list.

DRMS – MIR3 - For customers flagged to receive text messages and/or voicemails, the DRMS sends the messages to the MIR3 service over the Internet. MIR3 then distributes the texts and voicemails to the target customers.

Implementation

Initiation of the CBS depended on three main technical pre-requisites:

- Implementation and integration of AMI and MDMS systems with CIS

  The MDMS and AMI head end systems were installed and fully integrated with CIS well in advance of the pilot start date.

- Installation of AMI meters with communications networks to communicate usage data for pilot participants.

  The CBS called for all pilot participants to be located in the Rutland District. The rollout of AMI meters was a statewide effort and the Rutland district was the first area where meters were to be deployed.

- Implementation and integration of a DRMS system to support the administration of the pilot

  The Siemens DRMS procurement was completed in December of 2011 and installation and integration was completed in May of 2012 in advance of the beginning of the window during which DR events can be called.

CBS Technology Timeline

Year 1 – Summer 2012

May 2012 – The DRMS system was implemented and initial QA testing was completed.

June 2012 – Because GMP was billing customers from interval data, complete and timely deliver of meter information was essential to assure timely billing. As the AMI network was commissioning, inconsistent and spotty performance was impacting the ability to render timely bills for customers. Because the system was newly implemented, there was not a history of interval data that would have allowed the MDMS to estimate for gaps. By this time, approximately 30,000 customers were on the new meters. Addressing this issue required the diversion of application development resources that had been dedicated to the DRMS implementation. Because DRMS implementation could not be completed, the start of the pilot had to be delayed until the issues impacting billing could be resolved.

September/October 2012 – The AMI issues that were impacting billing were sufficiently resolved so that AMI rollout could resume. DRMS commissioning is completed. GMP is granted an exception from regulators so that events can be called after the tariff-mandated end of the summer season on August 31. Peak events called on September 14, 21, and 25, and October 5.

Year 2 – Summer 2013

June 2013 – According to the tariff, events may be called starting on June 1. All systems required to support the pilot are tested and ready to support the processing of DR events.

July 2013 – Six events called. During the week of July 15, five events were called on consecutive days. After the first event on July 15, a job was run to synchronize between CIS and MDMS to prepare for the next day's event. This irrevocably cleared billing determinants prior to the generation of bills reflecting the first day's event. In recognition of the lost data and the need to render timely bills, a calculation was performed to estimate a fair credit of $4.00 that was issued to all pilot participants.

August 2013 – Four events called. This completes the maximum of 10 peak events per year that GMP is authorized through applicable tariffs to call in advance of the end of the season on August 31.