

# Marblehead Municipal Light Department

Marblehead, Massachusetts

DE-0E0000308

## *ENERGYSENSE* CPP Pilot Interim Evaluation Report

**May 24, 2012**

## TABLE OF CONTENTS

<b>I.</b>	<b><i>Executive Summary</i></b> .....	<b>1</b>
<b>II.</b>	<b><i>Introduction</i></b> .....	<b>2</b>
<b>A.</b>	<b>Project Background</b> .....	<b>2</b>
<b>B.</b>	<b>Project Overview</b> .....	<b>2</b>
<b>C.</b>	<b>Study Hypotheses</b> .....	<b>3</b>
<b>III.</b>	<b><i>Project Description</i></b> .....	<b>4</b>
<b>A.</b>	<b>Design Elements</b> .....	<b>4</b>
<b>B.</b>	<b>Implementation</b> .....	<b>8</b>
<b>IV.</b>	<b><i>Evaluation Methods</i></b> .....	<b>10</b>
<b>A.</b>	<b>Impact Evaluation Methodology</b> .....	<b>10</b>
<b>B.</b>	<b>Data Collection</b> .....	<b>15</b>
<b>V.</b>	<b><i>Results</i></b> .....	<b>18</b>
<b>A.</b>	<b>Sample Participation Rates</b> .....	<b>18</b>
<b>B.</b>	<b>Peak Event Information</b> .....	<b>19</b>
<b>C.</b>	<b>Historical Usage Data Summary</b> .....	<b>20</b>
<b>D.</b>	<b>Benefits and Metrics Data Summary</b> .....	<b>21</b>
<b>E.</b>	<b>Impact Evaluation Results</b> .....	<b>21</b>
<b>F.</b>	<b>Process Evaluation Results</b> .....	<b>29</b>
<b>G.</b>	<b>Cost Effectiveness Results</b> .....	<b>31</b>
<b>H.</b>	<b>Participant Characteristics</b> .....	<b>32</b>
<b>I.</b>	<b>Bill Impacts</b> .....	<b>34</b>
<b>J.</b>	<b>Post-Pilot Survey Results</b> .....	<b>35</b>
<b>VI.</b>	<b><i>Conclusions</i></b> .....	<b>36</b>

## APPENDICES

- Appendix A: CPP Rate Tariff***
- Appendix B: Participant Enrollment Packages, including Pre-Pilot Survey***
- Appendix C: Marketing Material***
- Appendix D: Panel Regression Modeling Methodology and Results***
- Appendix E: Individual Regression Modeling Methodology and Results***
- Appendix F: End Summer Participant Packages, including Post-Pilot Survey***
- Appendix G: Post Pilot Survey Results and Narrative***

## I. EXECUTIVE SUMMARY

This interim evaluation report summarizes results from the first year of the Marblehead Municipal Light Department's (MMLD) two-year Critical Peak Pricing (CPP) pilot program. MMLD has undertaken the CPP Pilot program as part of a full system wide deployment of advanced metering infrastructure (AMI) funded in part by a grant from the U.S. Department of Energy's (DOE) Smart Grid Investment Grant (SGIG) Program. DOE's Technical Assistance Group (TAG) has provided valuable input into the pilot design as well as the evaluation and interpretation of results.

MMLD's CPP Pilot Program, branded "*EnergySense*", was designed as a summer only dynamic pricing pilot program. MMLD customers were recruited to participate in the two-year pilot using an opt-in enrollment model, and were randomly assigned to either the treatment or control group in the first year of the study. In total, 532 customers participated in the study with 269 assigned to the treatment group and 263 assigned to the control group. The treatment group was placed on the CPP rate from June 1<sup>st</sup>, 2011 through August 31<sup>st</sup>, 2011, which represented the first year of the program. The control group remained on their standard flat rate during this period. The table below illustrates the structure of MMLD's standard flat residential rate compared to the CPP rate. The CPP prices are only in effect during the months of June through August.

TABLE 1: STANDARD VS CPP RATE STRUCTURES

Rate Component	Standard Rate	CPP Rate
Basic Monthly Charge	\$4.25 per month	\$4.25 per month
Non-CPP kilowatt-hours	\$0.1425 per kWh	\$0.09 per kWh
CPP kilowatt-hours	\$0.1425 per kWh	\$1.05 per kWh

All customers who participated in the pilot were provided with access to an online web portal that provided real-time, sub-hourly feedback on energy consumption and cost. No enabling control technology was tested during the first year of the pilot, thus the Critical-Peak price signal was the extent of the treatment tested during this period. A total of three (3) Critical-Peak Periods were initiated over the course of the three month pilot, each lasting a total of six (6) hours.

Analysis of interval usage data indicated an average reduction of **0.74 kW** for customers in the treatment group during the three Critical-Peak Periods. This equated to a **37% reduction** in demand during these periods relative to the control group. Overall energy consumption on CPP event days was also slightly lower among the treatment group; a reduction of approximately **5 kWh** or **12% of total daily use** was noted.

Bill protection was offered to customers selected for the treatment group in the first year, however all customers saved money on the program. This is due in part to the noted reductions in power consumption during CPP events, but also largely attributable to the low overall number of event days. The rate was designed to be revenue neutral based on 12 event days. Since only 3 days were called, virtually all participants saw bill reductions. **86%** of customers in the treatment group reported a positive experience in the first year of the pilot

The second year of the pilot program will run from June through August, 2012. In the second summer, all participating customers will be placed on the CPP rate and a level of in home controlling technology is anticipated to be provided to help customers further control their loads on CPP days.

## **II. INTRODUCTION**

This report is an interim evaluation of Marblehead Municipal Light Department's (MMLD) two-year Critical Peak Pricing (CPP) pilot program. A final evaluation report will be prepared and submitted following the completion of the Year 2 study which will be run during summer 2012. GDS Associates was retained by MMLD to assist in the design, development, implementation, and evaluation of its smart grid pilot program. The Department of Energy (DOE) sponsored Technical Assistance Group (TAG) assigned to oversee and support this study provided invaluable contributions to the design, implementation, and evaluation of results. The design of the pilot study was closely coordinated between MMLD, GDS and the TAG and documented in MMLD's Consumer Behavior Study Plan (CBSP), originally dated October 29, 2010 and revised on November 16, 2010.

### **A. PROJECT BACKGROUND**

MMLD is a Massachusetts municipal utility that serves more than 10,000 electric customers in the Town of Marblehead, Massachusetts. In 2009, MMLD received a Smart Grid Investment Grant (SGIG) Award from the Department of Energy for a town wide Advanced Metering Infrastructure (AMI) project and the implementation of a demand-response smart grid pilot program. MMLD's smart grid pilot program is a two year consumer behavior study which is primarily focused on evaluating demand energy consumption impacts of summer based critical peak pricing program to guide future planning of smart grid projects.

### **B. PROJECT OVERVIEW**

MMLD's pilot program, "EnergySense", is a two-year program focused on evaluating Critical Peak Pricing (CPP) in Marblehead. In the first year of the two-year pilot (2011), customers were recruited into the program and randomly assigned to either treatment or control groups. The treatment group was placed on the pilot rate which featured a 35% discounted electric rate for all non CPP hours and a 750% rate increase during critical peak periods. Critical peak periods occurred on weekdays only, from 12pm to 6pm, as specifically declared by MMLD. During the summer of 2011, a total of three (3) critical peak periods were declared, and customers were notified the day prior to each CPP event. Part of the recruitment approach involved offering bill protection to customers in the first year, meaning they were guaranteed not to pay more on the pilot rate in 2011. Participating customers in both the treatment and control groups were provided with access to an online web portal for information feedback, but were not provided with any additional in-home enabling technologies. In the second year of the pilot, all customers will be placed on the CPP rate and a subset of customers may be offered additional enabling technologies.

## OBJECTIVES

The study was designed primarily to evaluate enrollment rates, energy impacts, and attrition. The “EnergySense” Pilot is conceptually similar to “Stop peaking” program that MMLD has run for many years in which signs are hung throughout the town to promote energy conservation during peak periods. MMLD has also previously conducted a water heater load control program using radio based one-way communication. MMLD’s current investment in an advanced metering infrastructure (AMI) enables a new age of dynamic pricing and load control technologies. This pilot seeks to evaluate and understand the potential impacts and benefits of a large scale deployment, in addition to customer adoption and interaction with the technologies and concepts. Studying impacts to customer’s bills under this type of rate structure was another important objective of the pilot. The AMI system also provides MMLD with an ability to specifically measure and quantify impacts of this type of program, something that was not possible under the previous stop peaking and water heater control programs.

## EXPECTED BENEFITS

The principle benefit expected to be realized from the pilot program was a reduction in system peak demand. MMLD also anticipated that many of the participating customers would realize bill savings through the discounted Non-CPP rate.

## C. STUDY HYPOTHESES

The Consumer Behavior Study Plan included four primary hypotheses for the study. Three of the four hypotheses addressed customer behavior between the first and second program years and are therefore not relevant to this interim evaluation. The one hypothesis of importance to this interim evaluation was that *“Participants placed on a CPP rate will reduce their peak demand during critical peak events compared to what participants would have done if they had stayed on a flat rate.”*

The three additional hypotheses that were included in the CBSP but are not addressed in this interim evaluation report are:

1. Participants who realize bill savings compared to their current flat rate in the first year will elect to participate in the second year of the pilot at a higher percentage rate than participants whose bills would have increased in the first year [in the absence of bill protection]
  - *Note: Since all participants saved on their bill in the first summer it is not feasible to evaluate this hypothesis in the second year. MMLD will attempt to determine whether customers with greater bill savings compared to their peers were more likely to participate in the second year of the pilot.*
2. A high percentage (>75%) of Year 1 Treatment customers who elect to participate in the second year of the study will accept the offer for free load control technology to be placed in their home.
3. First year Treatment group customers who elect to participate in the second year of the study will accept enabling technology at a higher rate than first year control group customers placed on the CPP rate in year 2.

### **III. PROJECT DESCRIPTION**

#### **A. DESIGN ELEMENTS**

##### **TARGET POPULATION**

The theoretical target population was all residential customers who would participate in a voluntary program if a permanent dynamic pricing tariff were offered. The operational target population, that is the group of customers who were recruited to participate, consisted of MMLD's entire residential population with monthly electricity consumption exceeding 200 kWh.<sup>1</sup> Accounts were also screened for those having a Marblehead billing address and those who did not were deemed ineligible. Because the CPP program is a simple rate tariff, the program was designed to be applicable to all of MMLD's residential customers. Internet access and ownership of a personal computer were not pre-requisites for participation. No specific customer segments or sub-populations were specifically recruited for the pilot. Due to sample size requirements, MMLD's entire qualifying residential population was recruited to participate in the study.

Customers who were participants of MMLD's legacy radio-based water heater load control system were neither specifically targeted nor excluded from the randomly selected group to which marketing was focused. Customers of MMLD's existing legacy control program who wished to participate in this study were not asked to leave the legacy program, however no control events had been initiated through this program in the last several years. MMLD did not initiate any events through the legacy program during the first year of the study nor will it do so in the second year.

##### **SAMPLE SPECIFICATION**

MMLD utilized an opt-in recruitment model to develop the study sample. Marketing material was distributed to randomly selected customers in multiple waves from March through April 2011. Customers were provided with basic information on the study and told they would be randomly selected to receive the "reduced electric rate" either during summer 2011 (Year One Treatment Group) or during summer 2012 (Year One Control Group). Interested customers called into MMLD and spoke with a representative who administered a brief intake survey to collect contact and household information that was later used to help stratify the sample. As is discussed in later sections of this report, the samples were stratified based on 2010 monthly electric usage and the presence of central air conditioning and electric water heating.

The definition of sample sizes for the study was a product of multiple iterations between MMLD and the TAG. Considering MMLD's limited residential population, it was ultimately decided to calculate a sample based on a realistic participation rate of 5% - a good result for most programs with aggressive recruitment. Given a total residential population of 10,000 customers, and an assumed response rate of 5%, a target sample size of 500 was targeted for the study. After screening customers for eligibility based on a minimum monthly electric usage of 200 kWh, and a Marblehead billing address, the eligible

---

<sup>1</sup> A minimum annual kWh level was established to eliminate non-dwelling type loads.

pool of customers fell to 6,065 accounts; however a total of 532 customers ultimately enrolled in the program, representing a participation rate of nearly 9%.

**ASSIGNMENT METHOD**

Customers who volunteered to participate in the study were randomly assigned to either the treatment or control group using a recruit and delay strategy. MMLD recruited interested customers from March through April, informing them that they had been accepted into the study but without stating whether they would receive the CPP rate or not in the first year. The enrollment process involved a brief phone survey to obtain contact information and to assess whether customers had central air conditioning or electric water heaters. This information, in conjunction with historical billing data, was used to stratify the sample. Following the stratification analysis, customers were randomly assigned to treatment and control groups ensuring equal distribution of strata to each group. MMLD elected to stratify the sample to reduce the potential for significant differences between the two groups compared with a simple random assignment

Two of the principle characteristics used to stratify the sample and randomly assign customers to either treatment or control were the presence of central air conditioning and electric water heaters. The two tables below illustrate the final composition of the two groups relative to these two characteristics. These tables reflect the two groups as they were composed at the end of the summer and take into account changes in group composition due to dropouts and customers removed for other reasons such as meter incompatibility.

**TABLE 2: CONTROL GROUP APPLIANCES**

<b>Control Group</b>	<b>No Electric WH</b>	<b>Electric WH</b>
Central AC	49 (19.3%)	17 (6.7%)
No AC or Room AC only	163 (64.2%)	25 (9.8%)

**TABLE 3: CPP GROUP APPLIANCES**

<b>CPP Group</b>	<b>No Electric WH</b>	<b>Electric WH</b>
Central AC	54 (20.5%)	19 (7.2%)
No AC or Room AC only	155 (58.7%)	36 (13.6%)

Once the treatment and control groups had been established, MMLD sent enrollment packages to each of the enrolled customers. The enrollment packages were tailored to the treatment and control groups respectively, and included a welcome letter, information on the program (for their group), and brief written survey.

## RATE AND NON-RATE TREATMENTS

### CPP RATE DESIGN ELEMENTS

MMLD's smart grid pilot program focuses on a critical peak pricing tariff. This pricing strategy works as an overlay on a customer's existing flat rate. The CPP rate tariff is included for reference in Appendix A to this evaluation report and summarized in the table below.

TABLE 4: STANDARD AND PILOT RATE STRUCTURES

Rate Component	Standard Rate	CPP Rate
Basic Monthly Charge	\$4.25 per month	\$4.25 per month
Non-CPP kilowatt-hours	\$0.1425 per kWh	\$0.09 per kWh
CPP kilowatt-hours	\$0.1425 per kWh	\$1.05 per kWh

The three (3) summer months of June through August are the peak months for the ISO-NE system. Review of historical MW system load data for MMLD from 2005 through 2009 indicated that MMLDs system peaks also occur during these three months, therefore these three months were selected as the critical peak months for the pilot. Based on the hourly load data for those three summer months, a critical peak pricing period consisting of non-holiday weekdays from 12pm through 6pm was established, with the option to call CPP events up to six hours during that period. All other hours on weekdays and all hours during weekends and holidays were considered Non-CPP hours during the three summer months, June through August. Notifications to customers of critical peak days were issued based on MMLD's projected load forecast; all events were six (6) hours in duration. There were three (3) critical peak day notifications during the three-month period.

Several types of costs that could be associated with the critical peak period described above were identified, including the current and projected forward capacity market ("FCM") cost, the capacity cost of new entry ("CONE"), and MMLD's current and projected monthly transmission cost. After examining these various costs, the current FCM cost of \$4.50 per kW-mo. (for 12 months per year) and the current transmission cost of \$5.42 per kW-mo. (for 3 months per year) were selected as the costs to be recovered by the Critical Peak Price ("CPP") adder. The combined FCM and transmission costs were divided by the estimated kWh in the critical peak period to compute the CPP adder. A standard rate of \$0.0990 per kWh reflecting MMLD's supply and transmission costs for the residential rate class was used to determine the revenue under the current retail rate structure, and the Non-CPP discount was calculated to achieve revenue neutrality for an average customer based on an assumed twelve (12) CPP events.<sup>2</sup>

---

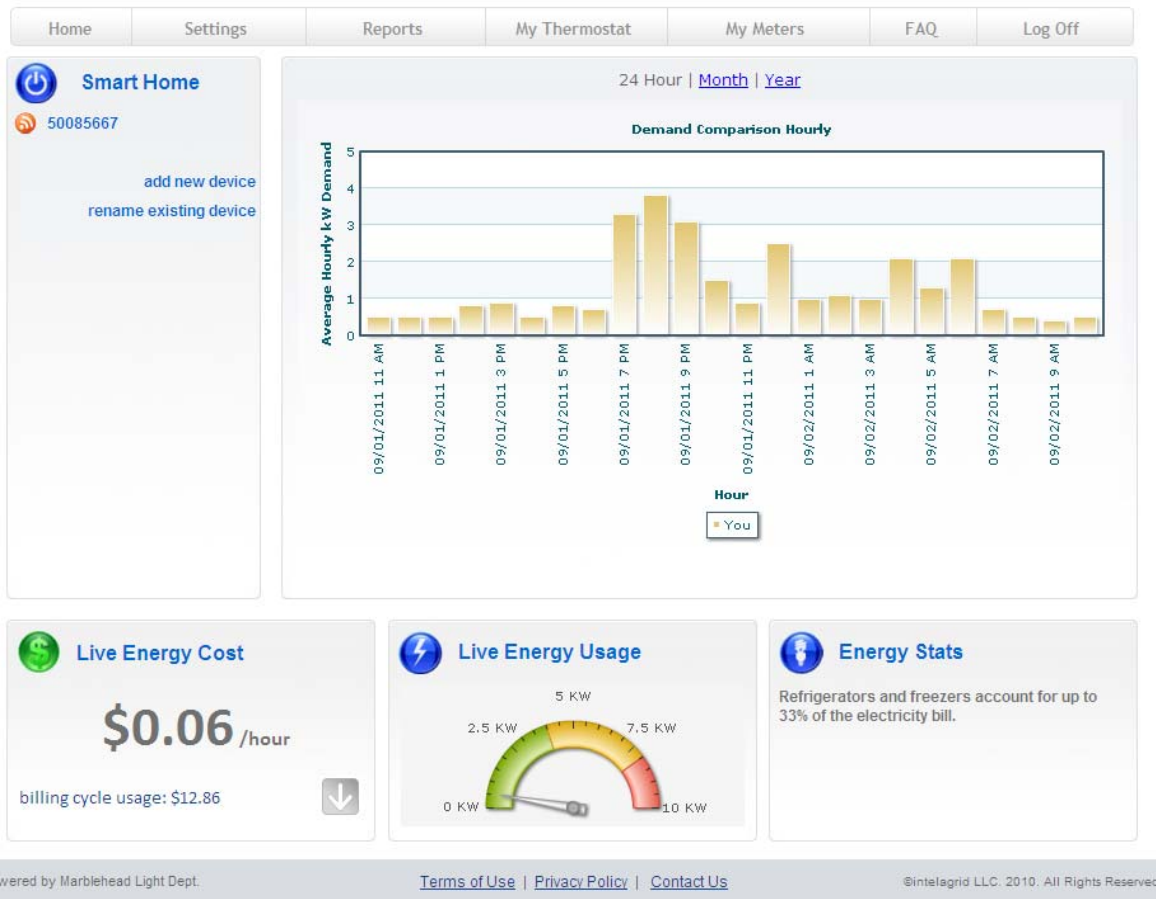
<sup>2</sup> A breakout of the CPP rate derivation and assumptions, including ratio to standard flat rate is available upon request



## TECHNOLOGY DESCRIPTION

In Year 1, all customers were provided with access to an online web portal which allowed them to monitor their consumption in real-time, view historical usage statistics to encourage energy conservation, and provided an estimation of their monthly bill. The web portal was hosted by Nexgrid who is the AMI implementation vendor selected by MMLD. A screenshot of the web portal is shown below.

FIGURE 1: NEXGRID INTELAHOME WEB PORTAL



No additional enabling technologies were provided in the first year of the study. Programmable Controllable Thermostat's (PCT) and water heater controls may be offered to customers in the second year although as of the date of this report that decision has not been finalized. For year one, the only technology provided was access to the online web portal. This was provided to both groups.

## INFORMATION DESCRIPTION

Customers were provided with enrollment packages prior to the start of the pilot that included two key documents. The first was a one-page "Pilot Details" flyer that provided basic information on the pilot design including duration, rate details, their meter exchange, and access to the online web portal. The pilot details flyer was tailored to whether the customer was in the treatment or control group. A second document was titled "Ways you Can Save" and provided simple and actionable tips for general energy conservation and then specifically for load curtailment during critical peak periods. Both the treatment

and control groups received the general energy conservation piece however only the treatment group on the CPP rate received the tips for conserving specifically on CPP days. Copies of the enrollment packages for the treatment and control groups are provided for reference in Appendix B.

MMLD also notified treatment group customers of a scheduled CPP event by 5pm the day before the event. This provided customers with advance notice to react to and plan for the higher prices accordingly. Notifications were sent according to customer’s preferences and included both phone and email notification. Customers were able to have notifications sent to multiple email address and phone numbers.

## **B. IMPLEMENTATION**

The table below illustrates the key milestone dates for Year One of the MMLD CPP pilot study.

**TABLE 5: KEY IMPLEMENTATION DATES**

<b>Date</b>	<b>Milestone</b>
March 8, 2011	First wave of mailings sent out
March 22-24, 2011	Second wave of mailings sent out
March 31, 2011	Third wave of mailings sent out
May 9, 2011	Enrollment packages sent to enrolled participants
June 6, 2011	Field installation of AMI meters began
June 1, 2011	Pilot Begins
June 18, 2011	Field installation of CPP group AMI meters complete
June 28, 2011	Field installation of Control group AMI meters complete
July 12, 2011	CPP Event #1
July 21, 2011	CPP Event #2
July 22, 2011	CPP Event #3
August 31, 2011	First Summer of Pilot Ends

### **SAMPLE RECRUITMENT AND MAINTENANCE**

MMLD launched marketing materials in early March 2011 and continued recruitment through the end of April. Direct mail marketing pieces were developed and mailed to a random selection of customers. Two separate direct mail pieces were developed; one was a 4-panel detailed brochure that provided more detailed program information and while it included mention of the opportunity for bill savings, also included “green” and “community benefit” messaging. The second marketing piece was a simple postcard that was much simpler and stressed only the cost savings opportunities of the program. The two marketing pieces are included for reference in Appendix C.

The first mailing went out to a randomly selected group of 2,500 qualified customers. A second mailing went out several weeks later with a second wave to the first group, and the first wave to a new random

group of 2,500 customers. A third mailing was also sent with a second wave to the second group, and a first wave to a third group of all remaining customers. This was sufficient to recruit more than the total quota of customers.

#### SAMPLE ATTRITION

Overall, MMLD experienced an extremely low level of attrition once the pilot began. Some dropouts occurred between the recruitment period and the launch of the pilot due issues with incompatible meters or MMLD not being able to install the new meter in sufficient time for the beginning of the pilot; however the rate of attrition during the study was very low. There were also very few questions or concerns from customers, likely due to the fact that all customers saved money on the pilot rate due to the low number of CPP events, and that there was no additional in-home technology installed. The fact that bill protection was offered to all customers in the first year also likely played a significant role in the low attrition rate because customers knew they were protected from higher bills.

#### **INCENTIVE APPROACH**

The principle incentive for customers to participate in the pilot was the opportunity to save money on their monthly electric bills. The marketing materials also focused on some of the community benefits of this type of program with respect to power stability and reducing the need for new power plants. Closely related to the opportunity for bill savings was the promise of bill protection in the first year which provided customers with an opportunity to pursue bill savings through the CPP rate with no risk of paying a higher bill.

## **IV. EVALUATION METHODS**

### **A. IMPACT EVALUATION METHODOLOGY**

The MMLD team estimated load impacts using three methodologies: 1) adjusted comparison of means, 2) a panel regression model, and 3) individual regression models. The three approaches allowed MMLD to verify the premise that customers did indeed respond to the price signals in a significant manner. After reviewing results from each of the three approaches, and through discussions with the DOE's Technical Assistance Group (TAG), it was decided that the adjusted comparison of means represents the best methodology for measuring impacts in year 1 of this project given the ideal randomized control design of the pilot. Each of the three methods produced similar results which are summarized in Section V of this Interim Evaluation Report.

#### **COMPARISON OF METHODOLOGIES TESTED**

The comparison of means approach simply compares the average hourly loads of the treatment group to the control group on CPP event days. If the two groups have been designed to be comparable in terms of usage and known demographic and appliance ownership characteristics, then the differences between the two loads can be reasonably determined to be the effect of the CPP rate. The pilot in year one was carefully designed using a randomized control design in order to make the comparison of means a viable methodology for estimating load impacts. The comparison of means approach is easy to calculate and easy to understand. However, it lacks the statistical rigor associated with the other two statistical modeling approaches. Furthermore, electricity consumption tends to vary significantly among randomly selected customers due to factors such as customer behavior, dwelling size, and appliance ownership. Panel and individual regression models tend to be better able to control for such differences and measure load impacts, provided there are sufficient days with and without events with similar weather.

A panel regression model uses both time series and cross sectional data to account for the various factors that tend to influence consumption. Three types of factors are considered in the panel regression prepared in this study: 1) factors that are fixed for a given customer, but vary by customer; 2) factors that vary over time but not for each customer (such as the day of the week); and, 3) factors that are fixed for each customer but also vary over time (such as ownership of air conditioning and its relationship with temperature). Panel models can explain significantly more variation in electricity consumption than techniques that do not take time varying factors into account. While panel regressions can increase the accuracy of impact estimates for the average customer, they cannot be used to meaningfully describe the impacts for specific groups of customers within the cross section. They are also less intuitive and more time-intensive to develop and analyze relative to a comparison of means approach.

Individual regression modeling involves creating a regression model to describe hourly loads for each customer in the pilot. The approach relies on pre- and post-treatment data to estimate load impacts. The approach is appropriate only when a large number of time periods are observed. Control groups are not required for an individual regression approach, although regressions can be estimated for a design that includes a control group. The results of the individual regression approach are more robust

if the pilot includes alternating or repeated patterns for treatment. This allows for observation of behavior both with and without treatment under similar conditions (such as extreme temperature days). Like panel regressions, the individual regressions are time-intensive and less intuitive than the comparison of means approach.

The comparison of means approach is subject to sampling error, whereas the panel and individual regression approaches are subject to specification error. In the Year 1 case, in which the three hottest days were all event days, the specification error for the statistical models may be an issue concerning the relationship between temperature and usage on hot days. As described below, MMLD will set forth a plan in Year 2 to hopefully help alleviate that concern. We have chosen to report the comparison of means approach herein. It is the simplest approach to describe and understand. As mentioned earlier, the three approaches in year one of the study have measured impacts that are very similar. The panel and individual regression approaches are presented in the Appendices.

## **YEAR TWO METHODOLOGY**

In the second year of the pilot, all customers that were assigned to the control group in year one will be migrated to the treatment group. There will be no control group in the second year. Therefore, an individual regression approach will be required for the impact evaluation in year two. With two summers of data for many of the customers, there will be sufficient pre-treatment data for estimation of regressions. The ability to test and verify several methodologies this year also indicates that the individual regression approach will sufficiently measure impacts in year two.

As described above, it is best to have observations with and without critical peak events under similar conditions. In order to best capture this type of critical information, MMLD is proposing to establish a threshold temperature condition in year two to trigger a possible event day. Then, we will actually call every other day that meets the criteria. We will select a threshold that targets a total of 12-15 possible event days in 2012, resulting in 6-8 actual event days called with another 6-8 hot days without an event. This approach should provide for load behaviors in our pilot customers on hot non-event days that are similar to the event days.

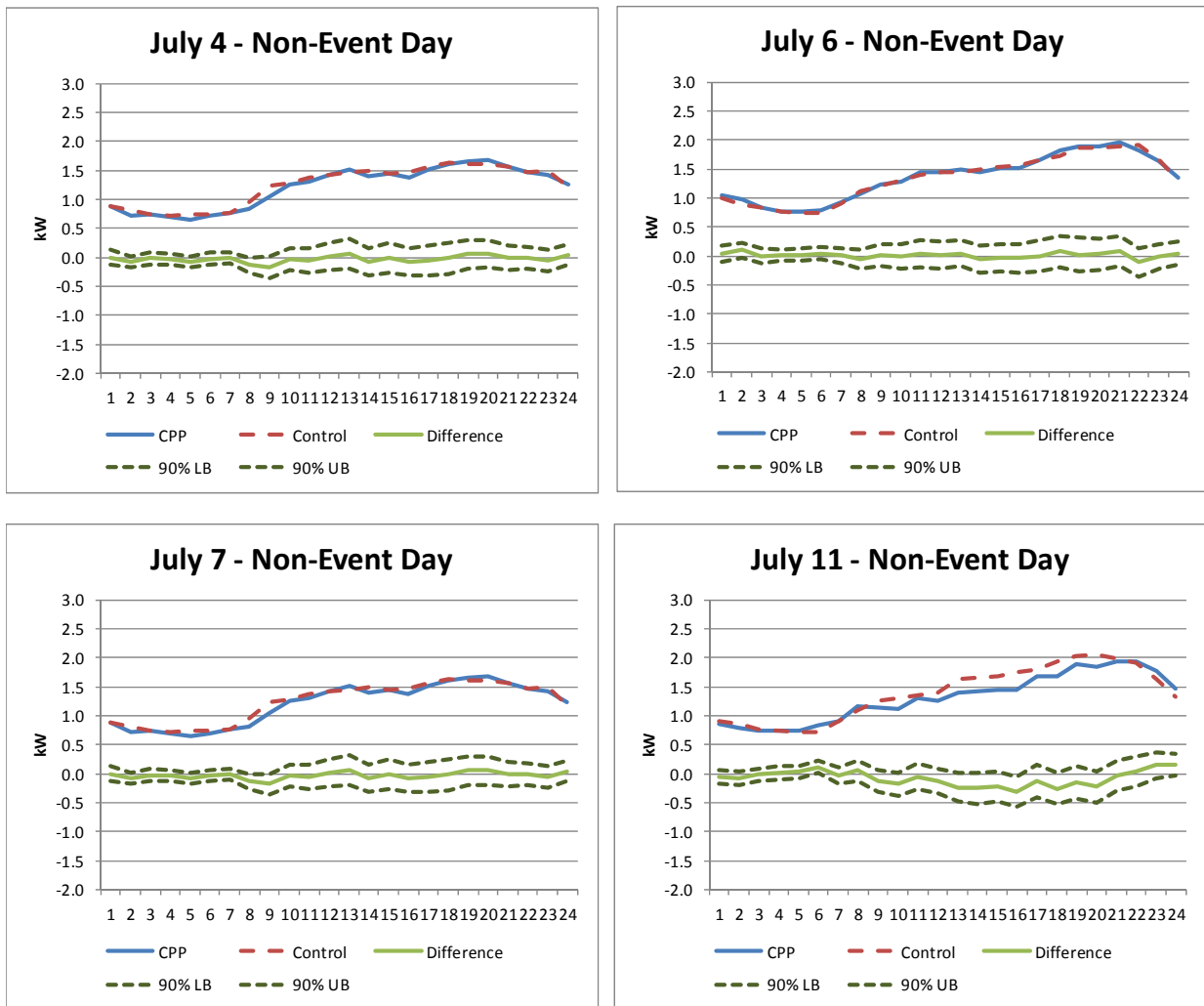
## **COMPARISON OF MEANS**

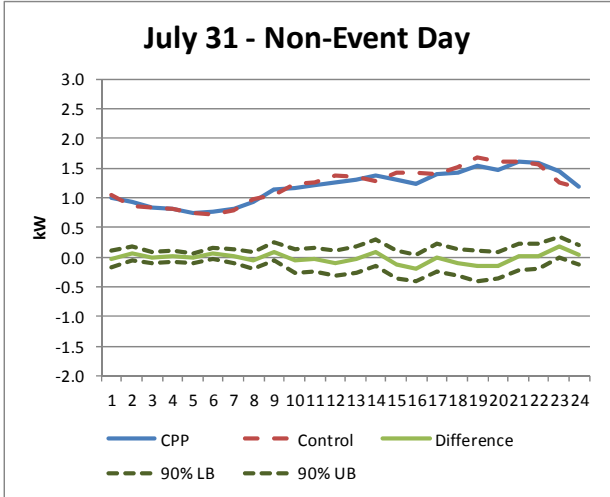
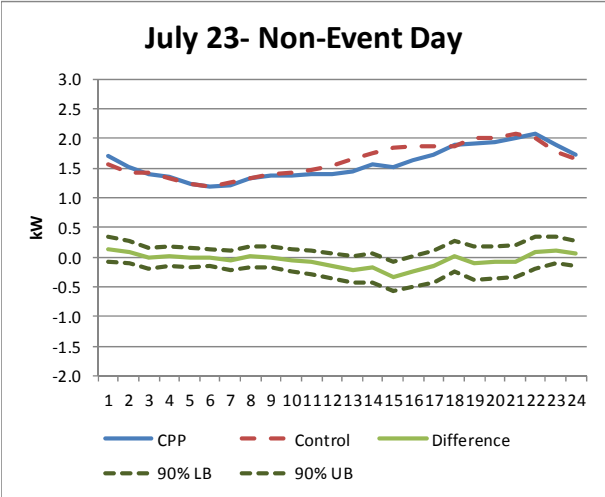
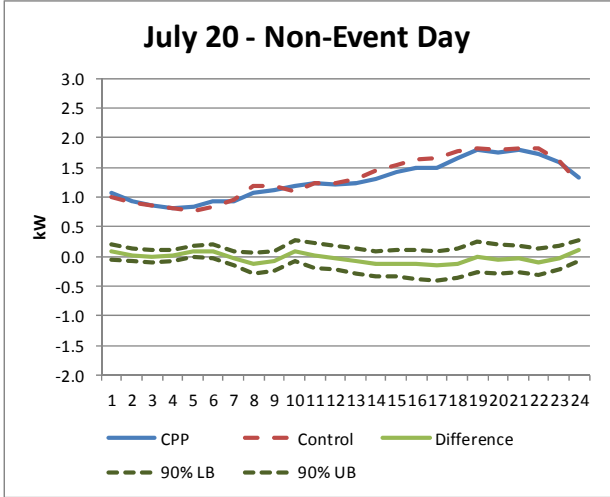
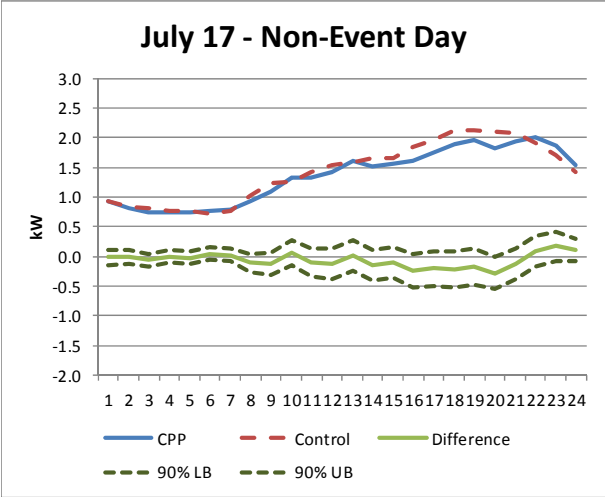
In the simple comparison of means approach, the loads on event days between CPP and control customers are compared and the difference represents the impacts associated with the CPP events. However, during non-event days, a difference in usage was noted between the two groups that was not apparent during the sample design phase of the program (based on 2010 billing history, the original Control and CPP groups had equivalent summer usage). This is an important issue since small biases in the reference load can lead to large biases in the impacts. During on-peak hours on the hottest non-event days, control loads were averaging 7%-8% higher than the CPP loads.

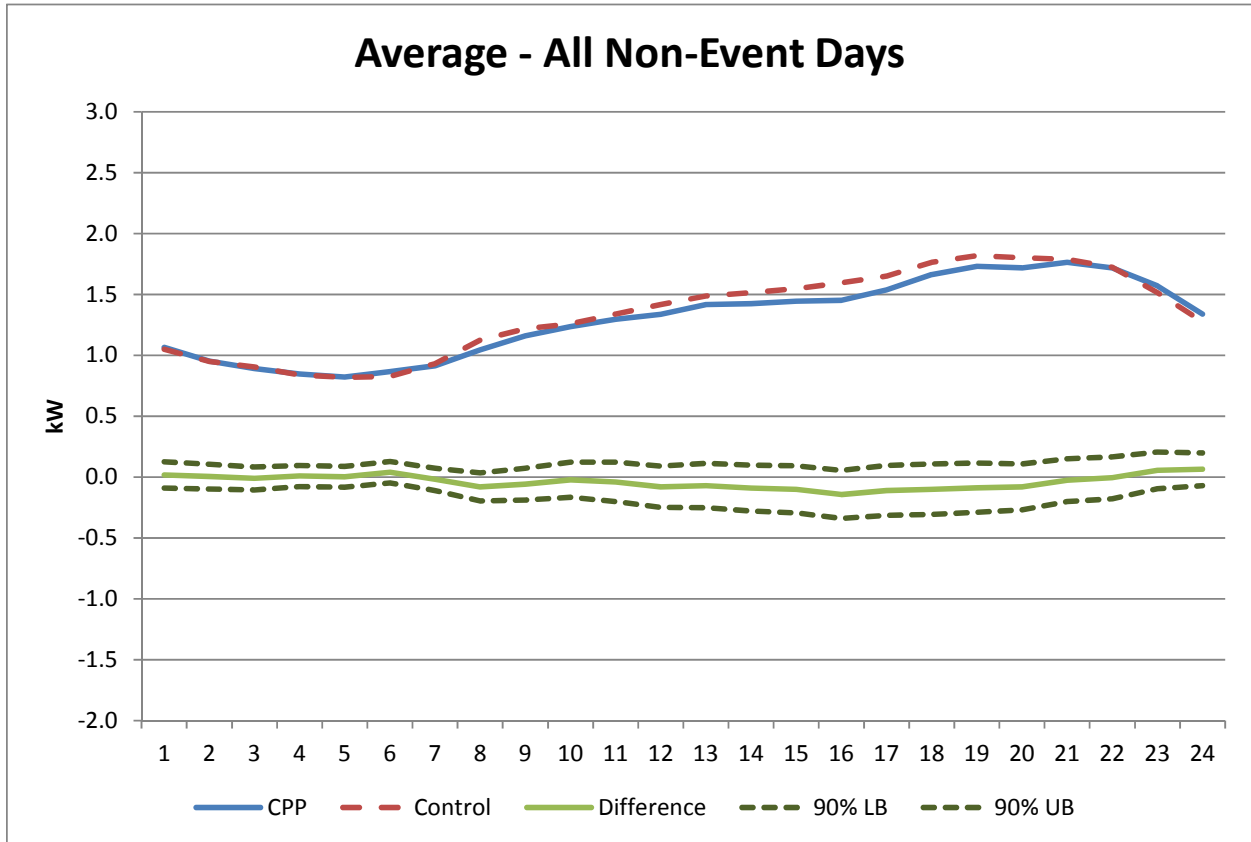
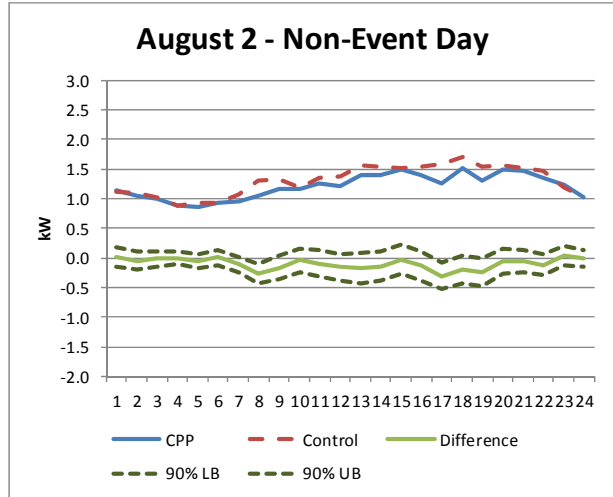
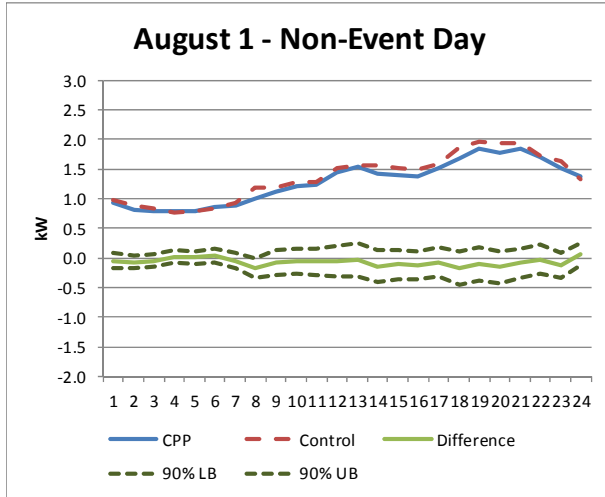
The MMLD team constructed confidence intervals on the difference between hourly control and hourly CPP group loads for each of the ten hottest non-event days. The confidence intervals, which all contain zero, indicate that we cannot conclude that the loads are statistically different. The charts below show the control and CPP average loads, the difference, and the confidence interval for the difference for each of the ten hottest non-event days. Although this indicates no statistically measurable difference in

the loads, other hypothetical issues could be leading to some difference. For instance, the treatment customers may be more aware of their consumption since they have received educational materials and are actively on a CPP rate. That awareness may lead to lower loads even on non-event days. Furthermore, as described in Section B below, a disproportionate number of control customers were excluded from the study due to one of several reasons. That exclusion may lead to bias in the data used in the impact evaluation. Therefore, we elected to make an adjustment to the comparison of means approach based on the hottest non-event days. The adjustment makes the impacts estimated by the method more conservative.

FIGURE 2: NON-EVENT DAY CONTROL AND CPP LOADS







The difference in loads on the ten hottest non-event days was used to adjust the Control loads to create an adjusted baseline for the CPP group. The difference between this adjusted baseline and the CPP loads then represented the impacts of the rate during event days. The formula below demonstrates how the baseline was calculated and how the impact is measured:



$$\text{Baseline}_{\text{event,h}} = \text{Control}_{\text{event,h}} \times (\text{CPP}_{\text{hot non-event,h}} / \text{Control}_{\text{hot non-event,h}})$$

$$\text{Impact}_{\text{event,h}} = \text{CPP}_{\text{event,h}} - \text{Baseline}_{\text{event,h}}$$

Where: h=hour

event,h = the average load in hour h of the event days

hot non-event,h = the average load in hour h of the 10 hottest non-event days.

The cause of the difference between the Control group and CPP group on non-event days was further investigated using billing analysis, as described later in the report.

## B. DATA COLLECTION

### PARTICIPANT ENERGY USE DATA

15-minute interval data was collected for all participating customers in the study. The data was stored by the AMI vendor, Nexgrid, and provided electronically to the MMLD team for evaluation. The data was received in the following format:

FIGURE 3: FORMAT OF RAW ENERGY USE DATA

(Last Name)	(First Name)	(Account #)	(Date & Time)	(Instantaneous kW Reading)	(Accrued kWh)	(Voltage)
lname	fname	account	device_tstamp	ekw	kwh	volts
DOE	JOHN	1234567	7/1/2011 2:06	0.79	245.8993	239
DOE	JOHN	1234567	7/1/2011 2:27	0.597	246.1878	239
DOE	JOHN	1234567	7/1/2011 2:48	0.925	246.5114	240
DOE	JOHN	1234567	7/1/2011 3:09	0.904	246.8331	240
DOE	JOHN	1234567	7/1/2011 3:30	0.643	247.0888	242
DOE	JOHN	1234567	7/1/2011 3:51	0.63	247.3552	240

The interval load data was reviewed by the MMLD team prior to its use in impact evaluation modeling. First, the 15-minute data was summarized to hourly. Several readings posted as consumption in excess of 9,000 kWh. These readings were removed from the data. Then, the data was scanned for large data gaps. Many of the customers had very small or no gaps in the data and the few that had larger data gaps (of several hours during a day) did not have gaps on event days. Therefore, no customers were excluded from the analysis due to missing interval data.

However, 40 control and 13 treatment customers were excluded from the analysis because no interval data was collected for these customers over the summer. The reasons for the missing accounts are described in the table below. The 23 control meters that went in too late were due to a paperwork error. The MMLD team noted that a disproportionate number of missing meters came from the control group (in excess of 15%). These missing meters may be part of the reason the control loads are higher than CPP loads on non-event days. To further investigate the extent to which these missing meters may

be biasing the evaluation, we examined billing history data for these accounts (since interval meters were not installed for the summer, we are unable to investigate loads at hourly or daily intervals). The most pertinent month for the evaluation is July 2011. The three event days and eight of the ten hottest non-event days occurred in July. The 40 excluded customers had an average July 2011 consumption of 1,011 kWh. The 210 Control customers used in the study had a July 2011 average consumption of 1,052. Based on the bill history for the most critical month, it does not appear that much bias was introduced into the study. Further, there were no systemic reasons why these customers were missed other than MMLD made sure to set CPP meters prior to Control meters. However, the 23 meters installed too late did not come from the same neighborhood or had some other demographic element in common that would lead to bias. Such incidences point out the fact that although the pilot is carefully planned to reduce bias, things out of our control happen that can introduce bias into the analysis. Performing three separate impact evaluations helps to validate the analysis.

### Reasons for Missing Data

Reason	No. Control	No. Treatment
Specialty Meter – Could Not Install	8	2
Homeowner Moved/Sold Home	1	3
Dropped Out of Program	3	0
Meter Installed Too Late	23	0
Other*	5	8
Total	40	13
* Includes wrong account numbers, meter not working, no access to meter, rusted meter base		

### SYSTEM ENERGY USE DATA

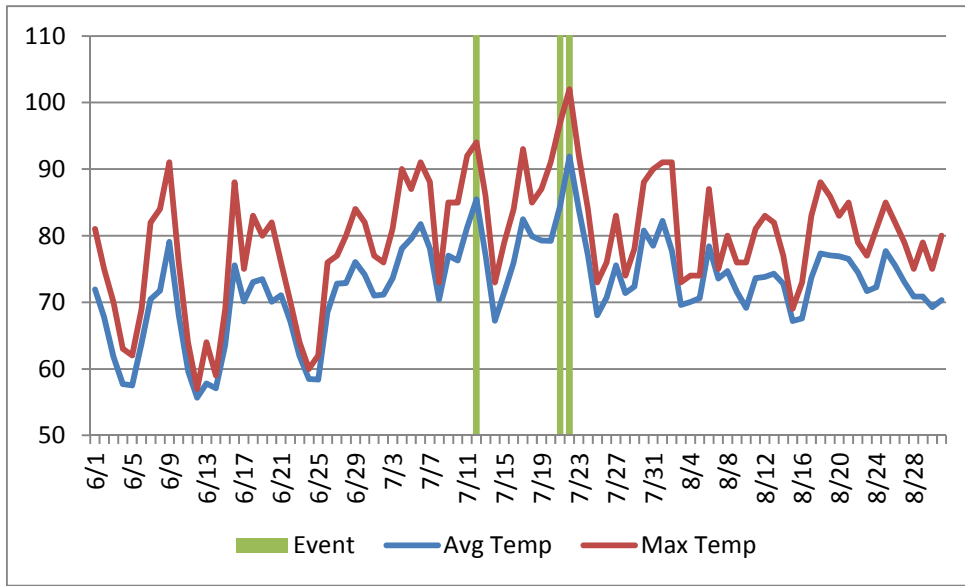
MMLD has hourly Tie Line metered data for their entire system that reports peak loads by day and hour. This data is utilized as the basis for billing through the Independent System Operator serving New England (ISO-NE). This data was used to evaluate the magnitude and timing of MMLD’s peak loads during the course of the summer, and how the timing of these peak loads coincided with critical peak events issued through the pilot program.

### WEATHER DATA

Hourly temperature data for Boston, Massachusetts was obtained from the National Oceanic and Atmospheric Administration (NOAA) and was used as part of the impact analyses. Cooling Degree Hours (“CDH”) were calculated from this hourly data based on the differential in actual temperature and a cooling set point of 65° F.

Three CPP event days were called by MMLD on the three hottest days of the summer. The figure below illustrates the weather data for the pilot period as well as the three days in July that were declared as critical peak days.

FIGURE 4: MAXIMUM AND AVERAGE WEATHER DATA FOR BOSTON MA



## PARTICIPANT DATA

Demographical and household information for study participants was collected during the enrollment process and through a written pre-pilot survey document. The enrollment process involved customers speaking with a MMLD representative who collected basic contact information and whether customers had central air conditioning or window air conditioners, and whether they used room air conditioners. This basic information was collected for all participants and used to help stratify the sample.

A written pre-pilot survey, provided to MMLD by DOE, was administered to all participants along with their enrollment packages. A copy of the survey is included in Appendix B to this interim evaluation report. Response to the pre-pilot survey was excellent – 469 responses out of 529 distributed surveys for a response rate of almost 89%. However, the surveys were administered without unique identifiers meaning that data collected is available at the sample level but not at the individual customer level, and is not conducive to cross-sectional analysis<sup>3</sup>. The pre-pilot surveys collected information on occupancy, appliances, income and education. Results are summarized in Section V.H.

Post pilot surveys were also administered to both the treatment and control groups in early September. These surveys included questions regarding notification methods, utilization of the web portal, actions during CPP events and other pertinent data. Response rates for the post pilot survey were slightly lower, 60% for the treatment group (161/269) and 46% for the control group (119/260) however these surveys were issued with unique identifiers that enable cross sectional analysis.

<sup>3</sup> A second round of surveys are being administered prior to the beginning of the second summer to provide data for cross-sectional analysis

## V. RESULTS

### A. SAMPLE PARTICIPATION RATES

The target sample size for the study was developed based on an estimated 5% participation rate which was described as a “good result for most programs with aggressive recruitment”. In total, MMLD marketed to 6,065 qualified customers and obtained 532 participants, for a participation rate of 8.8%.

MMLD utilized two types of marketing materials in the recruitment process. First was a 4-panel brochure that included more detail on the program and had more of a “green” message. The second was a simple postcard that focused on the potential cost savings on this type of rate. The first wave of mailings went to a group of roughly 2,400 customers and all received the brochure. Follow up postcards were sent to this group roughly 2 weeks later. Response rates to the first wave (6.2%) were considerably higher than to the second wave (3.7%) however this is not a true indication of response to messaging. The process for the second group of 2,500 customers was reversed. That group received the postcard first and the brochure second. MMLD does not have sufficient data to parse response rates by mailing but does note that the overall response rate from the second group (8.7%) was lower than the first group (9.7%). Anecdotally, MMLD staff who fielded customer calls indicated that customers had an overall better response to the brochures with the green message compared with the less detailed postcard that was focused on cost savings. The table below summarizes available data on participation rates for each customer group wave of promotional materials.

TABLE 6: RECRUITMENT ACTIVITY SUMMARY

Customer Group (# customers)	Mailing Number/Type	Participants	Response Rate
Group 1 (2,401)	Mailing 1 - Brochure	150	6.2%
Group 1 (2,401)	Mailing 2 – Postcard	84	3.7% <sup>4</sup>
Group 2 (2,500)	Mailing 1 - Postcard	218 <sup>5</sup>	8.7%
Group 2 (2,500)	Mailing 2 – Brochure		
Group 3 (1,164)	Mailing 1 - Brochure	74	6.4%
<b>TOTAL</b>		532	8.8%

<sup>4</sup> 2,401 less 150 responses from first mailing

<sup>5</sup> No data available on response to 1<sup>st</sup> versus 2<sup>nd</sup> mailing

## B. PEAK EVENT INFORMATION

A total of three (3) Critical Peak Events were declared during the course of the three month pilot period. The table below illustrates the 12 hottest days of the summer and indicates the three event days, which occurred on the three hottest days.

TABLE 7: CPP EVENT INFORMATION

Date	Event Day	Max Temp	Avg. Temp	MMLD System Peak (MW)	Hour of Peak
Friday, 7/22	X	102	91.9	31,185	16
Thursday, 7/21	X	97	84.5	27,738	17
Tuesday, 7/12	X	94	85.5	26,811	19
Sunday, 7/17		93	82.5	23,778	21
Monday, 7/11		92	81.2	23,796	21
Saturday, 7/23		92	83.9	24,903	19
Saturday, 7/16		91	76.0	17,280	22
Wednesday, 7/20		91	79.2	22,284	18
Monday, 8/1		91	82.2	22,095	21
Tuesday, 8/2		91	77.7	20,934	16
Monday, 7/4		90	78.0	20,961	19
Sunday, 7/31		90	78.5	18,972	21

The three Critical Peak events corresponded with the three highest system peak events during the pilot. Two of the system peak events, on 7/21 and 7/22, occurred during the critical peak period while the third, on 7/12, occurred just after the critical peak period ended, between 6pm and 7pm. MMLD’s CPP program was designed to capture the coincident peak with New England’s Independent System Operator (ISO-NE) which is the relevant peak for participating in forward capacity market programs. ISO-NE’s peaks do traditionally occur between the hours of 12pm and 6pm

Several interesting trends in Marblehead’s system load data are notable from the data. First is that the system peak load appears to show a stronger correlation to average daily temperature than to maximum daily temperature. This is likely because the average daily temperature is a better indicator of sustained heat wave conditions result in high use periods. The second notable trend is the timing of MMLD’s system peaks, almost all of which fall outside of the critical peak range – apart from the hottest days. This is likely because Marblehead is principally a bedroom community where residents come home after work and use appliances and cool down their homes. Generally, system loads on the weekends are less than during the week likely because many residents are out away from their homes on the weekends. The timing of MMLD’s peak is not relevant to future program design which aims to curtail demand during periods of ISO-NE’s peak, not necessarily during MMLD’s system peak which occurs later in the day than the region peak.

## C. HISTORICAL USAGE DATA SUMMARY

The CPP impact analysis revealed a reduction in peak demand during CPP event days due to a significant increase in price. The analysis of data collected also revealed a difference in load between the treatment and control group during non-event periods. On the 10 hottest, non-event days, peak period load for the control group exceeded load for the treatment group by approximately 7 percent. It was hypothesized that treatment group customers, after receiving their enrollment packages and education materials, and knowing they were on the CPP rate, exercised a level of energy conservation relative to the control group. A billing analysis was considered to investigate the differences between the treatment and control groups with respect to average monthly energy consumption during the test period. This analysis is discussed further below.

**Data Availability** - Historical monthly billing data was obtained for all study participants during the enrollment phase of the pilot; however, pre-pilot interval data for the study participants was not available. The historical billing data was not necessary for the impact evaluation because of the randomized control design; however, the data was used to test for non-price driven energy conservation impacts for both the treatment and control groups during the 2011 pilot period.

**Methodology and Analysis** - Regression analysis was the preferred approach for conducting a billing analysis. The intent was to specify a model including monthly consumption as the dependent variable and degree days, number of days in the billing period, and a binary variable representing the treatment periods (1 for months of treatment, 0 otherwise) as the independent variables. A review of the historical billing data revealed problems that prevented development of a reliable regression model. One, the treatment period began June 1, 2011 and ended August 31, 2011, which provided a maximum of only three months per customer of treatment period consumption. Furthermore, due to billing cycles, the vast majority of treatment period observations in June represented only a partial month, and many treatment period observations for August were not available<sup>6</sup>. Based on the data limitations, it was concluded that a reasonable billing analysis could not be conducted without a devoting a considerable amount of time and effort to developing a more complete set of kWh consumption data for treatment customers during the June through August time frame. Furthermore, given a set of clean data, there is the question if only three months of data for treatment customers provides a sufficient number of observations to adequately quantify the impacts between the treatment and control groups.

---

<sup>6</sup> A further explanation of the August billing period is included in Section F of this document

## D. BENEFITS AND METRICS DATA SUMMARY

The table below summarizes impact metrics for MMLD’s consumer behavior study. These metrics are based on guidance from DOE and the TAG group and are intended to provide a consistent methodology for evaluating results across multiple SGIG funded pilots.

TABLE 8: MMLD CONSUMER BEHAVIOR STUDY IMPACT METRICS

Impact Metric	Value <sup>1</sup>	Units	Description
Average Seasonal Impact on Electricity Consumption	-0.3%	% Change <sup>2</sup>	Average impact on consumption across 3 months (Jun-Aug)
	(3,747)	kWh/Season	
> Sampling Error	-34.6%	% kWh/Season	
Average Hourly Impact on Electricity Consumption Over All Events	-36.7%	% Change <sup>2</sup>	Over critical events in CPP Program (Three event days, HE 13-18)
	(186.72)	kW	
> Sampling Error	-3.8%	% kW	
Impact on System Coincident Peak Demand	-0.9%	% Change <sup>3</sup>	Program impacts when single hour Coincident Peak demand occurs (7/22/11 HE 16)
	(267.12)	kW	
> Sampling Error	-14.5%	% kW	
Impact on Future Reliability Requirements			Impact on planning reserve margin.

1 - Value is for a total of 252 customers participating in the pilot program on the CPP rate in 2011.

2 - Represents the % change for just the pilot customers.

3 - Represents the % of MMLD's 2011 Peak Demand of 31,185 kW.

## E. IMPACT EVALUATION RESULTS

As described above, the MMLD team calculated impact evaluations using three methodologies. The data presented in Section D above represents the results of the comparison of means approach. Two other approaches, as described in Appendix D and Appendix E, were used to help verify the comparison of means approach. As shown in the table below, the three methodologies provided similar impacts.

	<b>Comparison of Means</b>	<b>Panel Regressions<sup>7</sup></b>	<b>Individual Regressions<sup>8</sup></b>
Avg. kW Impact During Event Hours	(0.74)	(0.73)	(0.59)
% Impact	-36.7%	-36.6%	-31.7%
90% Confidence Interval	(0.95) – (0.54)	(0.87) – (0.60)	(0.89) – (0.30)
Avg Daily kWh Energy Impact on Event Days	(4.96)	(2.34)	(3.70)
% Impact	-12.1%	-6.1%	-9.3%
90% Confidence Interval	(7.94) – (1.98)	(5.52) – 0.84	(8.63) – 1.20

Given an impact of -0.74 kW, or -37%, during event hours, the arc elasticity can be estimated based on the rate differential. During event hours, the rate changes from \$0.09 per kWh to \$1.05 per kWh, a change of 1067%. The measured impact for this study represents an elasticity of -0.035.

The tables and figures below show the hourly impacts for the average event day and for each event day during the summer of 2011. The 90% confidence intervals indicate that, during event hours, we can be 90% confident that the adjusted difference in the control and treatment groups (the load impact associated with the CPP rate) is between 0.55 and 0.95 kW. Interestingly, we cannot conclude that there is a statistical difference or impact in the hours prior to or following a critical event, so it is not clear if there was significant pre-cooling or post-event snapback in consumption. Total energy savings for an event day is statistically significant with 90% confidence.

---

<sup>7</sup> See results and methodology in Appendix D

<sup>8</sup> See results and methodology in Appendix E



TABLE 9: AVERAGE OF ALL EVENT DAYS - IMPACTS

Hour Ending	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
					Lower	Upper
1	1.30	1.28	0.02	1.4%	(0.09)	0.12
2	1.18	1.16	0.02	1.9%	(0.47)	0.51
3	1.09	1.11	(0.02)	-2.1%	(0.10)	0.05
4	1.07	1.08	(0.01)	-0.8%	(0.17)	0.15
5	1.06	1.06	0.00	0.2%	(0.04)	0.05
6	1.11	1.10	0.00	0.3%	(0.00)	0.01
7	1.19	1.17	0.02	1.6%	(0.10)	0.14
8	1.34	1.35	(0.01)	-1.1%	(0.03)	0.00
9	1.57	1.52	0.05	3.6%	(0.09)	0.20
10	1.70	1.63	0.07	4.4%	(0.55)	0.69
11	1.68	1.79	(0.11)	-5.9%	(0.26)	0.05
12	1.68	1.82	(0.14)	-7.6%	(0.27)	(0.01)
13	1.19	1.90	(0.71)	-37.4%	(0.91)	(0.52)
14	1.20	1.92	(0.72)	-37.4%	(0.91)	(0.52)
15	1.24	2.04	(0.80)	-39.3%	(1.02)	(0.58)
16	1.27	2.00	(0.73)	-36.4%	(0.93)	(0.53)
17	1.36	2.09	(0.72)	-34.7%	(0.93)	(0.52)
18	1.40	2.16	(0.76)	-35.3%	(0.97)	(0.55)
19	1.93	2.29	(0.36)	-15.7%	(0.58)	(0.14)
20	2.09	2.26	(0.17)	-7.5%	(0.36)	0.02
21	2.25	2.28	(0.02)	-1.0%	(0.14)	0.09
22	2.29	2.20	0.09	4.3%	(0.66)	0.85
23	2.06	2.02	0.04	2.0%	(0.17)	0.25
24	1.79	1.78	0.01	0.6%	(0.01)	0.03
<b>Energy</b>	<b>36.04</b>	<b>40.99</b>	<b>(4.96)</b>	<b>-12.1%</b>	<b>(7.94)</b>	<b>(1.98)</b>
<b>HE 13-18</b>						
<b>(Event Hours)</b>	<b>1.28</b>	<b>2.02</b>	<b>(0.74)</b>	<b>-36.7%</b>	<b>(0.95)</b>	<b>(0.54)</b>

FIGURE 10: AVERAGE OF ALL EVENT DAYS - IMPACTS

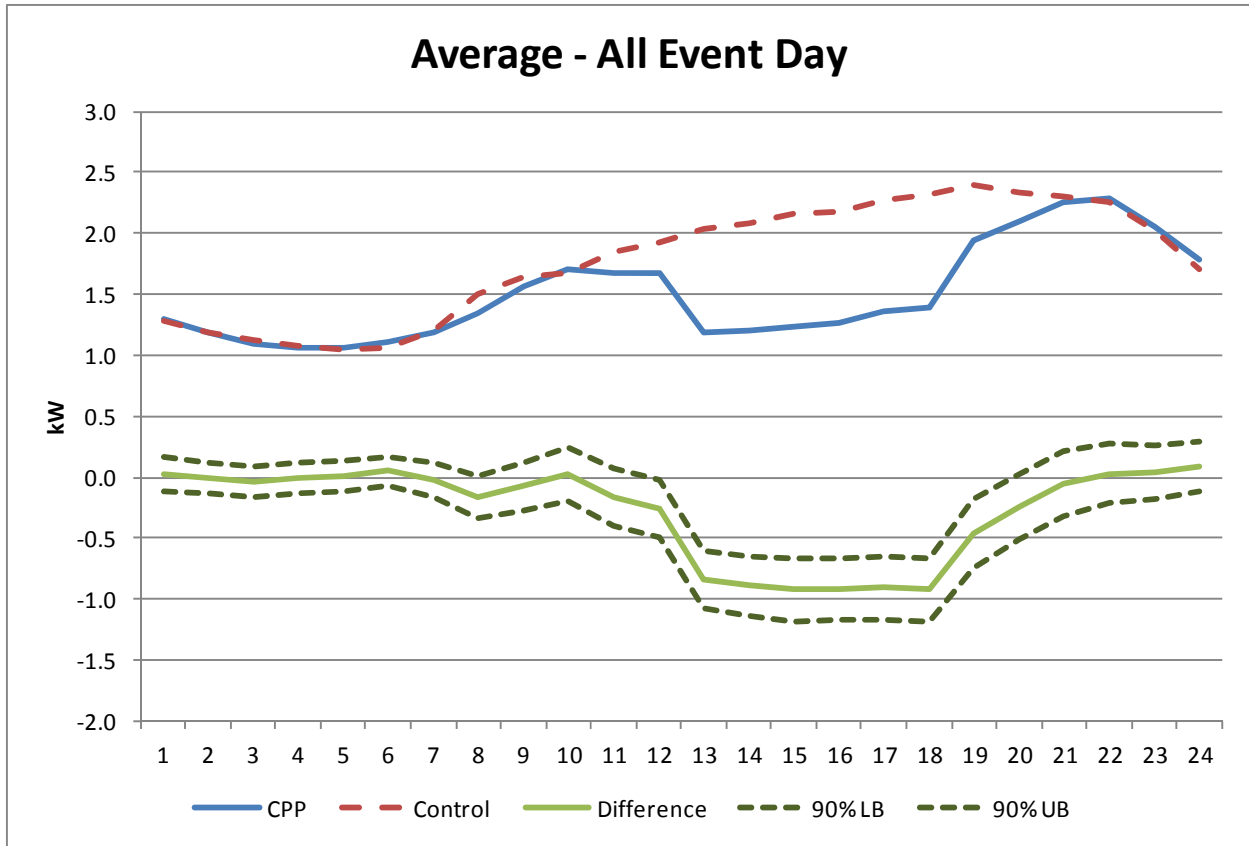


TABLE 11: IMPACTS ON JULY 12, 2011

Hour Ending	Temperature	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
						Lower	Upper
1	79	1.25	1.11	0.13	11.9%	(0.03)	0.29
2	78	1.13	1.03	0.11	10.5%	(0.09)	0.31
3	78	1.03	1.00	0.03	3.0%	(0.23)	0.29
4	78	1.01	0.99	0.03	2.7%	(0.11)	0.16
5	78	1.03	0.99	0.04	3.8%	(0.10)	0.17
6	77	1.06	1.01	0.05	5.3%	(0.03)	0.13
7	77	1.11	1.08	0.03	2.6%	(0.40)	0.45
8	79	1.22	1.24	(0.03)	-2.3%	(0.06)	0.00
9	82	1.43	1.40	0.03	2.1%	(0.04)	0.10
10	84	1.44	1.43	0.01	0.7%	(0.06)	0.08
11	88	1.35	1.58	(0.23)	-14.5%	(0.43)	(0.03)
12	90	1.42	1.66	(0.24)	-14.3%	(0.41)	(0.06)
13	92	1.05	1.59	(0.54)	-33.9%	(0.74)	(0.34)
14	93	1.05	1.64	(0.58)	-35.6%	(0.78)	(0.38)
15	94	1.10	1.73	(0.63)	-36.5%	(0.84)	(0.42)
16	94	1.09	1.76	(0.67)	-37.8%	(0.87)	(0.46)
17	94	1.24	1.86	(0.62)	-33.1%	(0.82)	(0.41)
18	93	1.29	1.97	(0.68)	-34.4%	(0.90)	(0.46)
19	91	1.81	2.14	(0.33)	-15.6%	(0.57)	(0.10)
20	90	1.96	2.13	(0.17)	-8.1%	(0.38)	0.04
21	88	2.12	2.15	(0.04)	-1.6%	(0.18)	0.11
22	86	2.10	2.09	0.01	0.6%	(0.05)	0.08
23	85	1.88	1.91	(0.02)	-1.1%	(0.27)	0.23
24	83	1.72	1.68	0.04	2.3%	(0.04)	0.12
<b>Energy</b>		<b>32.92</b>	<b>37.18</b>	<b>(4.27)</b>	<b>-11.5%</b>	<b>(7.43)</b>	<b>(1.11)</b>
<b>HE 13-18 (Event Hours)</b>		<b>1.14</b>	<b>1.76</b>	<b>(0.62)</b>	<b>-35.2%</b>	<b>(0.82)</b>	<b>(0.41)</b>

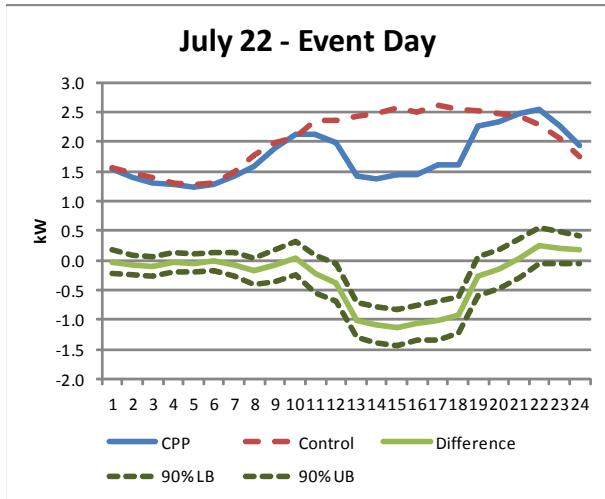
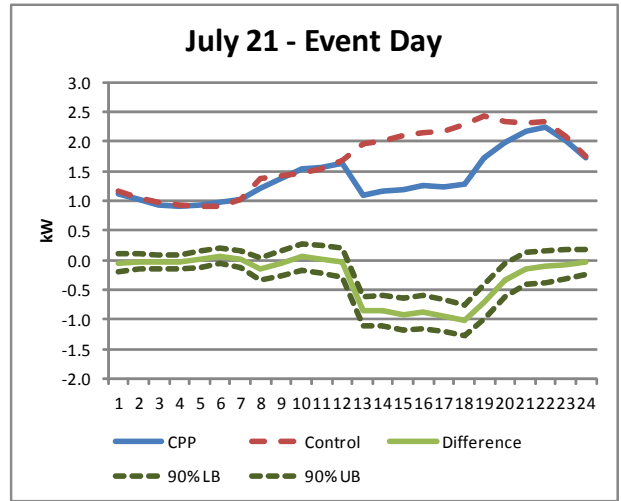
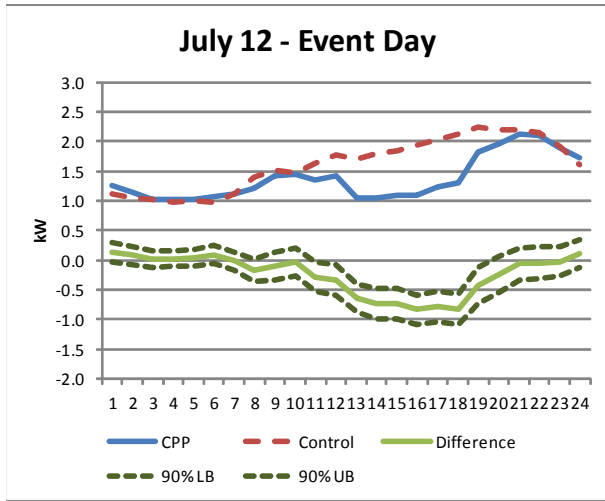
TABLE 12: IMPACTS ON JULY 21, 2011

Hour Ending	Temperature	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
						Lower	Upper
1	75	1.12	1.16	(0.05)	-4.0%	(0.20)	0.11
2	74	1.02	1.05	(0.03)	-2.5%	(0.16)	0.10
3	73	0.94	0.97	(0.04)	-3.6%	(0.15)	0.08
4	73	0.92	0.94	(0.02)	-2.4%	(0.14)	0.09
5	73	0.92	0.90	0.02	2.2%	(0.12)	0.16
6	73	0.97	0.90	0.07	8.0%	(0.05)	0.20
7	74	1.03	1.01	0.02	1.7%	(0.12)	0.16
8	77	1.21	1.36	(0.15)	-11.2%	(0.34)	0.04
9	82	1.38	1.43	(0.05)	-3.5%	(0.26)	0.16
10	84	1.54	1.48	0.06	4.0%	(0.16)	0.28
11	88	1.56	1.54	0.02	1.3%	(0.21)	0.25
12	91	1.63	1.67	(0.04)	-2.6%	(0.29)	0.20
13	94	1.09	1.95	(0.86)	-44.1%	(1.11)	(0.62)
14	97	1.16	2.01	(0.85)	-42.4%	(1.11)	(0.60)
15	96	1.18	2.10	(0.92)	-43.7%	(1.18)	(0.65)
16	96	1.27	2.14	(0.87)	-40.7%	(1.15)	(0.60)
17	95	1.23	2.17	(0.94)	-43.2%	(1.20)	(0.67)
18	93	1.28	2.30	(1.02)	-44.4%	(1.28)	(0.76)
19	90	1.73	2.43	(0.70)	-28.8%	(0.99)	(0.41)
20	89	1.98	2.33	(0.34)	-14.8%	(0.62)	(0.06)
21	88	2.17	2.31	(0.14)	-6.1%	(0.41)	0.13
22	85	2.23	2.33	(0.11)	-4.5%	(0.38)	0.17
23	84	2.02	2.09	(0.07)	-3.4%	(0.32)	0.18
24	83	1.72	1.76	(0.04)	-2.1%	(0.25)	0.18
<b>Energy</b>		<b>33.29</b>	<b>40.33</b>	<b>(7.04)</b>	<b>-17.5%</b>	<b>(11.33)</b>	<b>(2.76)</b>
<b>HE 13-18 (Event Hours)</b>		<b>1.20</b>	<b>2.11</b>	<b>(0.91)</b>	<b>-43.1%</b>	<b>(1.17)</b>	<b>(0.65)</b>

TABLE 13: IMPACTS ON JULY 22, 2011

Hour Ending	Temperature	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
						Lower	Upper
1	82	1.54	1.57	(0.02)	-1.4%	(0.21)	0.17
2	82	1.40	1.47	(0.08)	-5.3%	(0.25)	0.10
3	82	1.30	1.40	(0.09)	-6.7%	(0.26)	0.07
4	82	1.28	1.30	(0.03)	-2.1%	(0.18)	0.13
5	82	1.23	1.28	(0.05)	-3.5%	(0.20)	0.11
6	82	1.28	1.30	(0.02)	-1.4%	(0.18)	0.14
7	84	1.42	1.50	(0.07)	-5.0%	(0.27)	0.12
8	88	1.59	1.78	(0.18)	-10.3%	(0.41)	0.04
9	91	1.90	1.98	(0.09)	-4.4%	(0.35)	0.18
10	94	2.12	2.08	0.04	1.9%	(0.24)	0.32
11	96	2.13	2.36	(0.22)	-9.5%	(0.54)	0.09
12	98	1.99	2.36	(0.37)	-15.8%	(0.69)	(0.06)
13	98	1.42	2.44	(1.01)	-41.6%	(1.31)	(0.72)
14	100	1.38	2.47	(1.08)	-44.0%	(1.38)	(0.79)
15	102	1.44	2.57	(1.13)	-44.0%	(1.44)	(0.82)
16	102	1.45	2.51	(1.06)	-42.2%	(1.36)	(0.76)
17	102	1.61	2.62	(1.01)	-38.6%	(1.34)	(0.68)
18	101	1.61	2.53	(0.92)	-36.3%	(1.23)	(0.61)
19	99	2.26	2.53	(0.27)	-10.5%	(0.60)	0.07
20	96	2.33	2.48	(0.15)	-6.0%	(0.48)	0.18
21	93	2.47	2.43	0.04	1.7%	(0.28)	0.36
22	91	2.54	2.30	0.24	10.5%	(0.07)	0.55
23	90	2.27	2.06	0.21	10.3%	(0.06)	0.48
24	88	1.93	1.75	0.18	10.5%	(0.05)	0.42
<b>Energy</b>		<b>41.91</b>	<b>49.05</b>	<b>(7.14)</b>	<b>-14.6%</b>	<b>(11.12)</b>	<b>(3.17)</b>
<b>HE 13-18 (Event Hours)</b>		<b>1.49</b>	<b>2.52</b>	<b>(1.04)</b>	<b>-41.1%</b>	<b>(1.34)</b>	<b>(0.73)</b>

FIGURE 14: IMPACTS ON EACH INDIVIDUAL EVENT DAY



## **F. PROCESS EVALUATION RESULTS**

### **CUSTOMER RECRUITMENT**

Overall, the recruitment process was fairly straightforward and easy to implement. MMLD received a good response rate (~9%) to the marketing effort and there were very few questions from customers who called to enroll. Recruitment was helped by the fact that there were no compatibility restrictions as far as central air conditioning, heating system type, broadband internet, or other similar criteria. Each customer who received the promotional material was eligible to participate thus there was no need to turn away interested customers.

Of note is the impact that bill protection had on the recruitment of customers. Anecdotally, MMLD believes that bill protection had a significant impact on recruitment as it eliminated any perceived risk. Many customers who called with an interest in the program, but who were unsure if they wanted to participate, were easily convinced to participate on the basis of bill protection and the fact that they could try it without risk.

### **AMI INSTALLATIONS**

The timing of the Pilot Program proved to be a major logistical challenge and forced MMLD to adopt a deployment plan to accommodate the pilot schedule, rather than developing a deployment plan based on best practices for the system and adapting the pilot schedule to that plan. Specifically, the initial conceptual deployment plan was to first establish a complete backhaul network for the town, then to begin installing AMI meters throughout geographic regions. Installing meters in this fashion, with the backhaul already in place, would have strengthened the mesh network and facilitated the installations.

In practice, delivery of the backhaul equipment was delayed and was received after the first shipments of meters in Mid-May. The design of the Consumer Behavior Study necessitated that each study participant receive an AMI meter for the start of the study period, therefore MMLD had to rush to install AMI meters for each study participant which, due to the randomized nature of the pilot design, resulted in installations spread all across town. Because the backhaul was not fully in place, a somewhat makeshift backhaul system had to be developed to facilitate communications from these pilot participant meters. And because the meters were installed sporadically to satisfy requirements of the consumer behavior study, there was not a strong mesh network comprised of numerous adjacent meters. Ultimately, all of the meters and necessary backhaul components were installed by Mid-June and functioned properly for the pilot. The key finding from MMLD's perspective was that the schedule of the CPP pilot was allowed to dictate the deployment plan, resulting in added cost and complexity. It would have been far more preferable if the CPP Pilot had been delayed for a year until the backhaul and meter network were more established.

Once the initial rush of installing meters and backhaul equipment to serve pilot customers was concluded, installation of the remaining meters and backhaul has been much simpler and has actually exceeded the deployment schedule. MMLD has also conducted tests to confirm that meter reads

obtained through the AMI system are consistent with field register readings and to date have found no issues.

## **BILLING**

Managing the integration between AMI and billing and working through issues related to the CPP rate was one of the most challenging aspects of the project. The timing of this integration, coincident with the CPP Pilot and AMI meters and backhaul as discussed above, exacerbated the challenge.

The principle issue had to do with managing the integration between two outside vendors – the AMI vendor who provided monthly billing kWh for each billing component, and the billing system vendor who received and managed the billing data, and produced the monthly statements. MMLD was in the position of managing the handoff of this data, and quality checking any data manipulation that led to the final billing statements. This process would have been challenging had it been limited to just a new source of data (AMI vendor), however the simultaneous implementation of the pilot program and new billing components for certain subgroups of customers made the process more difficult. Ultimately, the billing integration was successful and any minor errors discovered along the way were corrected.

Interim billing – that is the bill customers received that included the start of the pilot – were another challenge from a billing perspective. MMLD did not adapt customer's billing cycle to align with the calendar months of the pilot. Rather, the interim bills were received on the normal billing cycle but included three components; kWh (prior to June 1), Non-CPP kWh, and CPP-kWh. Because all of the AMI meters were not in place on May 31<sup>st</sup>, all meters had to be manually read on this date and fed into the billing system. This caused some issues with double charging or not charging at all basic monthly charges and/or hydro credits. Each interim bill had to be individually reviewed for these issues and errors corrected before the bills could be issued. This issue added time and cost to the effort but is expected to be a one-time occurrence. Now that the AMI system is in place and functioning, interim billing for the next calendar year should be much simpler and will not require the manual reads.

Complexities with rounding, and presentment of billing components (CPP kWh and Non-CPP kWh) were encountered when the first CPP events were declared in July. Essentially, each component was rounded to the nearest whole number for billing purposes, but additional charges such as the Purchased Power Adjustment (PPA) were based on absolute register readings. Until a precise methodology for rounding and reporting was developed, there were some situations where the total register reading did not equal the sum of the parts. Quality checking and correcting each of the bills to avoid over or undercharging customers was very labor intensive and time consuming in August and resulted in many customers' August bills being held and instead delivered as part of a two-month bill received in September, as issuing a late bill would have exacerbated the billing situation. Since MMLD offers an online bill presentment and direct debit payment option to its customers, a bill issued two weeks late would have created a past due amount on the succeeding bill and automatically debited the customer account for both months. Additionally, a new due date would have been established as a result of the late issued bill, creating a double debiting of the customer account for the month of August. To avoid the double debit of customer accounts MMLD chose not to issue the August bill late and to instead allow the kWh usage to carry over into one September bill.



## **INFORMATION TECHNOLOGY**

MMLD's AMI vendor, NexGrid, handled most of the IT related aspects of the project which centered on the customer web portal. MMLD's role was primarily to quality check the data presented and assist in the resolution of any issues. Most issues noted were non-critical, and included improperly displayed rates during CPP periods, time stamps and detailed interval use data, inactive or incorrect links, and estimated bills. There were also some minor software debugging issues. Overall, the software has undergone much iteration to address these minor issues and has functioned very well with minimal required intervention from MMLD.

## **CRITICAL PEAK EVENT DISPATCH**

During the enrollment phase of the pilot, customers were asked to identify their preferred methods of communication, email or phone or both, and were prompted for the email addresses or phone numbers they would like to receive important messages on. Customers were allowed to select multiple emails and/or phone numbers. These contact lists were utilized for the distribution of critical peak event notifications on the day prior to an event. Overall, the process was very smooth from MMLD's perspective, and 94% of customers who responded to the post pilot survey indicated they recalled being notified of pending critical event days. 86% of customers responded they were satisfied with the type and content of communication regarding critical peak events.

One issue that arose with email notification was messages being returned because the light department was not an "approved sender". To deliver the email meant completing a brief form to pass the spam blocker. These issues will be corrected in Year 2 and while noteworthy, did not have a significantly adverse effect on the pilot. Looking forward, one process related finding is the work that would go into maintaining an updated contact list for participating customers. MMLD would be responsible for maintaining the list as new customers come online, others drop out or move, or change phone numbers or email addresses.

## **CUSTOMER SERVICE**

Overall, MMLD fielded very few customer service calls during the course of the pilot. Most inquiries had to do with late bills, or customers expecting to have access to interval data immediately following the installation of an AMI meter when in actuality it takes several days to process the paperwork before the data is displayed.

MMLD anticipates more calls during Year 2 of the study when bill protection is no longer offered and there is potential for more than three events. If the number of events increases significantly, it is likely that there will be a corresponding increase in customer service calls. Similarly, if enabling technology is offered to customers in Year 2 it is expected to cause an uptick in the number of customer calls. Customer service representatives will need to be trained in how to handle calls relating to in home technology.

## **G. COST EFFECTIVENESS RESULTS**

This section is not required per feedback from the TAG on 9/13/2011.

## H. PARTICIPANT CHARACTERISTICS

A pre-pilot survey conducted in April 2011 provided information about characteristics of all pilot customers. The tables below show the results of this survey. Participants that did not answer a question were removed from the calculations. The second column shows 2010 census data for the town of Marblehead to help illustrate similarities or differences between the pilot group and the town as a whole. When applicable, the third column compares these results to the Massachusetts Residential Appliance Saturation Survey<sup>9</sup> (MRASS) results - prepared in April 2009. These comparisons show how the participants are similar and different to the average Massachusetts residential utility customer.

**TABLE 15: PARTICIPANTS' CHARACTERISTICS**

Characteristic	% MMLD Pilot Respondents	2010 MMLD Census Data	MRASS Results
Own the Residence	96.4% <sup>e</sup>	78.4%	81%
Single-Family Home	92.8%	75.4%	64.7%
Apartment/condo in a >4 unit building	0.7%	-	14%
Duplex or two-family	3.9%	-	-
Townhouse or row house	2.6%	-	-
Residence Has Central AC	31.3%	-	29%
Residence has at least 1 Room AC	58.1%	-	64%
Have Programmable Thermostat	63.3%	-	62%
Set programmable thermostat to automatically change temperatures during day (Of those that have them)	67.7%	-	-
Residence has Electric Clothes Dryer	77.3%		82%
At least one person with a chronic illness or disability that requires regular or occasional in home medical treatment	4.2%	6.3% <sup>10</sup>	-
Someone home Monday to Friday sometime between 1 PM and 5 PM at least one day a week	92.5%	-	-
At least one person in household working full time for pay	65.0%	-	-
At least one person in household with a job where they work at home at least one weekday a week	45.6%	-	-
Remembered receiving information from electric utility asking to participate in a utility pilot program	97.7%	-	-

<sup>9</sup> Five Massachusetts electric energy efficiency program administrators – Cape Light Compact, National Grid, NSTAR Electric, Unitil, and Western Massachusetts Electric Company retained Opinion Dynamics Corporation to conduct a state-wide residential appliance saturation survey. The study effort consisted of a mail/Internet survey of close to 3,000 Massachusetts residential customers and an in-home verification of customer-provided data in 118 of the survey respondents' residences.

<sup>10</sup> Non-institutionalized civilians with a disability; census does not specify whether in-home care or treatment is received

Thought that the information was useful in helping decide whether or not to participate in the pilot	99.5%	-	-
Primary Language is English	98.9%	-	94.4%

Online census data for Marblehead was used to characterize the entire population of the town and to help determine whether any significant differences existed between the study group (those who accepted the offer to participate) and the town at large. In several cases as summarized above, the survey categories matched between the pre-pilot survey and census questions. In other cases, the data did not align exactly and could not be reported in table form. Below are some observations of some key similarities and differences between the two groups based on the pre-pilot survey and census data.

- 65% of pre-pilot survey respondents said that at least one person in the house is working full time for pay. At first, it seemed like 35% of households not having anyone working is a very high percentage, but taking into account the 26.1% of the total population of Marblehead that collects social security, 15.3% which have retirement income (likely overlap with the social security group), and those that work part time, and the percentage seems reasonable.
- The pre-pilot survey asked how many people older than 65 years live in the residence. 20.7% responded with one, and 25.6% responded with two, a total of 46.3% of households that have at least one person over the age of 65. Census data shows that only 27.2% of Marblehead households have at least one person older than 65. This difference appears to show a higher interest in the program from households with at least one person older than 65. This difference also supports that 65% of pilot participants had only one person working full time for pay.
- 45.6% of pre-pilot survey respondents said that they have at least one person in the household with a job where they work from home at least one workday per week. This number initially seemed high. However, taking into account that 10.1% of the Marblehead population always work at home, 81.7% of all Marblehead’s employed work in the fields of management, business, science, arts, sales, and office occupations, and the generally high income and large homes of Marblehead residents (allowing the space for home offices and the purchase of high-end equipment), it seems to be a reasonable percentage.
- 92.5% of pre-pilot survey respondents said that at least one person is home Monday through Friday at some point between 1:00PM to 5:00PM at least one day a week. Considering that 45.6% will meet this criterion through work, the fact that most children in school likely return home in this timeframe or will be on summer vacation (34.6% of homes have at least one person under the age of 18), and likely almost all of the retired population meeting this criterion, this high percentage is no surprise.

There does not appear to be any significant difference between the household income of the survey group and the entire Marblehead population. The tables below summarize household income from both the study participant group and the census data for the town.

Average Household Income	% All Respondents
\$10000 - \$20000	1.5%
\$20000 - \$30000	3.2%
\$30000 - \$40000	5.7%
\$40000 - \$75000	16.1%
\$75000 - \$90000	8.7%
\$90000 - \$100000	6.1%
\$100000 - \$150000	20.7%
> \$150000	28.3%

**Table 16: Household Income - study participants**

Average Household Income	% Households
\$10,000-\$14,999	4.0%
\$14,999-\$24,999	4.3%
\$25,000-\$34,999	5.6%
\$35,000-\$49,999	8.6%
\$50,000-\$74,999	12.7%
\$75,000-\$99,999	9.2%
\$100,000 - \$149,000	19.9%
> \$150000	31.5%

**Table 17: Household Income – MMLD Census Data**

However, there is a significant difference in education level. 52.5% of participants hold graduate school or professional degrees, while only 30.3% of the Marblehead population over the age of 25 hold them. The reason for this disparity is not clear. It could simply be that the average participant is well over the age of 25, therefore more likely to hold a higher degree. It could be that the member of the family who answered the survey is more likely to hold higher degrees than other family members. It could also be that the program appeals to those holding higher degrees more than others.

Education Level	% All Respondents
None or grade 1-8	0.0%
High School incomplete (grade 9 -11)	0.0%
High School graduate	4.0%
Technical/trade or vocational school AFTER high school	2.1%
Some college (no 4yr degree)	9.9%
College graduate	31.0%
Post-graduate or Professional Schooling	52.5%

**Table 18: Education - study participants**

Education Level	% Residents over 25
Less than 9th grade	0.4%
9th to 12th grade, no diploma	0.8%
High school graduate (includes equivalency)	10.7%
Some college, no degree	13.8%
Associate's degree	6.0%
Bachelor's degree	38.0%
Graduate or professional degree	30.3%

**Table 19: Education – MMLD Census Data**

This comparison shows that the program group is a close representation of the entire population of Marblehead, with the exceptions that there seemed to be a higher interest in the program from homeowners, residents of single family homes, those with graduate or professional degrees, and people over the age of 65.

## I. BILL IMPACTS

MMLD conducted an analysis of all participants' bill impacts at the conclusion of the three month pilot. It was determined that every customer on the CPP rate saved money over the summer compared to what they would have paid on their prior fixed rate, thus no bill credits were issued. Although there

were noticeable reductions in energy usage during the higher-priced CPP periods within the treatment group, these bill impact findings are attributable in large part to the fact that the rate was designed to be revenue neutral assuming twelve (12) CPP events. During summer 2011, MMLD only issued three (3) events.

## J. POST-PILOT SURVEY RESULTS

As was discussed in Section IV-C, post-pilot survey instruments were administered after the completion of the first year of the program. MMLD developed two separate survey instruments; one for the Year 1 Treatment group and one for the Control group. The Treatment survey was designed to assess customer satisfaction with the CPP rate treatment, usage of the web portal, identify which customers had central air and/or electric water heaters, and gauge the level of interest in having enabling technologies provided in Year 2. The Control group survey was a stripped down version of the Year 1 Treatment survey. Both surveys were administered via mail alongside a letter from MMLD which thanked customers for their participation in the program and offered a primer for what to expect in the second year of the pilot study.

MMLD received an excellent response rate to the surveys. 60% of treatment group members and 45% of control group members returned the post pilot survey. Detailed results and observations from the post pilot survey are included in Appendix G. Key observations from the post pilot survey include the following:

- ✓ 86% of treatment group customers had an overall positive experience in the pilot. 57% had a very positive experience.
- ✓ The vast majority of treatment group customers read, comprehended, and implemented recommended actions regarding both energy conservation and specific load curtailment strategies for CPP days.
- ✓ Treatment group customers were satisfied with the type and frequency of communication, however only 40% were able to identify the actual number of event days. 33% thought that fewer than 3 events had been declared, and 23% reported more.
- ✓ Only 39% of treatment group respondents reported using the web portal, and of those, over 42% only used it once. Very few customers were regular users of the web portal in the first year. Only 17% of control group customers accessed the web portal.
- ✓ For Treatment Group customers with electric water heaters or central air conditioning, 69% of respondents indicated they would be *very interested* in receiving enabling control technology in year 2. An additional 27% said they would be somewhat interested. Treatment group customers were more interested in receiving the technology if allowed to control it themselves or according to their preferences in response to price signals.
- ✓ For Control Group customers with electric water heaters or central air conditioning, 71% of respondents indicated they would be *very interested* in receiving enabling control technology in year 2. An additional 25% said they would be somewhat interested. Control group customers were also more interested in receiving the technology if allowed to control it themselves or according to their preferences in response to price signals.

## VI. CONCLUSIONS

The first year of MMLD's CPP Pilot Program was extremely successful in that customers were satisfied with the program and there was a noticeable load reduction impact among treatment group customers on Critical-Peak days. The timing of the first year of the pilot in relation to the deployment of AMI meters and backhaul, and integration of the AMI system with back end systems, proved very challenging as is discussed throughout the section on process evaluation.

The only hypothesis able to be evaluated after the first year was that *"Participants placed on a CPP rate will reduce their peak demand during critical peak events compared to what participants would have done if they had stayed on a flat rate."* This hypothesis was proved true using multiple methodological methods, and a considerable load reduction of over 36% was noted during critical peak periods.

# **APPENDIX A**

## ***CPP RATE TARIFF***

**MARBLEHEAD MUNICIPAL LIGHT DEPARTMENT**

Issued: April 22, 2011  
Effective: June 01, 2011

MDPU - 76  
Cancels New

Rate CPP

Available for lighting, space heating, water heating and all other domestic uses in a single private dwelling or individual apartment. The Critical Peak Period will only occur between the hours of 12pm and 6pm on twelve non-holiday weekdays during the months of June, July, and August.

Monthly Charge

	<u>Winter</u> Sep – May	<u>Summer</u> Jun - Aug
Basic Monthly Charge	\$ 4.25 per Month	\$ 4.25 per Month
Non CPP kilowatt-hours	\$ 0.1425 per kilowatt-hour	\$ 0.09 per kilowatt-hour
CPP kilowatt-hours	N/A	\$ 1.05 per kilowatt-hour

Terms and Conditions

The Department's terms and conditions in effect from time to time where not inconsistent with any specific provision of this tariff are part of this tariff.

All kilowatt-hour usage under this tariff is subject to the Purchase Power Adjustment Clause, MDPU - 74

All Terms and Conditions of this tariff are subject to applicable law

Marblehead Municipal Light Department  
80 Commercial Street  
P.O. Box 369  
Marblehead, Massachusetts 01945

By: \_\_\_\_\_  
Robert V. Jolly, General Manager



# **APPENDIX B**

## ***ENROLLMENT MATERIAL***



## MARBLEHEAD MUNICIPAL LIGHT DEPARTMENT

80 COMMERCIAL STREET • P.O. BOX 369  
MARBLEHEAD, MASSACHUSETTS 01945

**ROBERT V. JOLLY, JR.**  
GENERAL MANAGER

May 3, 2011

Dear Customer,

Thank you again for volunteering to participate in the Marblehead Municipal Light Department's (MMLD) *EnergySense* Pilot program. My name is Robert V. Jolly Jr. and on behalf of the MMLD, I would like to officially welcome you to the program. As a participant in our pilot program, you have been randomly selected to receive the reduced electric rate during the summer of 2012. You will be among the first households in town to receive a new "smart" electric meter and access to a dynamic web portal that will allow you to chart your energy consumption online.

This packet includes important information regarding the details of the *EnergySense* Pilot program and steps you need to take to confirm your enrollment. We encourage you to review the enclosed materials closely and let us know if you have any questions or concerns. Below is a list of materials included in this enrollment packet:

- ✓ **Pilot Details** – A program overview that includes pilot design, duration and rate details
- ✓ **Pre-Pilot Survey** – This brief, two page survey is important to understand the characteristics of customers participating in this program so we can evaluate and report results back to the U.S. Department of Energy.
- ✓ **Ways you Can Save** – Tips and tactics for limiting energy consumption during critical peak periods so you can take full advantage of the discounted rates during all other hours.

To confirm your enrollment in this program, please take a moment to complete the brief survey included in this packet. Completion of the survey is critically important for us to evaluate the success of the pilot so we ask that you please return the completed survey to us in the pre-paid envelope we have included with this packet. Once you complete and return the survey, we will proceed with scheduling the installation of a smart meter at your home.

Again, welcome to the program and thank you for volunteering to participate in this exciting and cutting edge smart grid initiative. Please do not hesitate to contact us with any questions you may have.

Sincerely,

Robert V. Jolly, Jr.  
General Manager

## EnergySense Pilot Program Details

Marblehead Municipal Light Department in conjunction with GDS Associates, Inc. and the Department of Energy's Technical Advisory Group has developed the *EnergySense* Pilot Program. The goals of the program are to gauge the level of community interest in a Critical Peak pricing program, evaluate demand and energy consumption impacts of a Critical Peak Price program for future planning purposes and to assess the impact of giving consumers access to web based tools that allow them to monitor their personal consumption. The results of this pilot initiative will help inform decisions regarding the smart grid and incentive based pricing programs going forward.

### **Pilot Design:**

The pilot will span for 15 months starting June 1<sup>st</sup> 2011 and ending August 31<sup>st</sup>, 2012. Customers who have volunteered to participate are randomly assigned to one of two groups; those who will receive the reduced electric rate during the summer of 2011 and those who will receive the reduced rate in summer of 2012. All participants will be among the first in town to receive a new smart meter.

### **Rate Details:**

Your group has been randomly selected to receive the reduced electric rate during the summer of 2012. For this upcoming summer, you will remain on your current fixed electric rate of approximately 14¢ per kilowatt-hour.

### **Meter Change:**

All participants in the *EnergySense* Pilot Program will receive a new smart meter at their home that is capable of transmitting energy use data in near real to you (through the web portal) and to MMLD. The meter change out will cause a momentary disruption in power but the new meter will otherwise function no differently from your current meter. The change will be made during May prior to the start of the pilot in June.

### **Web Portal:**

Participants in both rate groups will have access to a dynamic web portal that will enable them to chart their personal energy consumption online. To gain access to your personal web portal, please visit us at [www.marbleheadelectric.com](http://www.marbleheadelectric.com) and click on the "View Meter" tab at the top of the page then follow the on-screen instructions.

*For questions regarding the details of the EnergySense Pilot Program, Please call*

*Customer Service at (781) 631-5600*

## Energy Saving Tips for Your Household

**Refrigerators (15%) and other appliances (11%) can account for 26% of the energy consumed in your home (other appliances include dishwashers, clothes washers, dryers, etc.).**

- Air dry dishes instead of dishwasher drying cycle
- Wash only full loads of dishes
- Run clothes washer using cold water to conserve hot water
- Dry heavier loads separately from lighter materials, routinely empty lint filter, check exhaust connection for lint
- Don't keep your refrigerator or freezer too cold
- Recommended temperatures are 37° to 40°F for the fresh food compartment of the refrigerator and 5°F for the freezer section
- Unplug second refrigerators or freezers if they are not necessary

**Water heating can account for 15% of the energy consumed in your home.**

- Install aerators on faucets and low-flow showerheads to reduce hot water usage
- Reduce set point temperature on your water heater to 120° F
- Install a timer to turn off your water heater when less water heat is used, or when cost is highest, such as during the day.
- Take short showers instead of baths

**Home electronics can account for 11% of the energy consumed in your home.**

- Turn off your computer and monitor when not in use
- Plug home electronics, such as TVs and DVD players, into power strips and turn the power strips off when the equipment is not in use to eliminate “phantom” loads

**Air Conditioning can account for 10% of the energy consumed in your home.**

- Turn up your cooling set-point to save on energy — try 78° F
- Shut off your air conditioner and try using a fan or opening the windows at night
- Close shades in the summer — your house will block out more radiant heat from the sun in the summer months if the curtains are closed

**Lighting can account for 6% of the energy consumed in your home.**

- Turn off lights when a room is not being used
- Replace incandescent light bulbs with ENERGY STAR CFLs (up to 75% savings)
- Replace outdoor lighting with ENERGY STAR CFLs, LEDs, or solar powered fixtures

For a complete list of ideas, visit [www.EnergyStar.gov](http://www.EnergyStar.gov) and select the link “Save Energy at Home”



This is a quick and easy survey requested by the Department of Energy as part of a Smart Grid Investment Grant received by Marblehead Municipal Light Department. Your answers are protected and will be anonymous

Use a blue or black pen

**START HERE**

**MA1. Do you own or rent your home?**

Mark  ONE box

- Own  
 Rent

**MA2. What type of residence do you live in? Do you live in a...**

Mark  ONE box

- Single-family  
 Duplex or two-family  
 Apartment/condo in a 2-4 unit building  
 Apartment/condo in a >4 unit building  
 Townhouse or row house (adjacent walls to another house)  
 Mobile home, house trailer

**MA3. Does your home have central air conditioning?**

Mark  ONE box

- Yes  
 No

**MA4. Do you have any room air conditioners?**

Mark  ONE box

- Yes  
 No (GO TO MA6)

**MA5. How many room air conditioners do you have?**

**MA6. Do you have a programmable thermostat?**

Mark  ONE box

- Yes  
 No (GO TO MA8)

**MA7. Is the programmable thermostat currently set to automatically change temperatures during the day when no one is home?**

Mark  ONE box

- Yes  
 No

**MA8. Do you have an electric clothes dryer?**

Mark  ONE box

- Yes  
 No

**MA9. Including yourself, how many adults, 18 or older, currently live in your household?**

**MA10. And how many of these adults are over 65?**

**MA11. How many children under the age of 18 live in your household at least part of the week?**

**MA12. Do you or does anyone in your household have a chronic illness or disability that requires regular or occasional in-home medical treatment?**

Mark  ONE box

- Yes  
 No

**MA13. Is there someone home Monday to Friday sometime between 1 PM and 5 PM at least one day a week?**

Mark  ONE box

- Yes  
 No

**MA14. Is there anyone in your household working full time for pay?**

Mark  ONE box

- Yes  
 No (GO TO MA16)

**MA15. Do you or anyone in your household have a job where you work at home at least one weekday a week rather than go into an office or some other location?**

Mark  ONE box

- Yes  
 No

**TURN OVER AND CONTINUE** 

**MA16. Do you remember receiving information from your electric utility asking you to participate in a utility pilot program?**

Mark  ONE box

Yes

No (GO TO MA18)

**MA17. Was the information useful in helping you decide whether or not to participate in the pilot?**

Mark  ONE box

Yes

No

**MA18. What is the primary language spoken in your home?**

Mark  ONE box

English

Spanish

Chinese

Korean

Vietnamese

Russian

Other

**MA19. Last year -- that is, in 2010 -- what was your total household income from all sources, before taxes?**

Mark  ONE box

Less than \$10,000

\$10,000 to less than \$20,000

\$20,000 to less than \$30,000

\$30,000 to less than \$40,000

\$40,000 to less than \$75,000

\$75,000 to less than \$90,000

\$90,000 to less than \$100,000

\$100,000 to less than \$150,000

\$150,000 or more

**MA20. What is the LAST grade or class that you COMPLETED in school?**

Mark  ONE box

None, or grade 1-8

High School incomplete (grade 9-11)

High School graduate (grade 12 or GED certificate)

Technical, trade or vocational school AFTER high school

Some college, no four-year degree (includes associate degree)

College graduate (B.S., B.A., or other four-year degree)

Post-graduate or professional schooling after college (e.g., towards a Master's degree or Ph.D; law or medical school)



## MARBLEHEAD MUNICIPAL LIGHT DEPARTMENT

80 COMMERCIAL STREET • P.O. BOX 369  
MARBLEHEAD, MASSACHUSETTS 01945

ROBERT V. JOLLY, JR.  
GENERAL MANAGER

May 3, 2011

Dear Customer,

Thank you again for volunteering to participate in the Marblehead Municipal Light Department's (MMLD) *EnergySense* Pilot program. My name is Robert V. Jolly Jr. and on behalf of the MMLD, I would like to officially welcome you to the program. As a participant in our pilot program, you have been randomly selected to receive the reduced electric rate during the summer of 2011. You will be among the first households in town to receive a new "smart" electric meter and access to a dynamic web portal that will allow you to chart your energy consumption online.

This packet includes important information regarding the details of the *EnergySense* Pilot program and steps you need to take to confirm your enrollment. We encourage you to review the enclosed materials closely and let us know if you have any questions or concerns. Below is a list of materials included in this enrollment packet:

- ✓ **Pilot Details** – A program overview that includes pilot design, duration and rate details
- ✓ **Pre-Pilot Survey** – This brief, two page survey is important to understand the characteristics of customers participating in this program so we can evaluate and report results back to the U.S. Department of Energy.
- ✓ **Ways you Can Save** – Tips and tactics for limiting energy consumption during critical peak periods so you can take full advantage of the discounted rates during all other hours.

To confirm your enrollment in this program, please take a moment to complete the brief survey included in this packet. Completion of the survey is critically important for us to evaluate the success of the pilot so we ask that you please return the completed survey to us in the pre-paid envelope we have included with this packet. Once you complete and return the survey, we will proceed with scheduling the installation of a smart meter at your home.

Again, welcome to the program and thank you for volunteering to participate in this exciting and cutting edge smart grid initiative. Please do not hesitate to contact us with any questions you may have.

Sincerely,

Robert V. Jolly, Jr.  
General Manager

## EnergySense Pilot Program Details

Marblehead Municipal Light Department in conjunction with GDS Associates, Inc. and the Department of Energy's Technical Advisory Group has developed the *EnergySense* Pilot Program. The goals of the program are to gauge the level of community interest in a Critical Peak pricing program, evaluate demand and energy consumption impacts of a Critical Peak Price program for future planning purposes and to assess the impact of giving consumers access to web based tools that allow them to monitor their personal consumption. The results of this pilot initiative will help inform decisions regarding the smart grid and incentive based pricing programs going forward.

### **Pilot Design:**

The pilot will span for 15 months starting June 1<sup>st</sup> 2011 and ending August 31<sup>st</sup>, 2012. Customers who have volunteered to participate are randomly assigned to one of two groups; those who will receive the reduced electric rate during the summer of 2011 and those who will receive the reduced rate in summer of 2012. All participants will be among the first in town to receive a new smart meter.

### **Rate Details:**

Your group has been randomly selected to receive the reduced electric rate during the summer of 2011. This upcoming summer, your electric rate will drop from 14¢ down to 9¢ per kilowatt-hour for all non-critical peak pricing hours (roughly 97% of the time!). There will be up to 12 critical peak pricing periods during the summer, occurring only on non-holiday weekdays from 12:00pm to 6:00 pm. All other hours on weekdays and all hours during weekends and holidays are considered Non-CPP hours. Customers will be notified by 5pm the day before a Critical Peak Event so that they may take steps to reduce personal consumption and save money during these periods. During critical peak periods, the cost of electricity will increase sharply to \$1.05 per kilowatt hour.

### **Meter Change:**

All participants in the *EnergySense* Pilot Program will receive a new smart meter at their home that is capable of transmitting energy use data in near real to you (through the web portal) and to MMLD. The meter change out will cause a momentary disruption in power but the new meter will otherwise function no differently from your current meter. The change will be made during May prior to the start of the pilot in June.

### **Web Portal:**

Participants in both rate groups will have access to a dynamic web portal that will enable them to chart their personal energy consumption online. To gain access to your personal web portal, please visit us at [www.marbleheadelectric.com](http://www.marbleheadelectric.com) and click on the "View Meter" tab at the top of the page then follow the on-screen instructions.

*For questions regarding the details of the EnergySense Pilot Program, Please call*

*Customer Service at (781) 631-5600*



## Energy Saving Tips for Your Household

**Refrigerators (15%) and other appliances (11%) can account for 26% of the energy consumed in your home (other appliances include dishwashers, clothes washers, dryers, etc.).**

- Air dry dishes instead of dishwasher drying cycle
- Wash only full loads of dishes
- Run clothes washer using cold water to conserve hot water
- Dry heavier loads separately from lighter materials, routinely empty lint filter, check exhaust connection for lint
- Don't keep your refrigerator or freezer too cold
- Recommended temperatures are 37° to 40°F for the fresh food compartment of the refrigerator and 5°F for the freezer section
- Unplug second refrigerators or freezers if they are not necessary

**Water heating can account for 15% of the energy consumed in your home.**

- Install aerators on faucets and low-flow showerheads to reduce hot water usage
- Reduce set point temperature on your water heater to 120° F
- Install a timer to turn off your water heater when less water heat is used, or when cost is highest, such as during the day.
- Take short showers instead of baths

**Home electronics can account for 11% of the energy consumed in your home.**

- Turn off your computer and monitor when not in use
- Plug home electronics, such as TVs and DVD players, into power strips and turn the power strips off when the equipment is not in use to eliminate “phantom” loads

**Air Conditioning can account for 10% of the energy consumed in your home.**

- Turn up your cooling set-point to save on energy — try 78° F
- Shut off your air conditioner and try using a fan or opening the windows at night
- Close shades in the summer — your house will block out more radiant heat from the sun in the summer months if the curtains are closed

**Lighting can account for 6% of the energy consumed in your home.**

- Turn off lights when a room is not being used
- Replace incandescent light bulbs with ENERGY STAR CFLs (up to 75% savings)
- Replace outdoor lighting with ENERGY STAR CFLs, LEDs, or solar powered fixtures

For a complete list of ideas, visit [www.EnergyStar.gov](http://www.EnergyStar.gov) and select the link “Save Energy at Home”

## **Tips for Avoiding High Cost (Critical Peak) Periods**

**Shift you chores** - Perform household chores requiring power-hungry appliances—like washers, dryers, dishwashers, pool pumps, and vacuums—before 12 p.m. or after 6 p.m.

**Prepare easy meals** - Prepare afternoon snacks that don't require opening the fridge or using the stove or oven. Dinner is as easy as a quick microwave meal or a summer evening barbeque in the back yard.

**Pre-cool** - Cool your home by a few extra degrees in the morning before it gets hot outside, so your air conditioner won't have to work so hard – and your home begins the event at a lower temperature.

**Keep hot air out** - Draw your shades to keep the sun's rays out and seal air leaks around windows with low-cost weather stripping to keep pre-cooled air inside.

**Enjoy an afternoon out** - System events might be just the excuse you needed to get out of the house. Set the thermostat to 80 (or higher if you want!) and head to the mall, the library or beach, or even take in a summer movie with the kids.

**Programmable thermostat** - Set the air conditioning to turn on after 6 p.m. if you use a programmable thermostat.

**Unplug** - Unplug non-essential devices such as computers, printers, and entertainment electronics while you are home or before you leave. Power strips make it easy to turn off multiple devices with the flip of a switch

**Use timers** - Install plug-in or hard-wired timers on outdoor lights, pumps, dehumidifiers and other large appliances.

**Use online tools** - Use your MMLD web portal tools to check your meter usage data online at [www.marbleheadelectric.com](http://www.marbleheadelectric.com) and click “view meter”.



This is a quick and easy survey requested by the Department of Energy as part of a Smart Grid Investment Grant received by Marblehead Municipal Light Department. Your answers are protected and will be anonymous

Use a blue or black pen

**START HERE**

**MA1. Do you own or rent your home?**

Mark  ONE box

- Own  
 Rent

**MA2. What type of residence do you live in? Do you live in a...**

Mark  ONE box

- Single-family  
 Duplex or two-family  
 Apartment/condo in a 2-4 unit building  
 Apartment/condo in a >4 unit building  
 Townhouse or row house (adjacent walls to another house)  
 Mobile home, house trailer

**MA3. Does your home have central air conditioning?**

Mark  ONE box

- Yes  
 No

**MA4. Do you have any room air conditioners?**

Mark  ONE box

- Yes  
 No (GO TO MA6)

**MA5. How many room air conditioners do you have?**

**MA6. Do you have a programmable thermostat?**

Mark  ONE box

- Yes  
 No (GO TO MA8)

**MA7. Is the programmable thermostat currently set to automatically change temperatures during the day when no one is home?**

Mark  ONE box

- Yes  
 No

**MA8. Do you have an electric clothes dryer?**

Mark  ONE box

- Yes  
 No

**MA9. Including yourself, how many adults, 18 or older, currently live in your household?**

**MA10. And how many of these adults are over 65?**

**MA11. How many children under the age of 18 live in your household at least part of the week?**

**MA12. Do you or does anyone in your household have a chronic illness or disability that requires regular or occasional in-home medical treatment?**

Mark  ONE box

- Yes  
 No

**MA13. Is there someone home Monday to Friday sometime between 1 PM and 5 PM at least one day a week?**

Mark  ONE box

- Yes  
 No

**MA14. Is there anyone in your household working full time for pay?**

Mark  ONE box

- Yes  
 No (GO TO MA16)

**MA15. Do you or anyone in your household have a job where you work at home at least one weekday a week rather than go into an office or some other location?**

Mark  ONE box

- Yes  
 No

**TURN OVER AND CONTINUE** 

**MA16. Do you remember receiving information from your electric utility asking you to participate in a utility pilot program?**

Mark  ONE box

Yes

No (GO TO MA18)

**MA17. Was the information useful in helping you decide whether or not to participate in the pilot?**

Mark  ONE box

Yes

No

**MA18. What is the primary language spoken in your home?**

Mark  ONE box

English

Spanish

Chinese

Korean

Vietnamese

Russian

Other

**MA19. Last year -- that is, in 2010 -- what was your total household income from all sources, before taxes?**

Mark  ONE box

Less than \$10,000

\$10,000 to less than \$20,000

\$20,000 to less than \$30,000

\$30,000 to less than \$40,000

\$40,000 to less than \$75,000

\$75,000 to less than \$90,000

\$90,000 to less than \$100,000

\$100,000 to less than \$150,000

\$150,000 or more

**MA20. What is the LAST grade or class that you COMPLETED in school?**

Mark  ONE box

None, or grade 1-8

High School incomplete (grade 9-11)

High School graduate (grade 12 or GED certificate)

Technical, trade or vocational school AFTER high school

Some college, no four-year degree (includes associate degree)

College graduate (B.S., B.A., or other four-year degree)

Post-graduate or professional schooling after college (e.g., towards a Master's degree or Ph.D; law or medical school)

# **APPENDIX C**

***MARKETING MATERIAL***

Lower your electric bill  
**SIGN UP**

**GET DOWN!**



Go from **14¢** to **9¢\***  
per kilowatt hour

**Lower** long term power production  
**Lower** green house gas emissions

*\*Applies during non-peak periods only.*

# A per kWh REALLY adds up.



The MMLD Test Program:  
**“EnergySense”**  
80 Commercial Street  
Marblehead, MA 01945

**GET DOWN!** *Up to 250 households will receive a reduced electric rate from 14¢ to 9¢ per kWh this summer.*

**How does it work?** We'll install a smart meter at your residence. We ask you to limit your electric usage during Peak Periods. There will be 12 of these over the summer, on weekdays only, between Noon and 6 pm. *(We'll let you know at least one day in advance.)* During these periods your electric rate will be \$1.05 per kWh.

As an added incentive, we are allowing customers to try it at no risk for the first year! If your bill at the end of the summer is higher than what it would have been on your current rate, we'll refund the difference but you get to keep any savings!

**Who can participate?** To be eligible please contact MMLD right away. Not all customers will be selected to participate as space is limited. Participating households will be assigned, at random, to receive a reduced electric rate either during the summer of 2011 or 2012.



## **SIGN UP!**

Call Cindy Snow or Didi Rubano at **781.631.5600**

Or email: [csnow@marbleheadelectric.com](mailto:csnow@marbleheadelectric.com)  
[drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com)

## STARTING A GREEN REVOLUTION

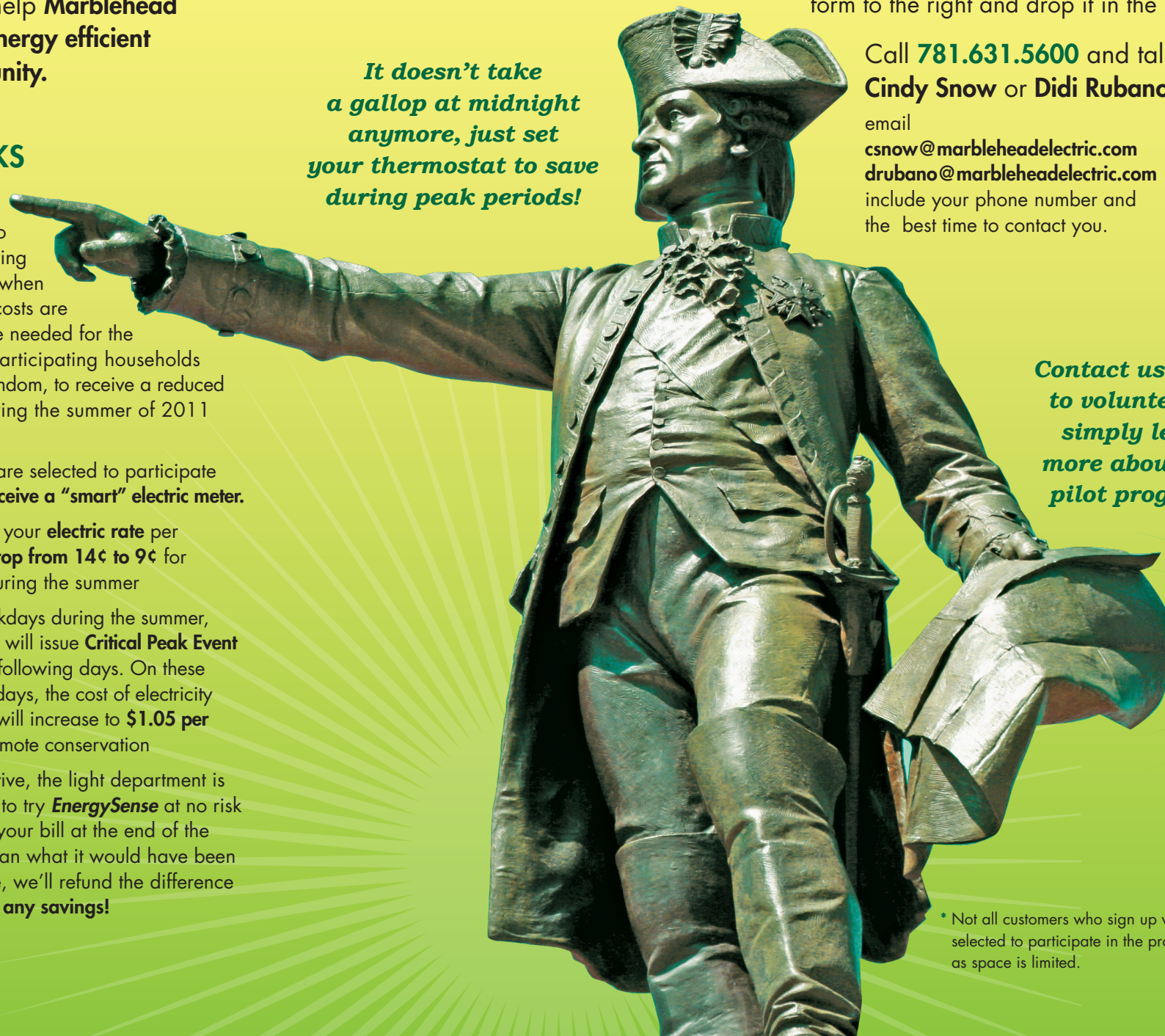
Lead the way to a new era of smart energy use and help **Marblehead** become a truly energy efficient American community.

## HOW IT WORKS

The **EnergySense** Pilot Program is designed to reduce energy use during peak summer periods when electricity generation costs are highest. **Volunteers** are needed for the two year study, and participating households will be assigned, at random, to receive a reduced electric rate either during the summer of 2011 or 2012.

- All volunteers who are selected to participate will be the first to **receive a "smart" electric meter.**
- During the summer, your **electric rate** per kilowatt-hour **will drop from 14¢ to 9¢** for **97%** of the hours during the summer
- Up to 12 peak weekdays during the summer, the light department will issue **Critical Peak Event** notifications for the following days. On these Critical Peak Event days, the cost of electricity from **12pm to 6pm** will increase to **\$1.05 per kilowatt hour** to promote conservation
- As an added incentive, the light department is allowing customers to try **EnergySense** at no risk for the first year! If your bill at the end of the summer is higher than what it would have been on your current rate, we'll refund the difference but you **get to keep any savings!**

*It doesn't take  
a gallop at midnight  
anymore, just set  
your thermostat to save  
during peak periods!*



## WANT TO SIGN UP?\*

You can call us, email us or fill out the form to the right and drop it in the mail.

Call **781.631.5600** and talk to **Cindy Snow** or **Didi Rubano.**

email  
[csnow@marbleheadelectric.com](mailto:csnow@marbleheadelectric.com)  
[drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com)  
include your phone number and  
the best time to contact you.

*Contact us today  
to volunteer or  
simply learn  
more about this  
pilot program.*

\* Not all customers who sign up will be selected to participate in the program as space is limited.

## YES!

I would like to **save money** and **energy** by participating in MMLD's pilot program **EnergySense.**

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

*Working together,  
we can lead the country  
in smart savings with*

**“EnergySense”**



IT'S EASY TO

**GO GREEN  
SAVE GREEN**

AND START A

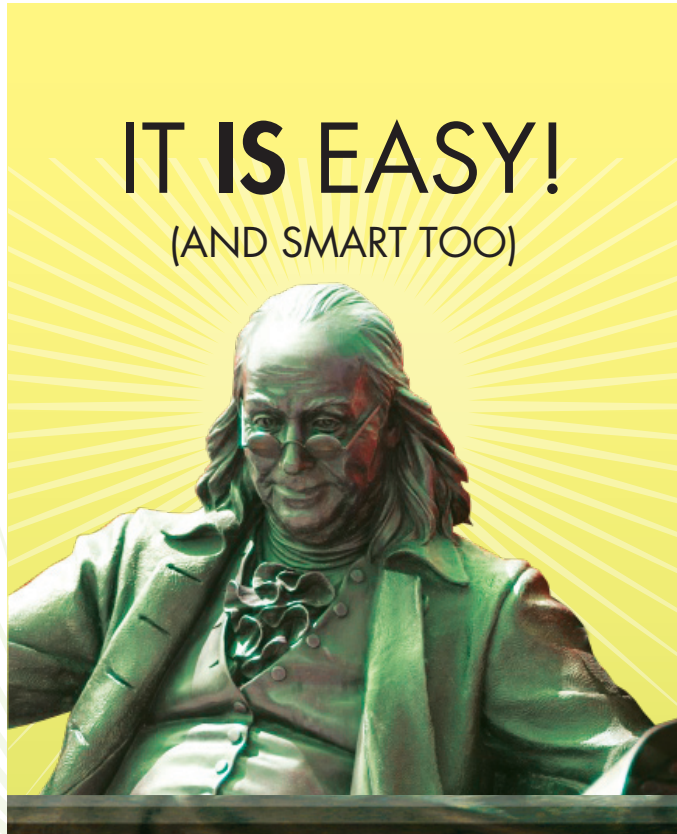
**GREEN  
REVOLUTION!**



Postage  
Required  
Post Office will  
not deliver  
without proper  
postage.



**“EnergySense”**  
Marblehead Municipal Light Department  
PO Box 369  
Marblehead, MA 01945-0369



**IT IS EASY!**  
(AND SMART TOO)

with the MMLD pilot program  
**“EnergySense”**

**GOING GREEN**

The program is an **easy** and **effective** way for you to **help protect the environment**. More efficient use of electricity will reduce the need for long term power production, thereby **reducing greenhouse gas emissions**.

**SAVING GREEN**

Pricing options and **real time usage information** will allow you to control your electric usage and **lower your electric bill!**

*We’re talking a drop from  
14¢ to 9¢ per kilowatt hour!*  
(that’s a 36% drop in the standard rate.)



**“EnergySense”**  
Marblehead Municipal Light Department  
PO Box 369  
Marblehead, MA 01945-0369

Help us start a  
**GREEN REVOLUTION!**

PRESORTED  
FIRST CLASS MAIL  
U.S. POSTAGE PAID  
MARBLEHEAD, MA  
PERMIT NO. 5002



WHAT IF IT WAS  
**EASY TO**  
**GO GREEN**  
**SAVE GREEN**  
**AND**  
START A  
**GREEN**  
**REVOLUTION?**

# **APPENDIX D**

## ***PANEL REGRESSION METHOD***

A panel regression was developed to estimate the impacts independent of the comparison of means approach. In order to best capture the trends in air conditioning usage during hot days (days similar to CPP event days) only the ten hottest non-event days were kept in the model. The model has an  $R^2$  of 0.6972.

The panel model specification is:

$$\begin{aligned}
 kW_{hr} = & \sum_{\alpha=1}^{210} a_{\alpha} \times CON_{\alpha} + \sum_{\beta=1}^{252} b_{\beta} \times CPP_{\beta} + c \times CDH_{Jul} + d \times CDH_{Jul}^2 + e \times CDH_{Aug} + f \\
 & \times CDH_{Aug}^2 \\
 & + \sum_{hr=1}^{24} g_{hr} \times H_{hr} \\
 & + \sum_{hr=1}^{24} h_{hr} \times WE_{hr} + \sum_{hr=1}^{24} i_{hr} \times Event_{hr} + \sum_{hr=1}^{24} j_{hr} \times Event_{hr} \times CDH \\
 & + \sum_{hr=1}^{24} k_{hr} \times (Event_{hr} \times CDH)^2 + \varepsilon_{hr}
 \end{aligned}$$

Where:

a,b,c,...k	Estimated coefficients
hr	Hour
$\alpha$	Index representing the number of control consumers
CON	Indicator variable for each control consumer $\alpha$
$\beta$	Index representing the number of CPP consumers
CPP	Indicator variable for each CPP consumer $\beta$
CDH_Jul	Cooling degree hours in hour hr in July
CDH_Aug	Cooling degree hours in hour hr in August
H	Indicator variable for the hour of the day
WE	Indicator for a weekend day
Event	Indicator for an event day
CDH	Cooling degree hour
$\varepsilon$	Error term

The equation above specifies the hourly demand for an individual customer. To estimate impacts of an event, the model estimate is calculated with and without the event-day variables for each event-day hour. The difference represents the model estimated impact of the critical peak event.

The panel approach predicts a load impact that is consistent with the comparison of means approach. The simple comparison of means predicts an average hourly reduction of 0.74 kW during event hours, and the panel model predicts 0.73 kW. The average impacts on an hourly basis for the panel approach are shown in the table on the next page.

TABLE D-1: PANEL REGRESSION – AVERAGE LOADS, BASELINE, AND IMPACTS ON EVENT DAYS

Hour Ending	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
					Lower	Upper
1	1.30	1.10	0.20	17.9%	0.07	0.33
2	1.18	0.98	0.21	21.3%	0.08	0.34
3	1.09	0.95	0.14	14.8%	0.01	0.27
4	1.07	0.90	0.17	18.8%	0.04	0.30
5	1.06	0.89	0.17	18.8%	0.04	0.30
6	1.11	0.93	0.17	18.3%	0.04	0.30
7	1.19	1.03	0.16	15.5%	0.03	0.29
8	1.34	1.25	0.09	7.1%	(0.04)	0.22
9	1.57	1.41	0.16	11.2%	0.03	0.29
10	1.70	1.47	0.23	15.7%	0.10	0.36
11	1.68	1.64	0.04	2.7%	(0.09)	0.18
12	1.68	1.73	(0.05)	-3.0%	(0.18)	0.08
13	1.19	1.84	(0.65)	-35.4%	(0.78)	(0.52)
14	1.20	1.88	(0.68)	-36.4%	(0.82)	(0.55)
15	1.24	1.93	(0.69)	-35.9%	(0.83)	(0.56)
16	1.27	2.01	(0.74)	-36.7%	(0.87)	(0.61)
17	1.36	2.15	(0.79)	-36.8%	(0.92)	(0.66)
18	1.40	2.25	(0.85)	-37.8%	(0.98)	(0.72)
19	1.93	2.23	(0.29)	-13.2%	(0.43)	(0.16)
20	2.09	2.21	(0.12)	-5.5%	(0.25)	0.01
21	2.25	2.15	0.10	4.6%	(0.03)	0.23
22	2.29	2.04	0.24	12.0%	0.11	0.38
23	2.06	1.85	0.21	11.3%	0.08	0.34
24	1.79	1.55	0.24	15.7%	0.11	0.38
<b>Energy</b>	<b>36.04</b>	<b>38.38</b>	<b>(2.34)</b>	<b>-6.1%</b>	<b>(5.52)</b>	<b>0.84</b>
<b>HE 13-18</b>						
<b>(Event Hours)</b>	<b>1.28</b>	<b>2.01</b>	<b>(0.73)</b>	<b>-36.6%</b>	<b>(0.87)</b>	<b>(0.60)</b>

# **APPENDIX E**

## ***INDIVIDUAL REGRESSION METHOD***

The individual regression approach involves estimating a regression model for each customer that predicts hourly load as a function of weather, event days, and the ten hottest non-event days. Then, a baseline is estimated for each customer on event days using the regression model but zeroing out event day effects. In the original assignment, customers were assigned to CPP and Control groups based on appliance ownership and summer usage characteristics. Customers were put into strata based on electric air conditioner ownership, electric water heater ownership, and summer usage. Then, the strata were assigned to control and CPP groups to provide for equivalent groups in usage and ownership patterns. In order to leverage the valuable data provided by the control group in the individual regression approach, the average load for control group customers in a strata were used as an independent variable in the models for a customer within that strata.

The model specification used for the individual regression models is provided below:

$$\begin{aligned}
 kW_{s,hr} = & a + b \times AvgContkW_s + c \times AvgContkWHot_s + d \times CDHJun + e \times CDHJun^2 + f \\
 & \times CDHJul + g \times CDHJul^2 + h \times CDHAug + i \times CDHAug^2 \\
 & + \sum_{hr=1}^{24} j_{hr} \times H_{hr} \\
 & + \sum_{hr=1}^{24} k_{hr} \times WE_{hr} \\
 & + \sum_{hr=1}^{24} l_{hr} \times CDH \times WD_{hr} \\
 & + \sum_{hr=1}^{24} m_{hr} \times Event_{hr} + \sum_{hr=1}^{24} n_{hr} \times CDH \times Event_{hr} \\
 & + \sum_{hr=1}^{24} o_{hr} \times (CDH \times Event_{hr})^2 + \varepsilon_{hr}
 \end{aligned}$$

where:

a,b,c,...o	Estimated coefficients
Hr	Hour
s	Strata representing customer's ownership status of electric AC and WH
AvgContkW	Average hourly load of all control customers in strata s
AvgContkWHot	Average hourly load for all control customers in strata s on 10 hottest non-event days
CDHJun	Cooling degree hours in hour hr in June
CDHJul	Cooling degree hours in hour hr in July
CDHAug	Cooling degree hours in hour hr in August
H	Indicator variable for the hour of the day
WE	Indicator for a weekend day
WD	Indicator for a weekday day
Event	Indicator for an event day
CDH	Cooling degree hour
ε	Error term

The equation above specifies the hourly demand for an individual customer. To estimate impacts of an event, the model estimate is calculated with and without the event-day variables for each event-day hour. The difference represents the model estimated impact of the critical peak event.

The goodness of fit for the individual models varies to some degree because of the difficulty of predicting individual load behavior based solely on weather and calendar variables (for instance, an individual consumer may take a week-long vacation that cannot possibly be captured in the models). However, the pilot is focused on measuring the behavior of the group of customers as a whole, or the behavior of an average CPP participant. Therefore, the  $R^2$  and goodness of fit statistics for the average customer are provided below, as well as a distribution of individual  $R^2$ .

FIGURE E-1: DISTRIBUTION OF R2 VALUES FOR ALL INDIVIDUAL REGRESSION MODELS

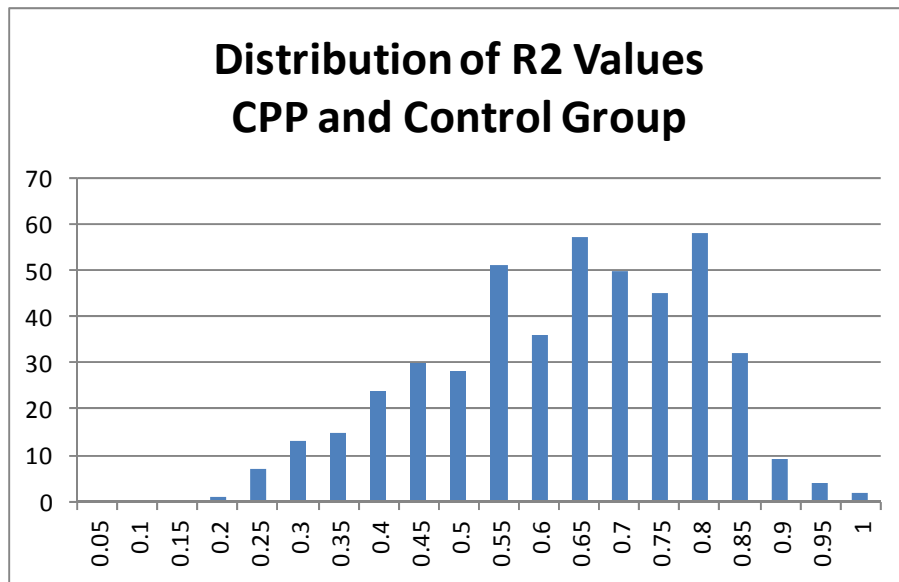


TABLE E-1: GOODNESS OF FIT STATS FOR AVERAGE CUSTOMER

Group	Mean	MAD <sup>1</sup>	MAPE <sup>2</sup>	R2
Control	1.15	0.02	2.1%	0.9626
CPP	1.07	0.05	5.3%	0.9440

1 - Mean Absolute Deviation across all hours in sample.

2 - Mean Absolute % Error across all hours in sample.

The individual regression approach measures impacts that are slightly lower than the comparison of means approach, but close enough to confirm the hypothesis that customers did respond to the CPP rate. The individual regressions estimate an average hourly impact during events of 0.59 kW, compared to 0.74 kW for the comparison of means approach. The average event day hourly impacts using the individual regression approach are shown in the table below.

TABLE E-2: INDIVIDUAL REGRESSION IMPACT RESULTS

Hour Ending	Event kW	Baseline kW	Impact kW	% Impact	90% CI on Impact kW	
					Lower	Upper
1	1.30	1.21	0.09	7.8%	(0.06)	0.25
2	1.18	1.12	0.06	5.4%	(0.08)	0.20
3	1.09	1.13	(0.04)	-3.3%	(0.18)	0.11
4	1.07	1.08	(0.01)	-0.8%	(0.15)	0.13
5	1.06	1.07	(0.01)	-0.8%	(0.16)	0.14
6	1.11	1.07	0.03	3.1%	(0.12)	0.18
7	1.19	1.14	0.05	4.1%	(0.10)	0.20
8	1.34	1.37	(0.03)	-2.0%	(0.22)	0.17
9	1.57	1.49	0.08	5.2%	(0.15)	0.30
10	1.70	1.45	0.25	17.0%	0.02	0.47
11	1.68	1.64	0.04	2.6%	(0.20)	0.28
12	1.68	1.66	0.02	1.4%	(0.22)	0.27
13	1.19	1.64	(0.45)	-27.3%	(0.70)	(0.20)
14	1.20	1.67	(0.47)	-28.3%	(0.76)	(0.19)
15	1.24	1.80	(0.56)	-31.2%	(0.87)	(0.26)
16	1.27	1.82	(0.55)	-30.1%	(0.85)	(0.26)
17	1.36	2.12	(0.76)	-35.7%	(1.08)	(0.43)
18	1.40	2.16	(0.77)	-35.5%	(1.09)	(0.45)
19	1.93	2.37	(0.43)	-18.4%	(0.78)	(0.09)
20	2.09	2.25	(0.16)	-7.3%	(0.52)	0.20
21	2.25	2.35	(0.09)	-4.0%	(0.42)	0.23
22	2.29	2.26	0.03	1.1%	(0.27)	0.32
23	2.06	2.05	0.01	0.4%	(0.26)	0.28
24	1.79	1.82	(0.03)	-1.6%	(0.29)	0.23
<b>Energy</b>	<b>36.04</b>	<b>39.74</b>	<b>(3.70)</b>	<b>-9.3%</b>	<b>(8.63)</b>	<b>1.20</b>
<b>HE 13-18</b>						
<b>(Event Hours)</b>	<b>1.28</b>	<b>1.87</b>	<b>(0.59)</b>	<b>-31.7%</b>	<b>(0.89)</b>	<b>(0.30)</b>



# **APPENDIX F**

## ***POST PILOT SURVEY***



## MARBLEHEAD MUNICIPAL LIGHT DEPARTMENT

80 COMMERCIAL STREET • P.O. BOX 369  
MARBLEHEAD, MASSACHUSETTS 01945

**ROBERT V. JOLLY, JR.**  
GENERAL MANAGER

Dear EnergySense Participant,

September 1<sup>st</sup> marked the end of year one of the *EnergySense pilot program*. THANK YOU for participating. We hope that your experience with the pilot thus far has been positive, and we truly value your feedback on what you liked or disliked, and how the program could be improved. We have included a brief written survey with a self-addressed stamped envelope. Please take a few minutes to complete and return the survey so we can better understand your experience.

This letter discusses important items regarding the pilot, including the transition from the incentive rate back to your previous fixed rate until next summer and what to expect for next year's program. If you have any questions, please do not hesitate to contact us (781) 631-5600, or by email at [drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com).

### ***Your Monthly Electric Bill***

As of September 1st, the incentive rate has ended and you have been returned to the standard flat electric rate you were on before the pilot began. This change will be reflected in your monthly electric bill for September. Some customers may not have received a bill in September. This is due to internal meter and billing verification processes the light department had to undertake. If you did not receive a bill in September, you can expect to receive bills for both months in October. You will continue to receive your monthly electric bill on or around the same date each month going forward.

You are still actively enrolled as a participant in the pilot program unless you specifically contact us and request to be removed from the pilot. As such, you will be placed back on the incentive rate starting June 1<sup>st</sup> of 2012. You will receive further communication from the Light Department over the next several months with details about the summer 2012 program.

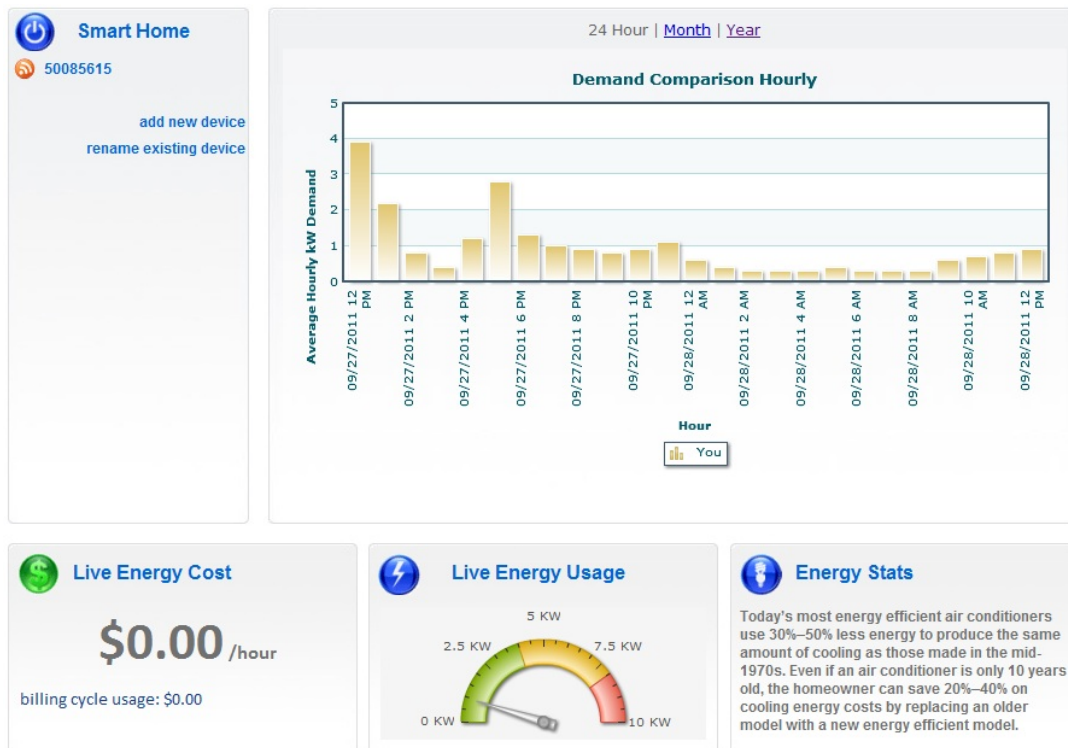
### ***Bill Protection***

As a condition of the Pilot, Marblehead Municipal Light promised bill protection to all treatment group participants in 2011 so that you would be guaranteed not to pay more as a result of participating in the program. Now that the pilot has ended, we are in the process of preparing billing analyses that compare charges on the incentive rate to charges that would have been on the standard rate. While our early analysis indicates that nearly all participants saved on the rate, if you indeed paid more on the pilot rate we will issue a credit on your Monthly electric bill received within the next two months.

Bill protection will NOT be included as part of the *EnergySense* pilot in 2012. As stated above, you will remain an actively enrolled participant in the pilot and placed on the incentive rate in June 2012 unless you specifically contact us and request to be removed from the program.

### Web Portal

All participants have been provided with access to a web portal that communicates with your smart meter *in real time* and shows you data on current and historical energy usage. Having access to the web portal empowers you to make more informed choices about your household energy usage. In addition to real time and historical energy usage, other features of the web portal include reports on time of use energy consumption, your billing summary, and a scrolling list of energy efficiency tips to help you save money. If you have not yet visited the web portal, it can be accessed at the Light Department Website and clicking on the “View my meter” tab at the far right side of the page. Below is a screen shot of a typical customer’s web portal home page:



The web portal will remain active through the entire pilot period and beyond, and you are encouraged to explore the web portal and the types of information provided. The survey attached has several questions regarding this portal. We are eager to hear your thoughts on the web portal and how it could be improved.

### ***What to Expect in Year Two***

The *EnergySense* Pilot is a two year program. Now that the first year of the pilot is complete, we will evaluate the results and prepare for the second year of the pilot. In year two, you will again be placed on the incentive rate that you received during the past summer. In addition, some participants with central air conditioning and/or electric water heaters may receive technologies such as smart thermostats and water heater switches that allow you to better manage energy consumption during critical peak events. We will be sending further correspondence before next summer with more information.

We are truly pleased that you volunteered to participate in this new and exciting pilot program. We have learned a great deal about these programs, the logistics of planning and implementing smart grid programs, and of your collective experiences with the technologies and program elements. We value your feedback and appreciate your willingness to participate in our pilot. If you have any further questions or comments, please don't hesitate to contact us at us (781) 631-5600, or by email at [drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com) or [csnow@marbleheadelectric.com](mailto:csnow@marbleheadelectric.com).

Best regards,

**Robert V. Jolly, Jr.**

General Manager

Marblehead Municipal Light Department



This is a quick and easy survey requested by the Department of Energy as part of a Smart Grid Investment Grant received by Marblehead Municipal Light Department. Your answers are protected and will be anonymous

Use a blue or black pen

**START HERE**

**MA1. How would you rate your overall experience with the first year of the Marble *EnergySense* Pilot Program?**

Mark  ONE box

- Very Positive
- Somewhat Positive
- Neutral
- Somewhat Negative
- Very Negative

**MA2. Do you remember personally receiving any information from Marblehead Light that told you how you could save money on your current electric bill by changing what activity you do in your home or when you do the activity?**

Mark  ONE box

- Yes
- No (GO TO MA 5)
- Don't Know (GO TO MA5)

**MA3. Did you think the information was useful?**

Mark  ONE box

- Yes
- No
- Don't Know

**MA4. Did you do anything that was suggested by this utility information to help you save money?**

Mark  ONE box

- Yes
- No
- Don't Know

**MA5. What actions did you take to help save money during Critical Peak Events? Please list all you can remember. If none, write "none".** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**MA6. Do you recall being notified of Critical Peak Events the day before they occurred?**

Mark  ONE box

- Yes
- No
- Don't Know

**MA7. Were you satisfied with the type and content of communication you received that notified you about Critical Peak Days?**

Mark  ONE box

- Yes, the type and frequency of communication kept me informed
- No, I was not made aware of CPP days as they were occurring
- No, the level of communication was excessive.
- Other \_\_\_\_\_

**MA8. How many Critical Peak Days do you recall being declared?**

**MA9. How do you feel your electrical bill for this summer compared with past years?**

- A lot lower than past summers
- Slightly lower than past summers
- About the same as past summers
- Slightly higher than past summers
- A lot higher than past summers (GO TO MA11)
- Don't Know (GO TO MA11)

**MA10. How do you feel your electrical usage for this summer compared with past years?**

- A lot lower than past summers
- Slightly lower than past summers
- About the same as past summers
- Slightly higher than past summers
- A lot higher than past summers (GO TO MA11)
- Don't Know (GO TO MA11)

**TURN OVER AND CONTINUE** →

**MA11.** Please list any reasons as to why you feel your electrical usage for this summer was more or less than past summers? (e.g. Summer 2011 was warmer/cooler, actively reduced usage in response to *EnergySense* Pilot, increase/decrease in size of household, etc.)

---

---

---

---

As part of the pilot program you were given access to a web portal which allows you to monitor your energy usage. The web portal is accessed through the Marblehead Light Department website ([www.marbleheadelectric.com](http://www.marbleheadelectric.com)) and clicking on the "view my meter" link. The following questions pertain to this web portal:

**MA12.** Did you ever access the web portal during the course of the pilot? If you mark "No" please explain why you never accessed it, and then skip to the next section

Mark  ONE box

Yes

No \_\_\_\_\_

**MA13.** How frequently did you access the web portal?

Mark  ONE box

Only accessed it once

At least once per month

More than twice per month

Don't Know

**MA14.** Do you feel that the web portal's interface was well laid out and easy to navigate?

Mark  ONE box

Yes

No

Somewhat

**MA15.** Did you feel that the information provided on the web portal was helpful?

Mark  ONE box

Very Helpful

Somewhat Helpful

Not at all Helpful

**MA16.** Please list any suggestions as to how the web portal could be more useful or engaging to you and your household? \_\_\_\_\_

---

---

---

The *EnergySense* Pilot will continue next summer and for some customers with central air and/or electric water heaters it may include technologies to help conserve energy during critical peak periods. The following questions pertain to these technologies. Your responses below are solely for Marblehead Municipal Light to understand compatibility with and interest in these technologies and they **DO NOT** represent any formal commitment to provide these technologies.

**MA17.** Does your home have either an electric water heater, central air conditioning, or both?

Mark  ONE box

Central Air only

Electric Water Heater only

Both, Electric Water Heater and Central Air

Neither

If you marked "Neither" for MA17, you may skip the remaining questions

**MA18.** Did your household previously participate in Marblehead Light's Water Heater Control Program?

Mark  ONE box

Yes

No

Don't Know

**MA19.** How interested would you be in receiving equipment next summer that would help you conserve energy during Critical Peak Event Days?

Mark  ONE box

Very Interested

Somewhat Interested

Not at all Interested

**MA20.** Would you be more or less interested in receiving the technology if it were automatically controlled by Marblehead Light on Critical Peak Event Days?

Mark  ONE box

More Interested

Neutral

Less Interested

**MA21.** Would you be more or less interested in receiving the technology if it were configured to respond automatically to the price of energy, and YOU had the ability to determine how you want the equipment to respond?

Mark  ONE box

More Interested

Neutral

Less Interested



## MARBLEHEAD MUNICIPAL LIGHT DEPARTMENT

80 COMMERCIAL STREET • P.O. BOX 369  
MARBLEHEAD, MASSACHUSETTS 01945

**ROBERT V. JOLLY, JR.**  
GENERAL MANAGER

Dear EnergySense Participant

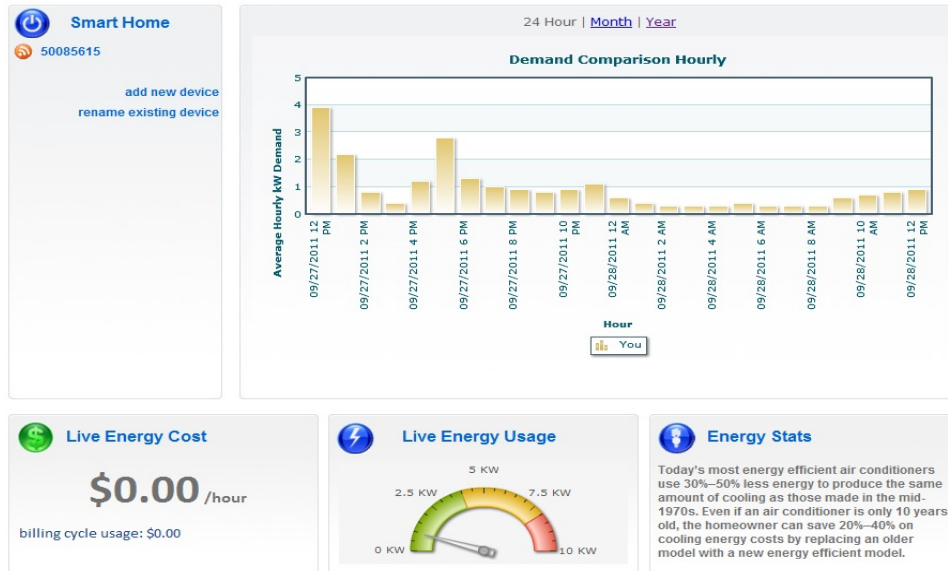
September 1<sup>st</sup> marked the end of year one of the *EnergySense pilot program*. THANK YOU for participating. Although you were not selected to receive the incentive rate in Year One, your contributions were invaluable to the success of the pilot by providing a baseline against which the incentive rate group was measured. In year two of the study which launches in June 2012, you will be placed on the incentive rate that you volunteered for earlier this summer unless you specifically contact us and request to be removed from the pilot.

This letter discusses important items regarding the pilot, including on-going availability of the web portal and what to expect for next year's program. If you have any questions, please do not hesitate to contact us (781) 631-5600, or by email at [drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com).

We have also included a brief written survey with a self-addressed stamped envelope. Please take a few minutes to complete and return the survey. Your response is important to help us evaluate the results of the pilot and to better understand your experience.

### ***Web Portal***

All participants have been provided with access to a web portal that communicates with your smart meter *in real time* and shows you data on current and historical energy usage. Having access to the web portal empowers you to make more informed choices about your household energy usage. In addition to real time and historical energy usage, other features of the web portal include reports on time of use energy consumption, your billing summary, and a scrolling list of energy efficiency tips to help you save money. If you have not yet visited the web portal, it can be accessed at the Light Department Website and clicking on the "View my meter" tab at the far right side of the page. Below is a screen shot of a typical customer's web portal home page:



The web portal will remain active through the entire pilot period and beyond, and you are encouraged to explore the web portal and the types of information provided. The survey attached has several questions regarding this portal. We are eager to hear your thoughts on the web portal and how it could be improved.

### ***What to Expect in Year Two***

The *EnergySense* Pilot is a two year program. Now that the first year of the pilot is complete, we will evaluate the results and prepare for the second year of the pilot. Starting in June 2012, you will be placed on the incentive rate that you volunteered for earlier this summer unless you specifically contact us to request out of the program. In addition, some participants with central air conditioning and/or electric water heaters may receive technologies such as smart thermostats and water heater switches that allow you to better manage energy consumption during critical peak events. We will be sending further correspondence before next summer with more information.

We are truly pleased that you volunteered to participate in this new and exciting pilot program. We have learned a great deal about these programs, the logistics of planning and implementing smart grid programs, and of your collective experiences with the technologies and program elements. We value your feedback and appreciate your willingness to participate in our pilot. If you have any further questions or comments, please don't hesitate to contact us at us (781) 631-5600, or by email at [drubano@marbleheadelectric.com](mailto:drubano@marbleheadelectric.com) or [csnow@marbleheadelectric.com](mailto:csnow@marbleheadelectric.com).

Best regards,

**Robert V. Jolly, Jr.**  
 General Manager  
 Marblehead Municipal Light Department





This is a quick and easy survey requested by the Department of Energy as part of a Smart Grid Investment Grant received by Marblehead Municipal Light Department. Your answers are protected and will be anonymous

Use a blue or black pen

**START HERE**

**MA1. How do you feel your electrical bill for this summer compared with past years?**

- A lot lower than past summers
- Slightly lower than past summers
- About the same as past summers
- Slightly higher than past summers
- A lot higher than past summers (GO TO MA11)
- Don't Know (GO TO MA11)

**MA2. How do you feel your electrical usage for this summer compared with past years?**

- A lot lower than past summers
- Slightly lower than past summers
- About the same as past summers
- Slightly higher than past summers
- A lot higher than past summers (GO TO MA11)
- Don't Know (GO TO MA11)

**MA3. Please list any reasons as to why you feel your electrical usage for this summer was more or less than past summers? (e.g. Summer 2011 was warmer/cooler, change in size of household, extended vacations, etc.)** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

As part of the pilot program you were given access to a web portal which allows you to monitor your energy usage. The web portal is accessed through the Marblehead Light Department website ([www.marbleheadelectric.com](http://www.marbleheadelectric.com)) and clicking on the "view my meter" link. The following questions pertain to this web portal:

**MA4. Did you ever access the web portal during the course of the pilot? If you mark "No" please explain why you never accessed it, and then turn survey over to next section.**

Mark  ONE box

- Yes
- No \_\_\_\_\_

**MA5. How frequently did you access the web portal?**

Mark  ONE box

- Only accessed it once
- At least once per month
- More than twice per month
- Don't Know

**MA6. Do you feel that the web portal's interface was well laid out and easy to navigate?**

Mark  ONE box

- Yes
- No
- Somewhat

**MA7. Did you feel that the information provided on the web portal was helpful?**

Mark  ONE box

- Very Helpful
- Somewhat Helpful
- Not at all Helpful

**MA8. Please list any suggestions as to how the web portal could be more useful or engaging to you and your household?**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

TURN OVER AND CONTINUE

The *EnergySense* Pilot will continue next summer and for some customers with central air and/or electric water heaters it may include technologies to help conserve energy during critical peak periods. The following questions pertain to these technologies. Your responses below are solely for Marblehead Municipal Light to understand compatibility with and interest in these technologies and they **DO NOT** represent any formal commitment to provide these technologies.

**MA9. Does your home have either an electric water heater, central air conditioning, or both?**

Mark  ONE box

- Central Air only  
 Electric Water Heater only  
 Both, Electric Water Heater and Central Air  
 Neither

If you marked "Neither" for MA9, you may skip the remaining questions

**MA10. Did your household previously participate in Marblehead Light's Water Heater Control Program?**

Mark  ONE box

- Yes  
 No  
 Don't Know

**MA11. How interested would you be in receiving equipment next summer that would help you conserve energy during Critical Peak Event Days?**

Mark  ONE box

- Very Interested  
 Somewhat Interested  
 Not at all Interested

**MA12. Would you be more or less interested in receiving the technology if it were automatically controlled by Marblehead Light on Critical Peak Event Days?**

Mark  ONE box

- More Interested  
 Neutral  
 Less Interested

**MA13. Would you be more or less interested in receiving the technology if it were configured to respond automatically to the price of energy, and YOU had the ability to determine how you want the equipment to respond?**

Mark  ONE box

- More Interested  
 Neutral  
 Less Interested

# **APPENDIX G**

## ***POST PILOT SURVEY RESULTS***

## **POST-PILOT SURVEY**

Post-pilot survey instruments were administered after the completion of the first year of the program. MMLD developed two separate survey instruments; one for the Year 1 Treatment group and one for the Control group. These survey instruments are presented in Appendix F. The Treatment survey was designed to assess customer satisfaction with the CPP rate treatment, usage and helpfulness of the web portal, identify which customers had central air and/or electric water heaters, and gauge the level of interest in having enabling technologies provided in Year 2. The Control group survey was a stripped down version of the Year 1 Treatment survey. Participants received the survey via mail alongside a letter from MMLD which thanked customers for their participation in the program and offered a primer for what to expect in the second year of the pilot study.

### **TREATMENT GROUP RESPONSE RATE**

Mailed: 269  
Received: 161  
% Response: 59.85%

### **CONTROL GROUP RESPONSE RATE**

Mailed: 263  
Received: 118<sup>11</sup>  
% Response: 45%

## **SURVEY RESULTS**

Below are the results of the surveys given to the participants. The Control Group was not asked the full set of questions.

---

<sup>11</sup> 14 of the 118 control surveys that MMLD received were incomplete because of an error on the survey which unintentionally directed customers to skip several questions, including those pertaining to ownership of electric water heaters and central air conditioning.

## 1) OVERALL EXPERIENCE

Table G-1, shown below, provides a breakdown of the responses to question MA1 on the Treatment Group survey: *How would you rate your overall experience with the first year of the Marblehead Light EnergySense Pilot Program?*

TABLE G-1: POST PILOT SURVEY (YEAR 1 TREATMENT) MA1 RESPONSE SUMMARY

<b>MA1: How would you rate your overall experience with the first year of the Marblehead Light EnergySense Pilot Program?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Very Negative	0	0.00%
Somewhat Negative	2	1.27%
Neutral	20	12.74%
Somewhat Positive	45	28.66%
Very Positive	90	57.32%
<b>Total Responses</b>	<b>157</b>	<b>100.00%</b>

### **Of the 90 participants who marked their overall experience as Very Positive...**

72 felt that their bill was lower (37 Slightly lower, 35 A lot lower)

15 felt that their bill was about the same or they didn't know (4 About the same, 10 Didn't know)

2 felt that their bill was higher (2 Slightly higher, 0 A lot higher)

### **Of the 45 participants who marked their overall experience as Somewhat Positive...**

22 felt that their bill was lower (18 Slightly lower, 4 A lot lower)

19 felt that their bill was about the same or they didn't know (10 About the same, 9 Didn't know)

3 felt that their bill was higher (2 A lot higher, 1 Slightly higher)

1 did not respond

### **Of the 20 participants who marked their overall experience as Neutral...**

9 felt that their bill was lower (8 Slightly lower, 1 A lot lower)

8 felt that their bill was about the same or they didn't know (5 About the same, 3 Didn't know)

3 felt that their bill was higher (2 Slightly higher, 1 A lot higher)

1 did not respond

### **Of the 2 participants who marked their overall experience as Somewhat Negative...**

1 felt that their bill was lower (1 Slightly lower, 0 A lot lower)

1 felt that their bill was higher (1 A lot higher, 0 Slightly higher)

Participants reported an overwhelmingly positive experience. Lower bills seem to be the predominant driver of positive program experience. However, 19 of the 45 that marked "Somewhat Positive" did not feel their bill had changed, and 3 of the 45 felt their bill was actually higher. 9 of the 20 Neutral participants felt that they'd saved while 8 did not feel their bill had changed. This shows that although lower bills appear to be the predominant driver, they are not the only one. Program inconvenience could have made the experience

negative, and the information, tools, and support could have made it positive.

## 2) UTILITY-PROVIDED INFORMATION PERCEPTIONS

The tables below provide a breakdown of the responses to questions MA2, MA3, and MA4 on the Treatment Group survey regarding the information provided by the utility on changing energy-related activities in their home.

TABLE G-2: POST PILOT SURVEY (YEAR 1 TREATMENT) MA2 RESPONSE SUMMARY

<b>MA2: Do you remember personally receiving any information from Marblehead Light that told you how you could save money on your current electric bill by changing what activity you do in your home?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Yes	141	88.68%
No	13	8.18%
Don't Know	5	3.14%
<b>Total Responses</b>	<b>159</b>	<b>100.00%</b>

TABLE G-3: POST PILOT SURVEY (YEAR 1 TREATMENT) MA3 RESPONSE SUMMARY

<b>MA3: Did you think the information was useful?</b>		
<b>Response</b>	<b>Frequency</b>	<b>% of Total</b>
Yes	133	95.68%
No	1	0.72%
Don't Know	5	3.60%
<b>Total Responses</b>	<b>139</b>	<b>100.00%</b>

TABLE G-4: POST PILOT SURVEY (YEAR 1 TREATMENT) MA4 RESPONSE SUMMARY

<b>MA4: Did you do anything that was suggested by this utility information to help you save money?</b>		
<b>Response</b>	<b>Frequency</b>	<b>% of Total</b>
Yes	116	87.88%
No	8	6.06%
Don't Know	8	6.06%
<b>Total Responses</b>	<b>132</b>	<b>100.00%</b>

The results of this survey question show that the utility information was useful to nearly all recipients in the treatment group, and resulted in action by a very large percentage of recipients. These responses support the hypothesis that conservation effects were presents in the treatment group beyond just the critical peak event days

### 3) TREATMENT GROUP ACTIONS

The table below provides a breakdown of the responses to question MA5 on the Treatment Group survey: *What actions did you take to help save money during CPP Events?*

TABLE G-5: POST PILOT SURVEY (YEAR 1 TREATMENT) MA5 RESPONSE SUMMARY

<b>MA5: What actions did you take to help save money during CPP Events? Please list all you can Remember. If none, write "none."</b>		
<b>Response Type</b>	<b>Frequency</b>	<b>Percent</b>
None	9	6.34%
Purchased EE Products	1	0.70%
Load shifting / Awareness & Conservation	119	83.80%
Load shifting /Awareness & Conservations / EE Purchasing	7	4.93%
Pre-cool / Load shifting / Awareness & Conservation	4	2.82%
Pre-cool / Load shifting / Awareness & Conservation / Purchased EE products	2	1.41%
<b>Total Responses</b>	<b>142</b>	<b>100.00%</b>

TABLE G-6: MOST COMMON RESPONSES TO POST PILOT SURVEY (YEAR 1 TREATMENT) MA5

<b>Most Common Responses</b>
Unplugging unused appliances
Turn off A/C
No laundry or dishwashing during CPP hours
Raising A/C Temperature
Cutting back on A/C use
Leaving house to run errands or spend more time outside
Making sure lights were off in empty rooms
Turn off hot water heater
No using dehumidifier
Use fans instead of A/C
Switching to CFLs
Pre-cooling before event

These survey responses show that a large percentage (83.8%) of treatment group customers took action by load shifting and remaining aware of usage during CPP hours to conserve energy where possible.

#### 4) CPP EVENT NOTIFICATIONS

This section provides a breakdown of the responses to questions MA6, MA7, and MA8 on the Treatment Group survey regarding their being notified of CPP events.

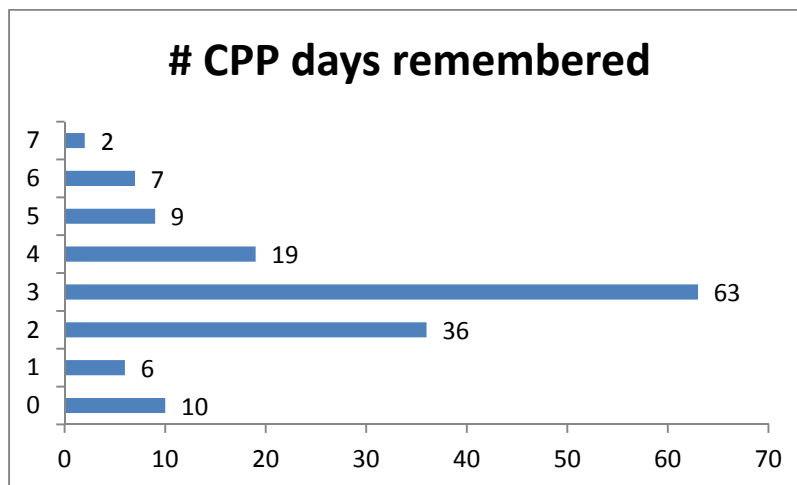
TABLE G-7: POST PILOT SURVEY (YEAR 1 TREATMENT) MA6 RESPONSE SUMMARY

<b>MA6: Do you recall being notified of Critical Peak Events the day before they occurred?</b>		
<b>Response Type</b>	<b>Frequency</b>	<b>Percent</b>
Yes	150	94.34%
No	8	5.03%
Don't Know	1	0.63%
<b>Total Responses</b>	<b>159</b>	<b>100.00%</b>

TABLE G-8: POST PILOT SURVEY (YEAR 1 TREATMENT) MA7 RESPONSE SUMMARY

<b>MA7: Were you satisfied with the type and content of communication you received that notified you about Critical Peak Days?</b>		
<b>Response Type</b>	<b>Frequency</b>	<b>Percent</b>
Yes: The type and frequency of communications kept me informed	138	86.25%
No: I was not made aware of CPP days as they were occurring	12	7.50%
No: The level of communications was excessive	1	0.63%
Other <i>Try to notify earlier</i>	9	5.63%
<b>Total Responses</b>	<b>160</b>	<b>100.00%</b>

FIGURE G-1: NUMBER OF CPP DAYS REMEMBERED BY TREATMENT GROUP CUSTOMERS



These results show that nearly all treatment group customers remember being notified of CPP events, and a large percentage (86.25%) were satisfied with the type and frequency of communications



regarding CPP events. However, only 63 out of 152 (41.5%) that responded with the amount of CPP event days that they remembered answered with the correct number (3). The 37 customers that remember more CPP events than actually happened may have been confused by the notifications. These customers could partly explain the discrepancy between the energy usage of treatment and control group customers on hot non-event days, as they may have performed energy-reducing activities on non-CPP days that they thought were CPP days. However, even more customers remembered less CPP days than there actually were, so it is possible that those customers took no special actions on CPP days due to a lack of awareness. These 42 customers that only remember one or two events may expose an inefficiency of the communication system.

## 5) EFFECTS ON ELECTRIC BILL AND USAGE

### *TREATMENT GROUP*

The tables below provide a breakdown of the responses to questions MA9 and MA10 on the Treatment survey regarding electricity usage and the customers' electric bill compared to past years.

TABLE G-9: POST PILOT SURVEY (YEAR 1 TREATMENT) MA9 RESPONSE SUMMARY

<b>MA9: How do you feel your electrical <u>bill</u> compared with past years?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Don't know	22	14.01%
A lot lower	41	26.11%
Slightly lower	65	41.40%
About the same	19	12.10%
Slightly higher	6	3.82%
A lot higher	4	2.55%
<b>Total Responses</b>	<b>157</b>	<b>100.00%</b>

TABLE G-10: POST PILOT SURVEY (YEAR 1 TREATMENT) MA10 RESPONSE SUMMARY

<b>MA10: How do you feel your electrical <u>usage</u> compared with past years?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Don't know	10	6.90%
A lot lower	15	10.34%
Slightly lower	77	53.10%
About the same	38	26.21%
Slightly higher	4	2.76%
A lot higher	3	2.07%
<b>Total Responses</b>	<b>147</b>	<b>101.38%</b>

TABLE G-11: CROSSTAB MATRIX FOR POST PILOT SURVEY (YEAR 1 TREATMENT) MA9 AND MA10

		MA9: Bill					
		A lot higher	A lot lower	About the same	Don't know	Slightly higher	Slightly lower
MA10: Usage	A lot higher	1	1			1	
	A lot lower		12			1	2
	About the same		7	11	3	3	14
	Don't know	1	1		6		2
	Slightly higher		2	1			1
	Slightly lower		18	7	3	1	46

TABLE G-12: CROSSTAB MATRIX FOR POST PILOT SURVEY (YEAR 1 TREATMENT) MA9 AND MA10

		MA9: Bill					
		A lot higher	A lot lower	About the same	Don't know	Slightly higher	Slightly lower
MA10: Usage	A lot higher	0.69%	0.69%			0.69%	
	A lot lower		8.28%			0.69%	1.38%
	About the same		4.83%	7.59%	2.07%	2.07%	9.66%
	Don't know	0.69%	0.69%		4.14%		1.38%
	Slightly higher		1.38%	0.69%			0.69%
	Slightly lower		12.41%	4.83%	2.07%	0.69%	31.72%

The most Treatment Group customers (31.7%) thought that they used slightly less electricity and had a slightly lower bill than the past years. 12.4% thought that their usage was slightly lower, but their bill was a lot lower. 9.7% thought that their usage was about the same, but their bill was slightly lower. Only a very small percentage thought that either their bill or usage increased. This shows that nearly all Treatment Group customers who attempted to reduce their usage also saw their bills reduce.

**CONTROL GROUP**

The tables below provide a breakdown of the responses to questions MA1 and MA2 on the Control Group survey regarding electricity usage and the customers' electric bill compared to past years.

TABLE G-13: POST PILOT SURVEY (YEAR 1 CONTROL) MA1 RESPONSE SUMMARY

<b>MA1: How do you feel your electrical <u>bill</u> compared with past years?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Don't know	18	15.38%
A lot lower	6	5.13%
Slightly lower	17	14.53%
About the same	55	47.01%
Slightly higher	17	14.53%
A lot higher	4	3.42%
<b>Total Responses</b>	<b>117</b>	<b>100.00%</b>

TABLE G-14: POST PILOT SURVEY (YEAR 1 CONTROL) MA2 RESPONSE SUMMARY

<b>MA2: How do you feel your electrical <u>usage</u> compared with past years?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Don't know	5	4.67%
A lot lower	2	1.87%
Slightly lower	22	20.56%
About the same	64	59.81%
Slightly higher	12	11.21%
A lot higher	2	1.87%
<b>Total Responses</b>	<b>107</b>	<b>100.00%</b>

47% of the Control Group thought that their electric bill was about the same, 18% thought that it was higher, and 19.7% thought it was lower. This shows that there were not significant external drivers that caused higher or lower bills for Control Group customers. 59.8% of the Control Group felt that their electrical usage was about the same, 22.4% thought that it was lower, and 13.1% thought that it was higher. The overall neutral perceived effects on customers' bills and perceived lower usage of the Control Group customers shows that for some customers, steps taken to reduce their usage have resulted in the same bill payment due to electricity cost increases over the same period.

## 1) WEB PORTAL

### TREATMENT GROUP

The tables below provide a breakdown of the responses to questions MA12, MA13, MA14, and MA15 on the Treatment Group survey regarding the web portal available for Treatment Group customers. Table G-18 shows how the customers that accessed the web portal more than once felt about its usefulness.

TABLE G-15: POST PILOT SURVEY (YEAR 1 TREATMENT) MA12 RESPONSE SUMMARY

<b>MA12: Did you access web portal during pilot?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Yes	61	38.85%
No	96	61.15%
<b>Total Responses</b>	<b>157</b>	<b>100.00%</b>

TABLE G-16: POST PILOT SURVEY (YEAR 1 TREATMENT) MA13 RESPONSE SUMMARY

<b>MA13: How frequently did you access the web portal?</b>		
<b>Response</b>	<b>#</b>	<b>% of Total Yes</b>
Only once	26	42.62%
At least 1/mo	18	29.51%
More than 2/mo	15	24.59%
Don't know	1	1.64%
Blank	1	1.64%
<b>Total</b>	<b>61</b>	<b>100.00%</b>

TABLE G-17: POST PILOT SURVEY (YEAR 1 TREATMENT) MA14 RESPONSE SUMMARY

<b>MA14: Did you feel that the web portal's interface was well laid out and easy to navigate?</b>		
<b>Response</b>	<b>Total</b>	<b>Percent</b>
Yes	30	49.18%
No	6	9.84%
Somewhat	19	31.15%
Blank	6	9.84%
<b>Total Responses</b>	<b>61</b>	<b>100.00%</b>

TABLE G-18: POST PILOT SURVEY (YEAR 1 TREATMENT) MA15 RESPONSE SUMMARY

<b>MA15: Did you feel that the information provided on the web portal was helpful?</b>		
<b>Response</b>	<b>Total</b>	<b>Percent</b>
Very helpful	17	27.87%
Somewhat helpful	33	54.10%
Not at all helpful	4	6.56%
Blank	7	11.48%
<b>Total Responses</b>	<b>61</b>	<b>100.00%</b>

TABLE G-19: POST PILOT SURVEY (YEAR 1 TREATMENT) WEB PORTALL ACCESS AND PERCEPTION OF USEFULNESS

<b>Of the people who accessed the web portal more than once, how many also responded that the information on the web portal was helpful?</b>						
<b>Response</b>	<b>At least 1/mo</b>		<b>More than 2/mo</b>		<b>Combined</b>	
	<b>#</b>	<b>% Total</b>	<b>#</b>	<b>% Total</b>	<b>#</b>	<b>% Total</b>
Very Helpful	7	41.18%	4	23.53%	11	64.71%
Somewhat Helpful	10	30.30%	10	30.30%	20	60.61%
	<b>Total</b>				<b>31</b>	<b>62.00%</b>

Based on the Treatment Group, marketing of the web portal appears to have been insufficient. Participants who did not use the web portal responded most commonly that it was because they forgot it was available, were too busy during the summer, or did not see the value. Many participants reported trouble with logging-in to the web portal because they didn't have password or the site was unresponsive. There were notes scattered throughout the survey complaining of inaccurate meter and billing data. 42% of participants who accessed the web portal only accessed it one time - including participants who attempted to use it but could not successfully log in. It was commonly reported that the interface was not very easy to navigate. Participants noted in the survey that the graphs were confusing and it was unclear what the data they were seeing was. 54.1% of participants who had accessed the web portal were repeat visitors - 29.51% said they visited at least once per month and 24.59% more than two times per month. 54.1% responded that the information provided on the web portal was only "Somewhat Helpful" - including 60.61% of the 31 participants who were frequent visitors.

**CONTROL GROUP**

Tables 29, 30, 31, and 32 shown below, provide a breakdown of the responses to questions MA12, MA13, MA14, and MA15 on the Treatment Group survey regarding the web portal available for Treatment Group customers. Table 28 shows how the customers that accessed the web portal more than once felt about its usefulness.

TABLE G-20: POST PILOT SURVEY (YEAR 1 CONTROL) MA4 RESPONSE SUMMARY

<b>MA4: Did you access web portal during pilot?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Yes	18	16.98%
No	88	83.02%
<b>Total Responses</b>	<b>106</b>	<b>100.00%</b>

TABLE G-21: POST PILOT SURVEY (YEAR 1 CONTROL) MA5 RESPONSE SUMMARY

<b>MA5: How frequently did you access the web portal?</b>		
<b>Response</b>	<b>#</b>	<b>% of Total Yes</b>
Only once	9	50.00%
At least 1/mo	5	27.78%
More than 2/mo	2	11.11%
Don't know	2	11.11%
<b>Total</b>	<b>18</b>	<b>100.00%</b>

TABLE G-22: POST PILOT SURVEY (YEAR 1 CONTROL) MA6 RESPONSE SUMMARY

<b>MA6: Did you feel that the web portal's interface was well laid out and easy to navigate?</b>		
<b>Response</b>	<b>Total</b>	<b>Percent</b>
Yes	11	61.11%
No	0	0.00%
Somewhat	5	27.78%
Blank	2	11.11%
<b>Total Responses</b>	<b>18</b>	<b>100.00%</b>

TABLE G-23: POST PILOT SURVEY (YEAR 1 CONTROL) MA7 RESPONSE SUMMARY

<b>MA7: Did you feel that the information provided on the web portal was helpful?</b>		
<b>Response</b>	<b>Total</b>	<b>Percent</b>
Very helpful	4	22.22%
Somewhat helpful	13	72.22%
Not at all helpful	0	0.00%
Blank	1	5.56%
<b>Total Responses</b>	<b>18</b>	<b>100.00%</b>

Only a small number (17%) of Control Group participants used the Web Portal at least once. Unlike the results from the Treatment Group, these results show a positive response. 61% thought that the interface was well laid out and easy to navigate and the rest of the respondents either did not answer or thought it was “somewhat” helpful. 22% found the information very helpful, while 72% found it somewhat helpful. None of the respondents thought that it was not at all helpful. These results show that additional marketing of the web portal will be necessary as these customers become CPP customers. These results could be interpreted to show that the basic features of the web portal, those that would be accessed by a Control Group customer are helpful and easy to navigate, but the more customer-specific sections that would be accessed by CPP customers are not as user-friendly.

## YEAR 2 TECHNOLOGY

### TREATMENT GROUP

The Tables shown below provide a breakdown of the responses to questions MA17, MA19, MA20, and MA21 on the Treatment Group survey regarding current water heater and central AC use as well as energy conservation technology available for Treatment Group customers in year 2 of the program.

TABLE-G23: POST PILOT SURVEY (YEAR 1 TREATMENT) MA17 RESPONSE SUMMARY

<b>MA17: Does your home have either an electric water heater, central air conditioning, or both?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Central Air only	35	22.15%
Electric Water Heater only	22	13.92%
Both	19	12.03%
Neither	82	51.90%
<b>Total Responses</b>	<b>158</b>	<b>100.00%</b>

TABLE G-24: POST PILOT SURVEY (YEAR 1 TREATMENT) MA19 RESPONSE SUMMARY

<b>MA19: How interested would you be in receiving equipment next summer that would help you conserve energy during CPP Event Days?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Very Interested	61	69.32%
Somewhat Interested	24	27.27%
Not at all Interested	3	3.41%
<b>Total Responses</b>	<b>88</b>	<b>100.00%</b>

TABLE G-25: POST PILOT SURVEY (YEAR 1 TREATMENT) MA20 RESPONSE SUMMARY

<b>MA20: Would you be more or less interested in receiving the technology if it were automatically controlled by Marblehead Light on CPP Event Days?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
More Interested	24	27.27%
Neutral	41	46.59%
Less Interested	23	26.14%
<b>Total Responses</b>	<b>88</b>	<b>100.00%</b>

TABLE G-26: POST PILOT SURVEY (YEAR 1 TREATMENT) MA21 RESPONSE SUMMARY

<b>MA21: Would you be more or less interested in receiving the technology if it were configured to respond automatically to the price of energy, and YOU had the ability to determine how you want the equipment to respond?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
More Interested	65	74.71%
Neutral	20	22.99%
Less Interested	2	2.30%
<b>Total Responses</b>	<b>87</b>	<b>100.00%</b>

TABLE G-27: CROSTAB MATRIX FOR POST PILOT SURVEY (YEAR 1 TREATMENT) MA20 AND MA21

		<b>MA21: Automatically Respond to Price Settings</b>		
		<b>Less Interested</b>	<b>More Interested</b>	<b>Neutral</b>
<b>MA20: MMLD Controlled</b>	<b>Less Interested</b>	2	18	2
	<b>More Interested</b>		19	5



Neutral		28	13
---------	--	----	----

TABLE G-28: CROSSTAB MATRIX FOR POST PILOT SURVEY (YEAR 1 TREATMENT) MA20 AND MA21

		MA21: Automatically Respond to Price Settings		
		Less Interested	More Interested	Neutral
MA20: MMLD Controlled	Less Interested	2.30%	20.69%	2.30%
	More Interested		21.84%	5.75%
	Neutral		32.18%	14.94%

48.1% of the Treatment Group respondents have central air conditioning, electric hot water, or both. None of the Target Group respondents reported that they have participated in the existing Water Heater Control Program. In their responses to MA20, participants demonstrated hesitation for utility controlled technology. Those who are hesitant about utility controlled technology seem more accepting of user-automated demand reduction technology. 70% of Treatment Group respondents were very interested in receiving enabling technologies, with 27.27% somewhat interested, showing that the implementation of technology will likely be well-received among this group.

#### CONTROL GROUP

The Tables below provide a breakdown of the responses to questions MA9, MA11, MA12, and MA13 on the Control Group survey regarding current water heater and central AC use as well as energy conservation technology available for Control Group customers when they become CPP customers in year 2 of the program.

TABLEG-29: POST PILOT SURVEY (YEAR 1 CONTROL) MA9 RESPONSE SUMMARY

MA9: Does your home have either an electric water heater, central air conditioning, or both?		
Response	Frequency	Percent
Central Air only	21	19.81%
Electric Water Heater only	13	12.26%
Both	12	11.32%
Neither	60	56.60%
<b>Total Responses</b>	<b>106</b>	<b>100.00%</b>

TABLE G-30: POST PILOT SURVEY (YEAR 1 CONTROL) MA11 RESPONSE SUMMARY

<b>MA11: How interested would you be in receiving equipment next summer that would help you conserve energy during CPP Event Days?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
Very Interested	48	70.59%
Somewhat Interested	17	25.00%
Not at all Interested	3	4.41%
<b>Total Responses</b>	<b>68</b>	<b>100.00%</b>

TABLE G-31: POST PILOT SURVEY (YEAR 1 CONTROL) MA12 RESPONSE SUMMARY

<b>MA12: Would you be more or less interested in receiving the technology if it were automatically controlled by Marblehead Light on CPP Event Days?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
More Interested	26	38.81%
Neutral	32	47.76%
Less Interested	9	13.43%
<b>Total Responses</b>	<b>67</b>	<b>100.00%</b>

TABLE G-32: POST PILOT SURVEY (YEAR 1 CONTROL) MA13 RESPONSE SUMMARY

<b>MA13: Would you be more or less interested in receiving the technology if it were configured to respond automatically to the price of energy, and YOU had the ability to determine how you want the equipment to respond?</b>		
<b>Response</b>	<b>Frequency</b>	<b>Percent</b>
More Interested	49	56.32%
Neutral	16	18.39%
Less Interested	3	3.45%
<b>Total Responses</b>	<b>68</b>	<b>78.16%</b>