a PPL company

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Kentucky Public Service Commission
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RECEIVED
APR 01 2011
PUBLIC SERVICE COMMISSION

April 1, 2011

RE: ***Application of Louisville Gas and Electric Company for an Order Approving a Responsive Pricing and Smart Metering Pilot Program***
Case No. 2007-00117

Dear Mr. DeRouen:

Enclosed please find Louisville Gas and Electric Company's 2010 Responsive Pricing and Smart Meter Pilot Program Annual Report pursuant to the Commission's Order dated July 12, 2007 in the above mentioned proceeding.

Should you have any questions concerning the enclosed, please contact me at your convenience.

Sincerely,

Rick E. Lovekamp

Rick E. Lovekamp

cc: Parties of Record

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

RECEIVED

APR 01 2011

PUBLIC SERVICE COMMISSION

In the Matter of:

APPLICATION OF LOUISVILLE GAS AND	**)**
ELECTRIC COMPANY FOR AN ORDER	**)**
APPROVING A RESPONSIVE PRICING	**) CASE NO. 2007-00117**
AND SMART METERING PILOT	**)**
PROGRAM	**)**

Responsive Pricing and Smart Metering Pilot Program Annual Report for Louisville Gas and Electric Company

April 1, 2011

Pilot Overview

On March 21, 2007, Louisville Gas and Electric Company ("LG&E") filed an application with the Kentucky Public Service Commission ("Commission") in Case No. 2007-00117 requesting Commission approval to develop a responsive pricing and smart metering pilot program ("Pilot"). In its application, LG&E stated its hypothesis that "a responsive pricing rate structure consisting of time-of-use and real-time, critical peak pricing components in conjunction with a Demand-Side Management ("DSM") program will likely maximize demand response for residential and commercial customers in a cost-effective manner."[1] To test its hypothesis, LG&E planned to use time-of-use rates and "smart" devices with secure communications to send pricing signals to a test group of customers, allowing them to choose to save money and decrease system demand by shifting their electricity usage away from peak generation system demand periods. The smart devices would also provide information regarding real-time and historical energy usage.

The Pilot was designed so that the Residential Responsive Pricing Service ("RRP") and General Responsive Pricing Service ("GRP") rate structures would be revenue-neutral for the Company. This means that a participating customer with a typical load profile would not experience a change in electricity costs if their usage pattern did not change. However, a customer's electric bill would decrease if usage shifted from higher-cost peak periods to lower-cost off-peak periods. Likewise, a customer's electric bill would increase if usage shifted from lower-cost off-peak periods to higher-cost peak periods.

By Order dated July 12, 2007, the Commission approved the Pilot for an initial term of three years that would serve up to two thousand customers. The Pilot was designed to include up to one hundred customers under Rate RS (residential) and up to fifty customers under Rate GS (commercial) to be enrolled on time-of-use rate structures. To determine if cost savings could be realized by some customers not on the time-of-use rates by using a combination of smart devices, the approved Pilot allowed for up to four hundred customers to be given a combination of such devices to provide the participating customers certain usage information, allowing the customers to change usage to produce cost savings, if desired.

LG&E filed a motion on September 15, 2008 to amend the July 12, 2007 Order to add up to an additional fifteen customers to the RRP rate structure. The additional customers were to be employees of General Electric Company ("GE") located on the same routes as the other Pilot customers. The request was made to cooperate with GE's effort to promote and test DSM-ready appliances in the employees' homes. The smart equipment provided by LG&E to the GE employees was to be identical to the other customers participating in the Pilot. The Commission's Order dated October 7, 2008 granted authority to include the additional GE employees.

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[1] *In the Matter of: Application of Louisville Gas and Electric Company for an Order Approving a Responsive Pricing and Smart Metering Pilot Program*, Case No. 2007-00117, Application at 4 (Mar. 21, 2007).

In compliance with Kentucky Public Service Commission Order in Case No. 2007-00117, LG&E filed 2008 and 2009 interim reports evaluating the Pilot on an annual basis. This interim report represents the third annual update on the Pilot evaluation.

Responsive Pricing Overview

Pursuant to the Commission's July 12, 2007 Order in this proceeding, LG&E filed with the Commission a tariff sheet establishing Residential and General Service Responsive Pricing which incorporated a time-of-use rate with critical peak pricing ("CPP"). This Responsive Pricing Tariff became effective in January 2008. Responsive Pricing was offered to customers on the six selected routes who had lived at their residences for at least twelve months. Responsive Pricing participation is voluntary and features four pricing periods (low, medium, high, and CPP) as opposed to a standard residential customer's flat rate (Rate Schedule RS). Low and medium pricing periods have rates lower than the standard residential rate and make up approximately 87% of the hours in a year. CPP events can occur during hours of high generation system demand for up to eighty hours per year, implemented at LG&E's discretion. Customers receive at least 30 minutes notice prior to CPP events, which has a rate of approximately five times that of the standard flat residential rate. The rate structure and pricing changes depending on the time of year and is detailed below.

June through September		
Time	**Weekdays**	**Weekends**
Midnight to 10 a.m.	Low	Low
10 a.m. to 1 p.m.	Medium	Low
1 p.m. to 6 p.m.	High	Medium
6 p.m. to 9 p.m.	Medium	Low
9 p.m. to Midnight	Low	Low

October through May		
Time	**Weekdays**	**Weekends**
Midnight to 8 a.m.	Low	Low
8 a.m. to 6 p.m.	Medium	Low
6 p.m. to 10 p.m.	High	Medium
10 p.m. to Midnight	Low	Low

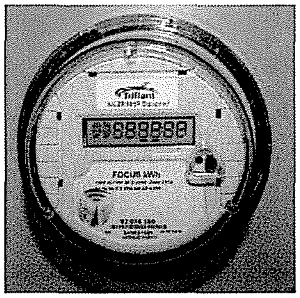
Residential ($/kWh)				
Month/Year	*Low*	*Medium*	*High*	*Critical*
Jan-08	0.0493	0.0615	0.1149	0.3069
Feb-08	0.0494	0.0615	0.1147	0.3059
Mar-08	0.0427	0.0546	0.1070	0.2954
Apr-08	0.0452	0.0571	0.1099	0.2997
May-08	0.0463	0.0582	0.1108	0.2998
Jun-08	0.0466	0.0587	0.1119	0.3029
Jul-08	0.0470	0.0591	0.1123	0.3033
Aug-08	0.0495	0.0617	0.1156	0.3094
Sep-08	0.0493	0.0615	0.1150	0.3076
Oct-08	0.0509	0.0631	0.1167	0.3095
Nov-08	0.0501	0.0623	0.1160	0.3092
Dec-08	0.0461	0.0583	0.1120	0.3052
Jan-09	0.0480	0.0602	0.1139	0.3069
Feb-09	0.0508	0.0632	0.1178	0.3137
Mar-09	0.0519	0.0643	0.1189	0.3150
Apr-09	0.0510	0.0636	0.1191	0.3183
May-09	0.0504	0.0629	0.1180	0.3160
Jun-09	0.0497	0.0622	0.1176	0.3165
Jul-09	0.0504	0.0629	0.1180	0.3160
Aug-09	0.0500	0.0625	0.1172	0.3140
Sep-09	0.0467	0.0591	0.1135	0.3091
Oct-09	0.0475	0.0599	0.1147	0.3114
Nov-09	0.0477	0.0602	0.1152	0.3129
Dec-09	0.0462	0.0587	0.1136	0.3107
Jan-10	0.0487	0.0613	0.1166	0.3150
Feb-10	0.0507	0.0634	0.1191	0.3193
Mar-10	0.0514	0.0640	0.1194	0.3184
Apr-10	0.0500	0.0623	0.1163	0.3102
May-10	0.0520	0.0645	0.1192	0.3158
Jun-10	0.0529	0.0656	0.1215	0.3222
Jul-10	0.0528	0.0653	0.1203	0.3181
Aug-10	0.0540	0.0670	0.1240	0.3287
Sep-10	0.0528	0.0656	0.1223	0.3260
Oct-10	0.0527	0.0653	0.1209	0.3207
Nov-10	0.0536	0.0665	0.1236	0.3285
Dec-10	0.0543	0.0673	0.1243	0.3293
Jan-11	0.0552	0.0682	0.1254	0.3307
Feb-11	0.0553	0.0685	0.1262	0.3338
Mar-11	0.0533	0.0664	0.1241	0.3312

Commercial ($/kWh)				
Month/Year	*Low*	*Medium*	*High*	*Critical*
Jan-08	0.0530	0.0677	0.1410	0.3064
Feb-08	0.0528	0.0674	0.1405	0.3053
Mar-08	0.0460	0.0604	0.1324	0.2948
Apr-08	0.0485	0.0630	0.1355	0.2990
May-08	0.0492	0.0637	0.1359	0.2987
Jun-08	0.0496	0.0642	0.1372	0.3019
Jul-08	0.0500	0.0646	0.1376	0.3023
Aug-08	0.0525	0.0673	0.1413	0.3083
Sep-08	0.0523	0.0670	0.1406	0.3066
Oct-08	0.0539	0.0687	0.1423	0.3084
Nov-08	0.0531	0.0679	0.1417	0.3082
Dec-08	0.0491	0.0639	0.1377	0.3041
Jan-09	0.0510	0.0658	0.1395	0.3059
Feb-09	0.0552	0.0702	0.1451	0.3123
Mar-09	0.0563	0.0713	0.1462	0.3136
Apr-09	0.0553	0.0705	0.1467	0.3167
May-09	0.0546	0.0698	0.1454	0.3144
Jun-09	0.0539	0.0691	0.1452	0.3149
Jul-09	0.0547	0.0698	0.1455	0.3144
Aug-09	0.0542	0.0693	0.1445	0.3124
Sep-09	0.0509	0.0659	0.1406	0.3075
Oct-09	0.0517	0.0668	0.1420	0.3099
Nov-09	0.0519	0.0671	0.1426	0.3113
Dec-09	0.0504	0.0655	0.1409	0.3092
Jan-10	0.0526	0.0678	0.1436	0.3130
Feb-10	0.0558	0.0711	0.1476	0.3185
Mar-10	0.0565	0.0717	0.1478	0.3176
Apr-10	0.0544	0.0693	0.1434	0.3089
May-10	0.0565	0.0715	0.1467	0.3145
Jun-10	0.0574	0.0728	0.1495	0.3208
Jul-10	0.0572	0.0724	0.1480	0.3168
Aug-10	0.0592	0.0750	0.1540	0.3302
Sep-10	0.0579	0.0736	0.1522	0.3276
Oct-10	0.0577	0.0731	0.1502	0.3223
Nov-10	0.0588	0.0746	0.1536	0.3301
Dec-10	0.0595	0.0753	0.1544	0.3309
Jan-11	0.0606	0.0765	0.1557	0.3325
Feb-11	0.0608	0.0768	0.1569	0.3356
Mar-11	0.0588	0.0748	0.1547	0.3331

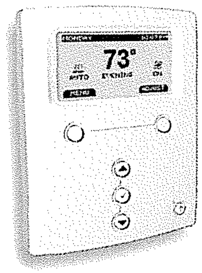
Smart Device Overview

The Pilot was designed to utilize four kinds of smart devices: smart meters; programmable thermostats; in-home energy usage displays; and load control switches. Customers participating in the Responsive Pricing group (including the GE group) receive all available devices listed above. The remaining Pilot customer groups receive a choice of up to three in-home devices in addition to the smart meter. The customer groups are further defined on page nine and ten of this report.

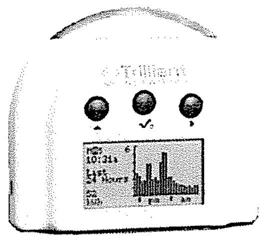
Smart Meter: This is a typical electric service meter equipped with an electronic card that communicates over the secure network. The meter utilizes two-way communication and provides LG&E with real-time usage data.



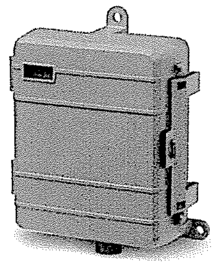
Programmable Smart Thermostat: The thermostat has a simple design with many features, including a display of the rate plan time of use costs ($/kWh). The thermostat has a programmable temperature offset that can automatically react by raising the thermostat setting during high pricing periods, but can be overridden by the customer if desired. LG&E has the ability to communicate and send text messages to the thermostat to inform the customer when a CPP event is in effect. Not only will the text message alert the customer of the CPP event taking place, but will also notify them of the duration of the event. These text messages will remain displayed on the thermostat screen until acknowledged by the customer. The customer can modify some thermostat settings from anywhere by accessing a website.



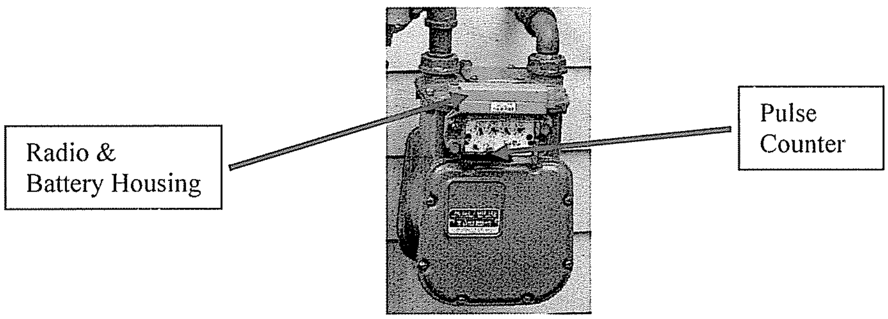
In-Home Display (IHD): The IHD is a table-top device that displays real-time energy usage and the current pricing tier. Also, the top of the IHD has a color wheel representing the pricing tier (e.g., red indicates high-priced periods). Twenty-four-hour and thirty-day historical energy usage and costs are displayable as well. The IHD can be set to update pricing monthly on a predetermined day (e.g., the seventh of every month) to coordinate closely with the customer's typical meter read date.



Load Control Switch: This switch, also known as a remote appliance controller ("RAC"), is placed on an electric water heater that can be programmed to shut off water heater operation during higher-priced periods. RACs can also be installed on pool pumps. Customers have the ability to override such switches if they so choose by accessing a website.



Natural Gas Meter Module: In addition to the above devices, a device that is an add-on module to existing natural gas meters has been incorporated into the smart network. The gas module can be placed into service without removal and re-installation of the existing meter's index, and contains sensors integrated into its cover that act as a pulse counter. The gas module has a battery life in excess of twenty years, and stores data locally. Usage data is reported twice daily over the secure network. Like smart meters, these devices provide usage information for billing purposes and eliminate the need to deploy a meter reader monthly to these locations.



Pilot Implementation

LG&E evaluated potential routes in 2007 and it was decided to incorporate six different routes in an effort to execute the Pilot in areas representative of the entire service territory. The routes were selected to include city and rural environments. Exhibit 1 shows a map of the service territory indicating general route locations. A summary of criteria used in selecting the routes is highlighted in the following table.

Criteria	Route 1	Route 2	Route 3	Route 4	Route 5	Route 6
Customer Density	High	High	High	Moderate	Moderate	Low
Foliage Density	Moderate	Moderate	Moderate	Low	Low	High
Terrain Dynamics	Low	Low	Moderate	Moderate	Moderate	High
Customer Variety	Low	Moderate	Moderate	High	High	Moderate
Property Size	Low	Low	Moderate	Moderate	Moderate	High

The "Customer Variety" criterion in the table above relates to energy usage, customer type (residential and commercial), and building size. The "Property Size" criterion relates to the acreage of the property.

LG&E contracted with Trilliant, Inc. ("Trilliant") to be the hardware provider for the Pilot. Trilliant was responsible for installing the communications network and provided communications cards for the smart meters, as well as the other smart devices discussed herein. LG&E contracted with GoodCents Solutions ("GoodCents") to install the smart devices. The smart meter communication network construction began in September 2007 and GoodCents began installing smart devices at customers' residences and businesses along the selected routes in November 2007.

On each route, GoodCents installed smart meters on homes and businesses. Communication modules were added to the natural gas meters for those customers who receive those services to allow full automated meter reading capabilities through the communication network. Each route also contains at least two data collectors, known as communication gates. These devices are used to accumulate all the metering data and serve as network coordinators. The data collected is sent to a server via internet protocol ("IP"). Multiple communication gates were installed in each route for redundancy. This allows the data to be continually reported through the network. LG&E and GoodCents installed additional signal-repeating equipment where there were long distances between meters and communication gates. This was especially prevalent in the rural route as the equipment relays messages to and from in-network devices and helps improve overall network performance.

All electric smart meters and the communication infrastructure were installed by the end of January 2008. Upon completion of the installations, a directed marketing effort ensued to attract customers to participate in the Pilot. The initial efforts targeted customers interested in the time-of-use rate. The goal was to have this group identified, equipment deployed, and customers educated prior to the summer of 2008. The original application suggested that the Pilot would be deployed within six months of approval. However, the challenges of smart metering being an emerging technology, being a new program to both LG&E and our customers, equipment availability and attracting participants ultimately delayed device deployment.

As a result of LG&E's marketing efforts and increased customer communications, 94 RS and 4 GS customers were participating in the Pilot by December 2009 (on the RRP and GRP rate schedules, respectively). However, by February of 2011 the numbers of residential customers (RS) declined to 78 (including the GE customers). In contrast, the number of GS customers grew to five.[2] Thus a total of sixteen customers requested to be removed from the Responsive Pricing program and provided the following reasons: three customers moved from the residence; one GE customer installed a new suite of home appliances; eleven customers reported very marginal savings, if any, and did not want to continue participating; and one customer installed a new HVAC system.

The sixth and final marketing and education effort directed toward developing the remaining customer groups in the Pilot was deployed in 2010 in the form of personalized direct mail campaign. This effort yielded an overall increase of the number of participants in the remaining Pilot customer groups by only 17 as compared to last year's results. Due to consistent low customer receptiveness to multiple marketing campaigns, LG&E found that developing additional marketing strategies to enroll the remaining participant groups was no longer appropriate and decided to cease further marketing efforts.

[2] It has been difficult to sign up GS customers, as many of these customers are concerned about the comfort of their own customers during high priced time-of-use periods.

Pilot Customer Group Goals

The Pilot incorporated several combinations of smart devices to determine whether customers would change their electric and gas usage if provided with various types of tools and energy cost information. Customers residing on the selected metering routes that did not volunteer for Responsive Pricing were eligible to receive one or more smart devices: up to one hundred fifty customers would receive programmable thermostats and IHDs; up to one hundred fifty customers would receive programmable thermostats and RACs; and up to an additional one hundred customers would receive only IHDs. The following tables summarize device installations for the Pilot.[3]

Pilot Device Goals

Pilot Goals	Smart Meters	Programmable Thermostat	In Home Display	Load Control Switch	Control Type
Responsive Rate Customer Group	150	150	150	150	Responsive Pricing Rate
GE Customer Group	15	15	15	15	Responsive Pricing Rate
Thermostat and Display Group	150	150	150		No Rate Control
Demand Conservation Group	150	150		150	No Rate Control
Display Only Group	100		100		No Rate Control
Control Group	1,450				No Rate Control
Total	2,015	465	415	315	

[3] Load control switch installations on water heaters are less than first anticipated due to LG&E's service territory heavy utilization of natural gas as an energy source.

2010 Pilot Device Actual[4]

2010 Pilot Participants	Smart Meters	Programmable Thermostat	In Home Display	Load Control Switch[3]	Control Type
Responsive Rate Customer Group	74	82	70	16	Responsive Pricing Rate
GE Customer Group	9	9	8	1	Responsive Pricing Rate
Thermostat and Display Group	85	90	85	0	No Rate Control
Demand Conservation Group	13	12	7	8	No Rate Control
Display Only Group	93	0	93	0	No Rate Control
Control Group	1,535				No Rate Control
Total[4]	1,809	193	263	25	

2010 Device Deployment by Route: # Customers per Category

2010 Route #	Meters			Responsive Pricing	GE Employees	Programmable Thermostat	In-Home Display	Load Control Switch
	Residential	Commercial	Gas					
Route 1	271	13	222	5	1	9	13	1
Route 2	90	43	101	0	0	5	6	0
Route 3	201	30	115	10	0	20	35	0
Route 4	367	6	343	16	4	57	69	0
Route 5	348	31	351	25	3	62	87	0
Route 6	399	10	0	18	1	40	53	24
Total	1,676	133	1,132	74	9	193	263	25

[4] Some customers have more than one type of device. For example, customers with two air conditioner units could have two thermostats and in-home display if desired.

2010 Residential Responsive Pricing Results and Analysis[5]

Operational

Approximately 99% of electric meters and 69% of gas modules report energy usage on a regular basis. Non-reporting meters continue to be generally related to foliage issues, location of meters, and occasional hardware malfunctions. More specifically, LG&E discovered that a noticeable number of gas modules were exhibiting unpredictable network performance and reporting energy usage intermittently. LG&E removed approximately 28% of gas modules in an effort to better understand device hardware malfunctions. In addition, LG&E continued to monitor performance of the remaining gas modules and began collecting visual meter reads to ensure acceptable operational performance and continuous customer service. LG&E has recognized that different variations of emerging technologies need to be evaluated on a periodic basis. Though this process may not be warranted within the scope of the Pilot, LG&E believes such evaluations are necessary to allow for the development of ongoing quality control and understanding of potential interoperability issues as new technologies and standards continue to develop.

Also, Route 6 has provided valuable insight into the operations of network infrastructure in rural areas. In particular, LG&E has learned that network performance can be improved through deployment of additional signal repeating equipment to overcome natural barriers such as foliage and the distance between the meters and communication gates. At the same time, LG&E recognizes that there are areas of identified routes where the costs associated with deploying additional network equipment may not be economically justifiable.

CPP Event Timing

[5] Though the Pilot includes residential and commercial customers, too few commercial customers have participated in the Pilot to allow for a separate analysis of their behavior.

During peak energy usage hours, a critical peak pricing (CPP) period was called on eight occasions during the summer of 2010. CPP events lasting 4 hours in duration occurred from 15:00 (3:00 p.m.) to 19:00 (7:00 p.m.) on June 17, June 18, June 22, June 23, June 25, and August 10. CPP events lasting 3 hours in duration occurred from 15:00 (3:00 p.m.) to 18:00 (6:00 p.m.) on July 15 and July 23. The warmest critical day had a high temperature of 100 degrees, much warmer than the average high temperatures for Louisville, which typically range between 95 and 96 degrees.

Summer CPP Event Log			
Year	**Date**	**Time (EST)**	**MAX Temperature (°F)**
2008	July 18	16:00 - 18.00	92
	July 21	16:00 - 18:00	89
	August 11	16:00 - 18:00	79
	August 12	16:00 - 18.00	81
	September 4	16:00 - 18:00	86
2009	June 2	15:00 - 19.00	89
	June 19	14:00 - 18.00	91
	June 24	14:00 - 18:00	91
	June 26	14:00 - 18.00	92
	July 28	14:00 - 18.00	82
	August 26	14:00 - 18:00	89
2010	June 17	15:00 - 19:00	90
	June 18	15:00 - 19.00	93
	June 22	15:00 - 19.00	93
	June 23	15:00 - 19.00	94
	June 25	15.00 - 19.00	91
	July 15	15:00 - 18:00	94
	July 23	15:00 - 18:00	95
	August 10	15:00 - 19.00	100

Weather

Louisville, Kentucky had an unusually warm summer in 2010 as measured by the total number of cooling degree-days recorded. The number of cooling degree days recorded for the summer of 2010 was approximately 2,000 days, which is significantly warmer than the previous five summers (summer of 2009 recorded 1,100 days, summer of 2008 recorded 1,600 days, summer of 2007 recorded 1,700 days, the summer of 2006 recorded at 1,300 and the summer of 2005 recorded 1,600 days). The warmest month recorded in 2010 was August.

Third-Party Evaluations

LG&E contracted with GoodCents Solutions to conduct the evaluation, measurement and verification (EM&V) analysis and determine the potential load reductions associated with the Responsive Pricing Pilot program. GoodCents evaluated hourly meter data for the summer cooling season of June through September 2010 with the primary goal of determining how customers responded to the Responsive Pricing time-of-use rates, focusing primarily on the critical peak pricing ("CPP") events. The analysis utilizes regression modeling and provides considerable detail about the Pilot's 2010 operations. GoodCents' fully detailed analysis report can be found in Exhibit 2.

GoodCents' analysis was based on the approximately 90 Responsive Pricing customers and the approximately 1,400 other residential customers and included energy usage for critical price days as well as non-critical price days. The number of customers evaluated by GoodCents is different than actual number of participants reported earlier in this report due to different time periods being discussed and customers' move-ins and move-outs.

The analysis of the summer 2010 time periods reflected that the maximum average load reduction was 0.98 kW and occurred at hour 15:00. Tables below display average load reductions over all CPP days for each customer group when compared to control group customers. Hour 18:00 and 19:00 reductions are negative due to bounce-back effect discussed later in the report.

Summer 2010 Average Load Reductions (kW)					
June and August Events - 4 Hours of CPP					
Group	**Hour**				
	15:00	**16:00**	**17:00**	**18:00**	**19:00**
Responsive Rate Group	0.96	0.89	0.57	0.57	-0.42
GE Group	1.83	1.59	1.04	1.25	-0.07
Thermostat & Display	0.79	0.44	0.14	0.13	-0.49
*Display Only	-	-	-	-	-
July Events - 3 Hours of CPP					
Group	**Hour**				
	15:00	**16:00**	**17:00**	**18:00**	**19:00**
Responsive Rate Group	0.98	0.91	0.55	-0.27	-0.24
GE Group	1.46	1.02	1.05	-0.14	-0.46
Thermostat & Display	0.91	0.58	0.22	-0.38	-0.62
*Display Only	-	-	-	-	-
*The Display Only group exhibited no load reductions during CPP in 2010					

EM&V results from GoodCents' analysis shows high-quality load reductions for demand response. Average load reductions resulting from critical pricing periods vary from 0.5 kW to 1.0 kW per hour. On June 25, 2010, the CPP events demonstrated that at 15:00 (3:00 p.m.), on a 91 degree day, LG&E can expect a load reduction of 1.1 kW per Responsive Pricing participant. Although data demonstrates that Responsive Pricing customers are curtailing their usage for the first few hours of the critical peak pricing period, they appear to have overridden their curtailment efforts during the last hour of the CPP events. The load reductions found resulting from critical peak pricing periods are higher than the load reductions found in previous EM&V studies of LG&E's Demand Conservation Load Management Program at the same operational temperatures and hour of control.

Demand Conservation vs. Responsive Pricing Load Reductions			
Hour	Demand Conservation (kW)*	Responsive Pricing (kW)	Difference (kW)
15:00	0.536	0.958	0.422
16:00	0.291	0.886	0.595
17:00	0.314	0.567	0.253
*2006 analysis load reduction for 88-93 degree days			

Each of the customer groups illustrated on page ten of this report, with the exception of the Display group, demonstrated load reduction during the CPP periods. However, the Display and the Thermostat and Display groups demonstrated largest load reductions on non-CPP event days.

The Thermostat and Display group's largest load reduction was 1.03 kW, which occurred on July 20 at hour 14. This load difference corresponds to 35% reduction in the Thermostat and Display group's load. Additionally, almost half of this group's energy usage occurs in the low tier of the rate schedule.

The Display group showed consistently no load reductions on the CPP days during the summer of 2010 with energy usage similar to that of control group during all hours of the day. Instead, the largest energy usage difference of 0.371 kW occurred at hour 17:00 and was observed on June 27 which was not a CPP day. Analysis of the average energy usage during each tier of the Responsive Pricing rate schedule for almost all Display group customers found that approximately half of the customer's energy usage occurs in the low tier of the rate schedule (52%). In comparison, 53.5% of the Control group's energy usage occurs in the low tier of the rate schedule.

Overall the Responsive Pricing load reductions were greatest in the first hour of the critical peak pricing period and then decreased throughout the evening. Customers are beginning to use the appliances or turning up the air conditioning before the critical peak pricing period is over during hours 18:00 and 19:00. The daily load shapes for the average Responsive Pricing customers changed and resulted in daily demand being shifted from high-priced hours to lower-priced hours. Based on a comparison of the average hourly energy usage between the Responsive Pricing group and Control group, load was found to shift from higher-priced weekday hours to the lower-priced off-peak and weekend time periods.

In contrast, the winter analysis reflects no CPP events during the months of October 2010 through February 2011 due to LG&E being a summer-peaking utility. Because a significant portion of LG&E's service territory uses natural gas for heating, smaller electric energy reductions would be expected during winter periods. Therefore, it is ideal to implement CPP during summer periods in summer peaking utilities.

The analysis of the Responsive Pricing Pilot's third and last summer of data demonstrates participating customers have continued to decrease their energy usage slightly in high- and critical-peak priced periods; however, Responsive Pricing customers used more energy overall throughout the summer periods compared to non-Responsive Pricing residential customers.

GE Employees

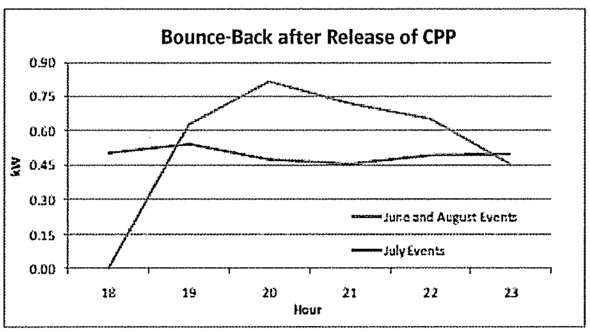
Smart device installation for the GE employees began the last week of October 2008 and was completed by mid-December 2008. Up to fifteen GE employees were approved by the Commission for inclusion into the Pilot as Responsive Pricing customers; however, currently only nine GE employees are participating on the Pilot. The GE Group showed the largest reductions during the CPP periods during the summer of 2010 with the maximum average load reduction of 1.83 kW recorded at hour 15:00. On average the GE group demonstrated load reductions of 0.85 kW more than the Responsive Rate group. The combination of smart appliances with the Responsive Pricing program allows the customers to reduce demand on the LG&E system.

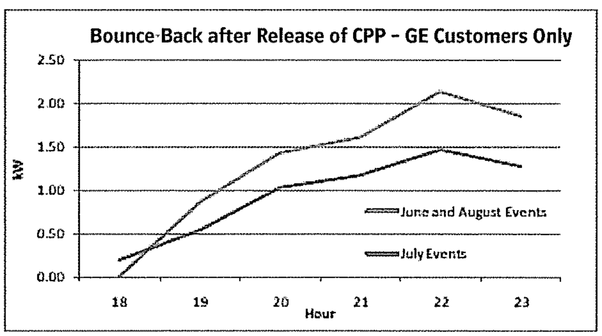
Bounce –Back Effect

When a load control or CPP period ends, it is imperative not to create a new system load peak. This phenomenon can occur when HVAC systems operate to lower or raise the temperature in the premise to a predetermined thermostat setting. This phenomenon is known as a snapback or bounce-back effect. Varying the total system load through added communications technologies between the utility and premise equipment may mitigate negative results related to bounce-back. However, further studies would be needed to validate the true overall impact.

Based on the bounce-back effect data captured in 2009, LG&E decided to evaluate whether CPP events should be called for a longer period that extends further into the evening hours (e.g., should the CPP event end at 7:00 p.m. instead of 6:00 p.m.) to determine whether the bounce-back effect might be impacted. Thus, 2010 CPP events were implemented in two different durations to help investigate the effect on the size and duration of the bounce-back period after the release of critical peak rate. All 2010 CPP events began at 15:00 (3:00 p.m.). June and August CPP events concluded at 19:00 (7:00 p.m.), while July CPP events concluded at 18:00 (6:00 p.m.). GoodCents analyzed the Responsive Pricing and the GE customers specifically for bounce-back effect after the end of the CPP control period.

As evidenced in 2009, the 2010 bounce-back for GE customers was more pronounced than for Responsive Pricing customers, as depicted in the graph below. This is believed to be attributed to all smart appliances coming back online instantaneously after the last hour of a CPP event. It should be noted that the appliances which GE customers used in the Pilot were first generation GE smart appliances. GE has indicated that the latest generation of smart appliances being developed incorporates methods designed to mitigate the bounce-back effect. The graph below shows the bounce-back after release of the critical rate for the Responsive Pricing customers and the bounce-back after release of the critical rate for GE customers, respectively.





The four-hour CPP events implemented in June and August exhibited a larger bounce-back than the three-hour CPP events implemented in July. Responsive Pricing customers demonstrated an average bounce-back of approximately 0.8 kW following a four-hour CPP event and 0.5 kW following a three-hour CPP event. Moreover, GE customers demonstrated an average bounce-back of 2.0 kW following a four-hour CPP event and 1.5 kW following a three-hour CPP event. In comparison, the Responsive Pricing customers and GE customers both demonstrated an average bounce-back of approximately 0.6 kW in 2009. Consequently, the effect of the eventual bounce-back may be directly correlated with the duration of the CPP period, regardless of the time the CPP event began. Understanding both the amount and timing of bounce-back is important in assessing its impact on total system peak demand.

Participant Usage and Costs

GoodCents compared the energy usage by price tier and then utilized the data to calculate a standard bill and Responsive Pricing Rate bill for the Responsive Pricing participants for the summer of 2010. For the billing cycles of June through September, the Responsive Pricing customers incurred an average total bill of $516.08. In comparison, the Responsive Pricing customers would have incurred an average total bill cost of $523.66 during the same billing cycles if billed on the traditional residential rate. GoodCents also determined that Responsive Pricing customers used more energy on the low and medium priced weekend rates than on the weekday rates compared to customers on the traditional rate structure.

Responsive Pricing customer usage data is detailed in the following table. Pilot participant 12-month historical usage (i.e., usage prior to beginning of Pilot) and Pilot usage are included. The data is displayed in kWh and $ for minimum, maximum, and average per participant. Minimum and maximum values are based on average monthly usage by participant for each specified time period. Costs are total customer electric billed costs. A customer's usage for each period can vary for many reasons and depends on when the customer enrolled in the program (i.e., electrical usage in cooling season will generally be higher than heating season because air conditioners use large amounts of electricity and many customers' heating units primarily use natural gas).

Responsive Rate Participant Usage and Cost		**Monthly Energy Usage (kWh)**			**Monthly Total Billed Cost ($)**		
		Minimum	Maximum	Average	Minimum	Maximum	Average
12 Months Prior to Pilot	2007	335	2,942	1,273	31	280	99
Pilot	2008	435	3,631	1,503	33	409	113
	2009	116	3,400	1,296	17	213	93
	2010	111	3,293	1,422	19	226	110

Program Costs

The program costs versus plan can be found in the following chart. The plan contained expenses starting in 2008; however, some expenses were incurred in 2007 related to Pilot planning. The Pilot actual spend through 2008 was $197,000 less than plan. The major variance to the planned budget through 2008 was due to delays in receiving equipment and continued definition of contractual milestones with the technology vendor. The over spend in the 2009 and 2010 budget was due to extensive customer market research; aggressive marketing campaigns; steady customer communications efforts; in-home equipment installations and network equipment service.

Program Expenses ($000)	**2007-2008**	**2009**	**2010**	**2011**	**Total**
Pilot Budget	$1,272	$260	$260	$125	$1,918
Pilot Actuals	$1,076	$526	$431	TBD	$2,033

Customer Communications

In response to customer feedback captured in 2009, LG&E took the opportunity to evaluate various methods of communication, interaction and feedback between the Responsive Pricing customers and the company. The main objective of this effort was to create a stronger sense of "community" and provide more direction to pilot participants with their energy consumption.

In March 2010, LG&E launched a web site specifically designed for Responsive Pricing participants. The availability of this web site was communicated with all Responsive Pricing participants through e-mail. The web site was designed to enable the customers to obtain information and guidance from LG&E to help customers optimize their energy consumption on an individual basis. LG&E posted regular articles on a monthly basis and encouraged customers to actively participate by commenting on the articles and sharing their experiences with LG&E's Responsive Pricing program. Articles covered variety of topics, including the Responsive Pricing bill layout; critical peak pricing preparedness; energy efficiency; and the transition between pricing schedules. Additionally, LG&E included reference guide documents to help customers re-familiarize themselves with in-home equipment when needed.

LG&E experienced a noticeably low level of interaction from the Responsive Pricing participants. For instance, LG&E captured the number of customer visits to the web site in an effort to track frequency of site traffic and customer awareness. For the months of March through August, the main "Home" page received 57 hits; the "About the Program" page received 19 hits; and the "Feedback" page received only 6 hits. Likewise, only 4% of the Responsive Pricing customers actively submitted comments using web site's feedback function, mainly to acknowledge the articles posted and provide general opinion.

Moreover, LG&E performed an analysis for each of the Responsive Pricing customers based on their individual energy usage behaviors over the summer of 2009 period comparing both their overall energy bill on the Responsive Pricing rate with the traditional RS rate and the timing of their energy usage to that of other customers participating in the pilot. The results of this analysis were used to generate personalized customer reports for each of the 92 participating Responsive Pricing customers. LG&E mailed the customer reports to the Responsive Pricing customers in May 2010. LG&E designed the reports to help Responsive Pricing customers better understand what measures to take in order to shift their usage from the High and Critical rate periods. In addition, the Responsive Pricing customers were advised to: (1) monitor the changes in rate periods using the in-home display; (2) use non-essential appliances, such as the dishwasher, clothes washer and dryer during off-peak times; (3) adjust thermostat and hot water settings to minimize usage during the High and Critical rate periods and (4) avoid use during the Critical rate period, whenever possible.

The customer reports established that an average Responsive Pricing customer experienced a 1.4% bill decrease for the summer 2009 billing period. Similarly, nearly 11% of the Responsive Pricing customers demonstrated more than 6% in bill savings. On the other hand, approximately 6.5% of the Responsive Pricing customers experienced a bill increase of 10% or more for the summer 2009 billing period. In addition, the customer reports established that 17% of the Responsive Pricing customers were almost bill neutral. Consequently, the number of the Responsive Pricing participants declined by approximately 11%. Customers, who decided to no longer participate, informed LG&E that the opportunity for energy cost savings was the main reason they had signed up.

Example of the customer report for an average Responsive Pricing customer can be found in Exhibit 3.

Conclusion

The Responsive Pricing Pilot implementation and operations to date have been successful. The equipment and communication technologies deployed continue to be fully operational and have achieved the purposes of the pilot. Nevertheless, LG&E has recognized the need to give strong consideration to up-and-coming technologies in metering and network communications, which could help overcome geography-specific barriers as well as help evaluate implementation risks associated with emerging technologies.

The findings to date indicate that load reductions can be achieved through implementation of time-of-use pricing and CPP events. Moreover, customers on the Responsive Pricing Tariff are receptive to pricing signals as evidenced by the shifts in their energy usage. In addition, customers are willing to receive information and communication to inform them on the impact of their existing behaviors and areas for improvement.

The temperatures during summer 2010 were significantly warmer than previous years and provided considerable data for evaluation. The results were positive and produced demand savings up to 1 kW per Pilot participant. Average bounce-back was greater on days when the critical peak pricing period was in effect for four hours than on the days when the critical peak pricing period was in place for three hours. The maximum average load increase after CPP is released amounts to 0.8 kW.

In response to customer feedback captured in 2009, LG&E launched a web site specifically designed for Responsive Pricing participants to help customers share their experiences and program feedback. In addition, LG&E provided all Responsive Pricing participants with a personalized customer report which included analysis on their individual energy usage behavior as well as tips on using energy more efficiently. The resulting impact of this customized approach initiated slightly more communication and interaction from Responsive Pricing customers. Nonetheless, customer reaction to aforementioned methods of communication continued to be unremarkable.

LG&E recognizes that ongoing customer engagement and behavior will require further understanding and evaluation to ensure active customer participation, participant education and retention. Also, LG&E plans to continue understanding and evaluating customer perspectives of new emerging technologies.

Exhibit 1

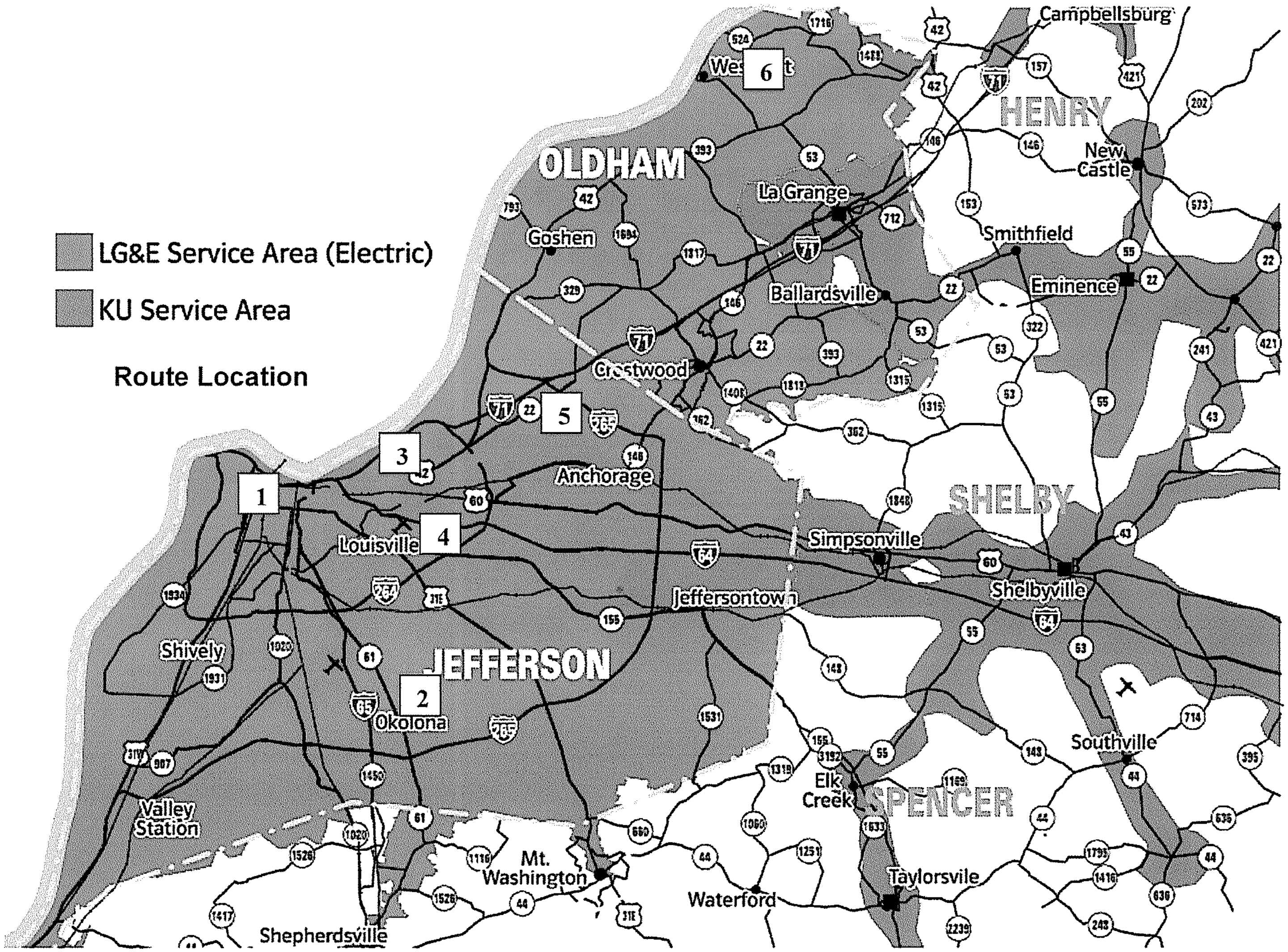

LG&E Service Area (Electric)
KU Service Area
Route Location
1
2
3
4
5
6
OLDHAM
HENRY
SHELBY
JEFFERSON
SPENCER
Campbellsburg
Westport
New Castle
La Grange
Goshen
Smithfield
Ballardsville
Eminence
Crestwood
Anchorage
Louisville
Simpsonville
Shelbyville
Jeffersontown
Shively
Okolona
Southville
Elk Creek
Valley Station
Mt. Washington
Waterford
Taylorsvile
Shepherdsville

Exhibit 2

Demand Side Management Pilots

M&V CPP Report

A Report

To

LG&E

From

GoodCents

November 2010

400 Perimeter Center Terraces, NE | Suite 245 | Atlanta, GA 30346 | 800.653.3445 |

Executive Summary

Introduction

In 2008, LG&E started the Responsive Pricing (SmartRate) and Smart Meter pilot program, designed to provide residential customers a variable rate schedule for their energy usage during the summers of 2008, 2009 and 2010. During peak energy usage hours a critical peak pricing (CPP) rate was initiated on 8 occasions throughout the summer of 2010 for the SmartRate customers. The participating SmartRate customers were provided SmartStat and SmartView equipment, as well as professional energy management advice and the ability to pre-program their thermostats settings to respond to the various pricing rates. Most thermostats were programmed for a 2-degree increase at the beginning of the high price tier of the rate schedule (1:00 pm) and the thermostat was increased an additional degree if a CPP event was called.

LG&E divided customers into five main customer groups in order to determine the savings associated with the Responsive Pricing and Smart Meter pilot program: the SmartRate Group, the Information Only group, the Demand Conservation group, the Display Only group, and the Control group. The GE group was a subgroup of the SmartRate group. Each participant group was a self-selection convenience sample resulting from recruitment by LG&E staff from the smart meter pilot population. The smart meter allowed energy usage data to be collected on an hourly basis for the length of the pilot. GoodCents received energy usage data for approximately 90 SmartRate customers and approximately 1,400 residential customers beginning with the date that the smart meter equipment was installed.

GoodCents was contracted to conduct the measurement and verification (M&V) analysis and determine the potential load reductions associated with the SmartRate program. The following report explains in detail the analysis methodology, as well as the results.

Weather Analysis

The variation of weather and climate has a great impact on the SmartRate program's effectiveness and the resulting load reductions. The majority of customers participating in the SmartRate program live near the Louisville area. Louisville, Kentucky had an unusually warm summer in 2010 as measured by the total number of cooling degree days recorded. The Louisville area experienced 2,062 cooling degrees days (CDD) during the summer of 2010. The 30 year average for Louisville is 1,410 CDD from March to September. During the summer of 2009 there were 1,290 recorded CDD. The summer of 2010 was warmer than normal by 652 CDD, in addition to being warmer than the previous summer by 772 CDD.

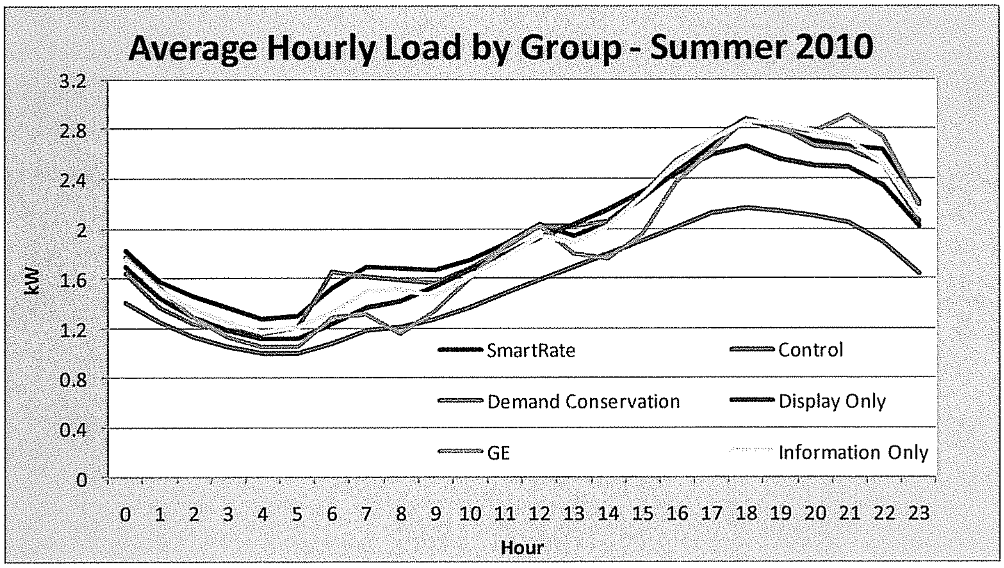
A critical period was called eight times during the summer of 2010 for SmartRate customers. The warmest critical day, August 10th, had a high temperature of 100 Degrees (F). This is warmer than expected high temperatures for Louisville, which typically range between 95 and 96 Degrees (F).

Load Impact Analysis

As mentioned in the introduction, customers with smart meters were divided into five groups and one subgroup. The table below shows each of the customer groups and subgroups, as well as the number of customers within each group and the program features.

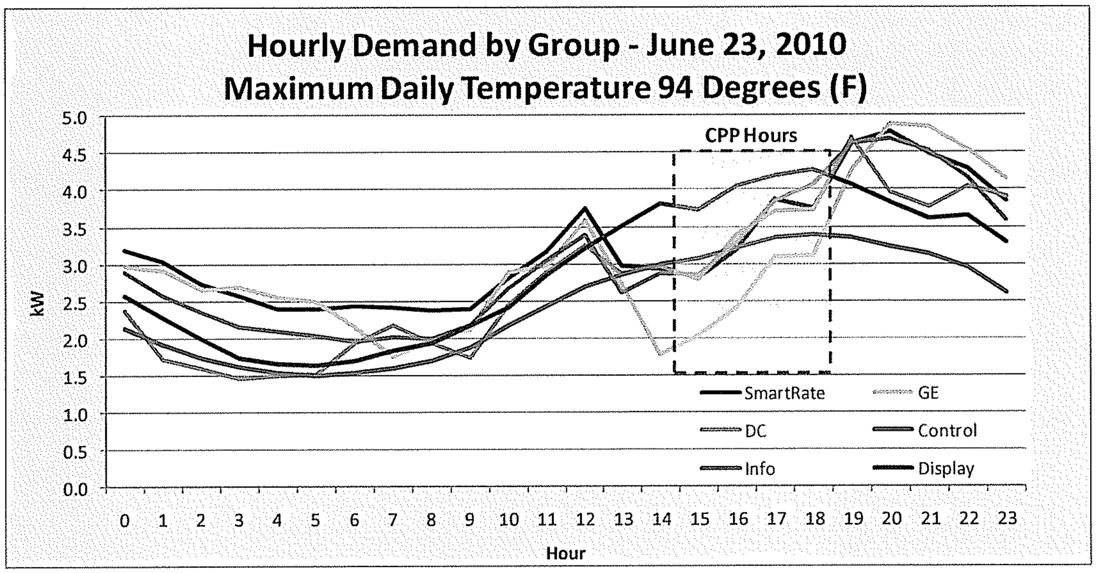
LG&E RRP Customer Groups - Summer 2010					
Customer Group	**SmartRate**	**Information Only**	**Demand Conservation**	**Display Only**	**Control Group**
Number of Customers	90	79	13	89	1409
Program Features	Thermostat, Display Device, Water Heater Control, and CPP Rate	Thermostat and Display Device	Thermostat and Water Heater Control	Display Device	
Sub Group	GE				
Number of Customers	10				
Program Features	Smart GE Appliances				

As the following graph demonstrates, the average load of the Control group was lower than the average load of each of the test groups during almost every hour of the summer of 2010. This makes identifying and quantifying load reductions problematic because the test group's overall consumption is so much higher.



It was decided that a subset of the Control group should be created whose monthly usage mirrored that of the test group. This will allow load reductions to be identified and quantified. There were 1,409 customers in the initial Control group. It was concluded that selecting a random subset of 500 customers with similar monthly energy usage would be large enough to keep the benefits of having a large sample size. A separate Control comparison group was selected each month for each experimental group. This Control comparison group is referred to as 'Residential Customers' in this report. A more detailed explanation of the sample selection methodology is included in Appendix A.

Once the data is compiled and Control comparison groups selected, GoodCents verifies each critical day using graphical methods by developing an average load shape for each day that the critical peak rate was initiated for all of the customer groups. The plot below shows the usage of all customer groups on the CPP day of June 23rd.



The GE SmartRate customers show the largest load reductions followed by the SmartRate customers.

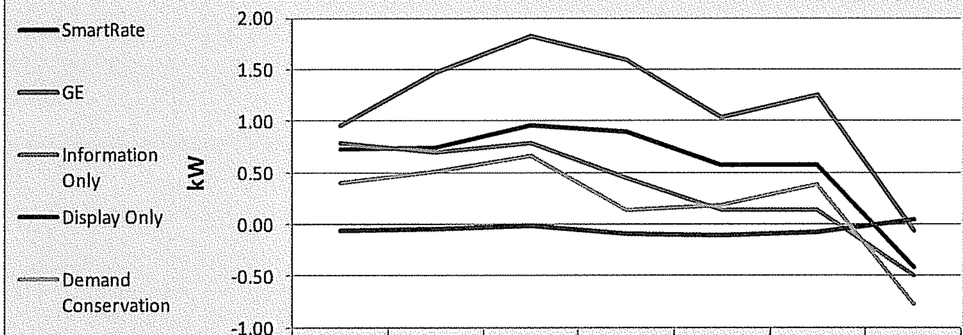
During the summer of 2010, critical peak pricing events were called on a total of eight days. The following table provides the dates and classification of the two types of events, along with the number of Cooling Degree Days.

Reference Table - Critical Peak Pricing Events				
Month	**Day**	**CDD**	**Start Time (EDT)**	**End Time (EDT)**
June	17	15	3:00 PM	7:00 PM
June	18	18	3:00 PM	7:00 PM
June	22	20	3:00 PM	7:00 PM
June	23	22	3:00 PM	7:00 PM
June	25	16	3:00 PM	7:00 PM
July	15	18	3:00 PM	6:00 PM
July	23	22	3:00 PM	6:00 PM
August	10	26	3:00 PM	7:00 PM

One CPP day, August 10th, had a maximum temperature of 100 Degrees (F). Surprisingly, load reductions on this day, were among the smallest of the eight CPP events. This suggests that there may be a point where customers begin to ignore the critical rate and use their air conditioning regardless of what it costs.

The average load reduction, or difference between the Control comparison group and each of the other customer groups, was calculated for each CPP day during the critical period. The average load reductions, or differences, for each hour and critical day are shown in the table below for each customer group. Hour 19 is negative and indicates bounce-back from the critical rate and will be discussed later in the report.

Load Reduction Comparison - June and August CPP Events

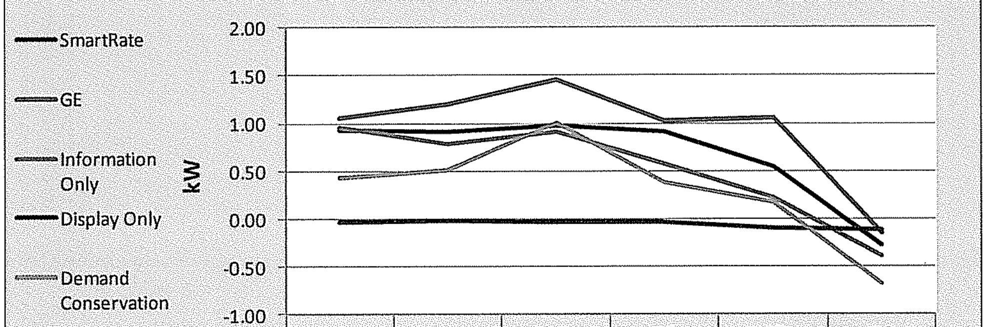


	13	14	15	16	17	18	19
SmartRate	0.72	0.74	0.96	0.89	0.57	0.57	-0.42
GE	0.95	1.46	1.83	1.59	1.04	1.25	-0.07
Information Only	0.79	0.70	0.79	0.44	0.14	0.13	-0.49
Display Only	-0.06	-0.05	-0.01	-0.09	-0.11	-0.08	0.05
Demand Conservation	0.40	0.51	0.66	0.13	0.18	0.38	-0.77

Hour

During the July CPP Events, the Critical rate ends at 6:00 pm; therefore, hour 18 is negative.

Load Reduction Comparison - July CPP Events



	13	14	15	16	17	18
SmartRate	0.93	0.91	0.98	0.91	0.55	-0.27
GE	1.06	1.20	1.46	1.02	1.05	-0.14
Information Only	0.96	0.79	0.91	0.58	0.22	-0.38
Display Only	-0.04	-0.01	-0.04	-0.03	-0.10	-0.11
Demand Conservation	0.44	0.52	1.01	0.38	0.18	-0.68

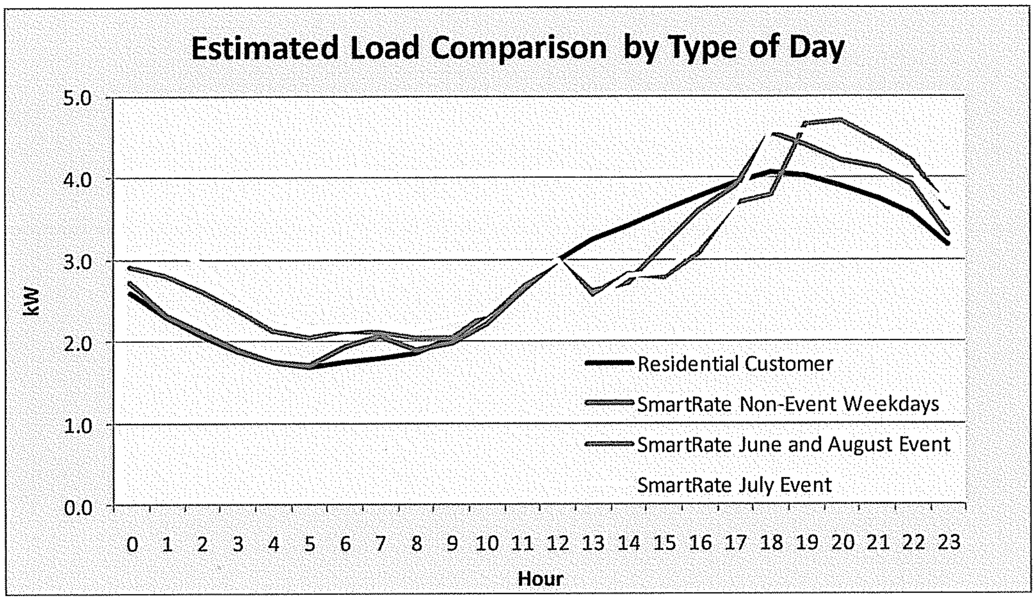
Hour

Overall, the GE group had the highest adjusted load reduction at 1.83 kW during hour 15 of the June and August events. For example, if air temperature were to remain constant at 92 Degrees (F) for the duration of a CPP event, an average GE group customer would be expected to use 7 fewer kilowatt hours than a comparable residential rate customer between 1:00 pm and 7:00 pm. The Regression model of GE customers using critical and high price tier days shows that the critical price accounts for 0.77 kW of this reduction. The high price tier in effect on non-critical days accounts for the remainder, or 1.06 kW.

Information Only and Demand Conservation customers show load reductions almost equal to the SmartRate group during early afternoon hours. The thermostats provided to these customers were pre-programmed to adjust up and down according to the SmartRate schedule. This is a considerable result because these customers have no financial incentive to modify their behavior.

Regression models were developed in order to determine the load reduction for the SmartRate group, including GE customers, on critical (CPP) days as compared to high price tier non-critical days. The highest average load reduction found on 2010 critical days was 0.98 kW, during hour 15 of the July events. The Regression model of SmartRate customers using critical and high price tier days shows that the critical price accounts for 0.52 kW of this reduction. The high price tier in effect on non-critical days accounts for the remainder, or 0.46 kW.

The following graph compares the SmartRate group's estimated load on a typical CPP day using regression coefficients determined during the modeling process.

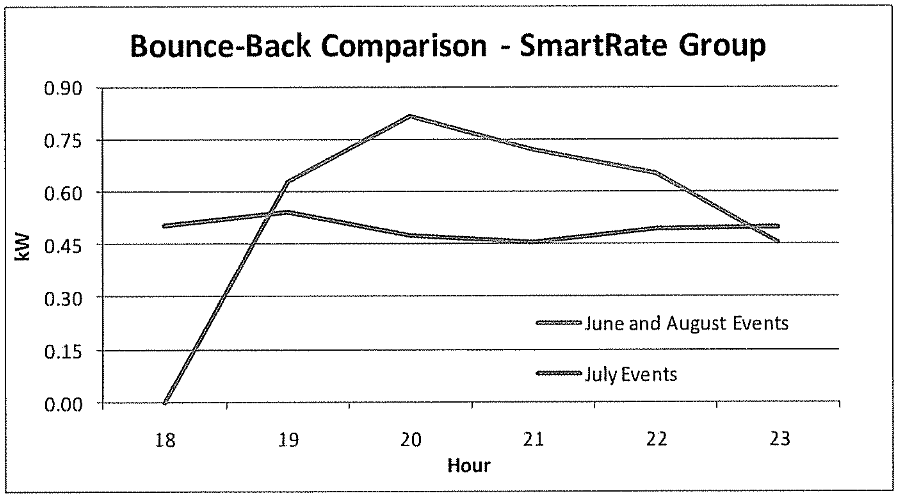


Bounce-Back after Release of Critical Rate

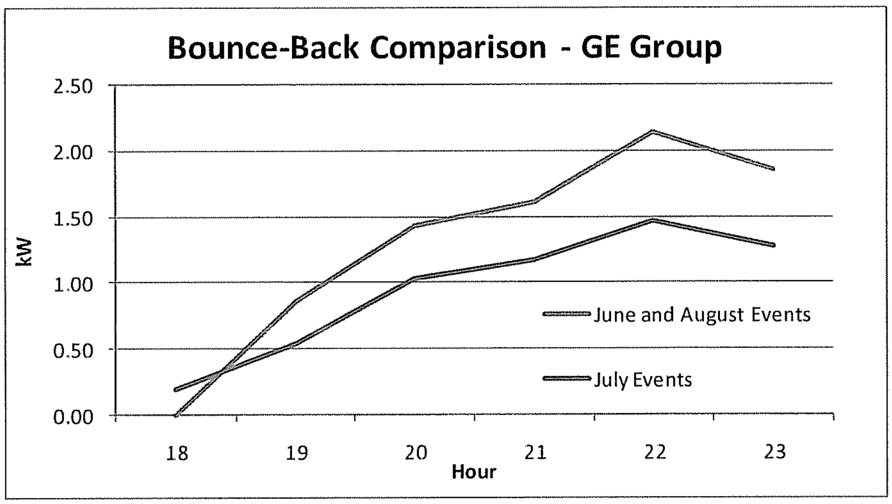
Any utility instituting load reduction programs for HVAC systems must be careful not to create a new peak when control or a critical rate is released. This phenomenon occurs because the HVAC systems will run to lower or raise the temperature in the home to pre-control thermostat settings and is known as the snapback or bounce-back effect. GoodCents analyzed the SmartRate and the GE customers specifically for this effect due to the large amount of control exhibited during the critical rate period.

CPP events of two different durations were called to investigate the effect on the size and duration of the bounce-back period. All 2010 events began at 3:00 pm EDT. The June and August events lasted until 7:00 pm, while the two July events concluded at 6:00 pm. On CPP event days, the SmartRate group is billed according to the 'High' pricing tier from 1:00 pm to 3:00 pm and the 'Critical' rate takes effect at 3:00 pm.

The graph below shows the bounce-back after release of the critical rate for the SmartRate customers. The SmartRate customers show the largest bounce-back in the second hour after the critical pricing for both the 3 hour and 4 hour events.



The following graph examines the bounce-back period for the GE group.



The bounce-back for GE customers is more pronounced than SmartRate customers and the high bounce-back period lasts for the rest of the day, peaking at hour 22. The 4 hour CPP events called in June and August show a larger bounce-back than the 3 hour events called in July.

The load increase after CPP is released is substantial and should be taken into account by system planning if the SmartRate program is offered to significant numbers of customers. The size of the eventual bounce-back appears to be directly correlated with the duration of the CPP period.

Billed Energy Comparison for SmartRate Customers

GoodCents was supplied SmartRate (including GE customers) customers' summer billed energy usage before the rate was implemented in 2007. From this information, a comparison of summer behavior before and after the SmartRate implementation was developed. All of the energy use in a home is not weather dependent; therefore, a baseline load of 29 kWh per day was subtracted from each month's mean energy use to calculate an average weather dependent load for each month. The summers of 2007 and 2010 were considerably warmer than the summer of 2009; therefore, the data is weather normalized.

The following chart shows the monthly comparisons for 2007, 2009 and 2010.

LG&E SmartRate Billing Comparison Before and After Rate Implementation

Month	Year	Number of Customers	Mean Monthly Billed Energy	Baseline kWh	Weather Dependent kWh	CDD	Weather Dependent Energy per CDD
June	2007	98	1503	870	633	376	1.684
June	2009	97	1296	870	426	338	1.260
June	2010	90	1879	870	1009	492	2.051
July	2007	98	1657	899	758	396	1.914
July	2009	97	1565	899	666	271	2.458
July	2010	90	2022	899	1123	507	2.215
August	2007	98	1923	899	1024	629	1.628
August	2009	97	1395	899	496	325	1.526
August	2010	90	2007	899	1108	560	1.979
September	2007	98	1829	870	959	350	2.740
September	2009	97	1427	870	557	192	2.901
September	2010	90	1314	870	444	266	1.669
Total 2007		98	6912	3538	3374	1751	1.927
Total 2009		97	5683	3538	2145	1126	1.905
Total 2010		90	7222	3538	3684	1825	2.019

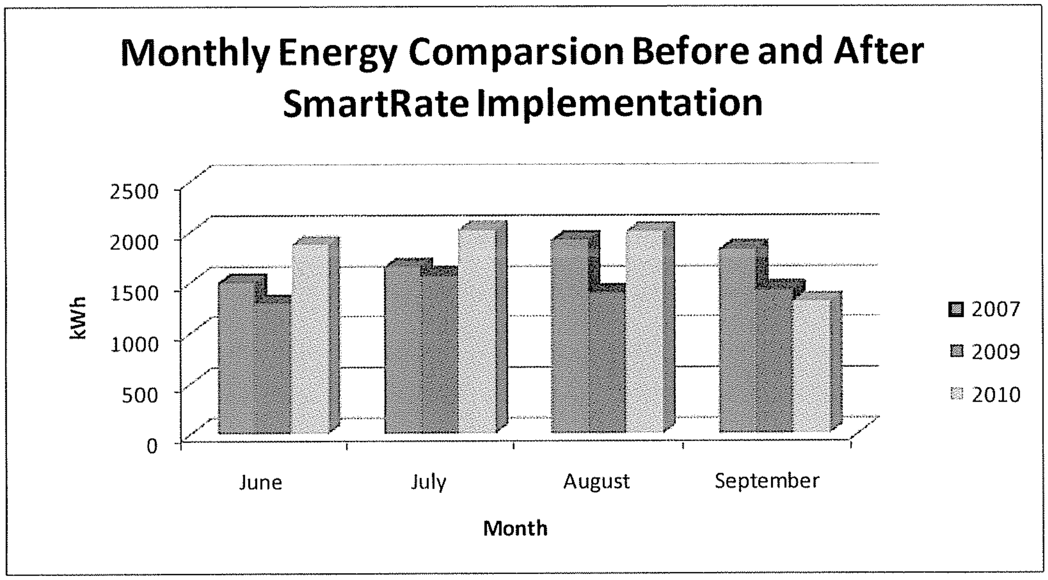
-2007 CDD values are from Louisville International Airport. 2009 and 2010 CDD values are from Bowman Field
-2008 billing data was omitted because not all SmartRate customers had been installed by June 2008
-Baseline level of 29 kWh per day is the average SmartRate daily use when the Number of Degree Days < 5

Based on the information presented in the table above, it does not appear that participation in the SmartRate program affects the amount of energy customers use per CDD. Each year SmartRate customers use a little over 2 kWh, above baseline, per CDD. The major impact of the SmartRate program is when customers use energy, not how much energy they use. The following table compares each year's weather dependent usage based on the 30 year average number of summer CDD in Louisville.

LG&E SmartRate Billing Data Comparison Before and After Rate Implementation Weather Normalized Summer Energy Comparison				
	Weather Dependent Energy per CDD	Normal CDD	Weather Normalized Energy in kWh	Difference from 2007
Summer 2007	1.927	1271	2449	-
Summer 2009	1.905	1271	2421	-28
Summer 2010	2.019	1271	2566	117

SmartRate customer behavior in 2009 indicates that they would use slightly less weather dependent energy than they would have in 2007. This was reversed in 2010. Based on these results, the effects of this program would be better described as load-shifting, rather than load-reducing. The main focus of this report is to examine the size and scale of these shifts.

In the graph below, the average monthly consumption of the SmartRate customers before program implementation, 2007, is compared to the average monthly consumption since implementation.



Conclusions and Recommendations

M&V results show consistent load reductions for the SmartRate program. Average hourly load reductions resulting from CPP implementation vary from 0.55 kW to 0.98 kW. The highest observed difference between the SmartRate group and its Control comparison group during the summer of 2010 occurred on June 25th. From 3:00 pm to 4:00 pm, when the temperature was 91 Degrees (F), LG&E saw an average load reduction of 1.10 kW per SmartRate participant.

GoodCents determined the average proportion of use under each price tier for each month and then used this information to calculate both a standard bill and SmartRate bill for an average SmartRate customer for the summer of 2010 (June - September). The SmartRate customer had a total summer bill of $516.09 on SmartRate pricing. The same customer would have been billed $523.65 on the normal Residential rate. GoodCents also determined that customers on the SmartRate program used 22.1% of their summer weekday energy during hours when the 'High' and 'Critical' rates were in place. Standard residential customers used 25.5% of their summer weekday energy during these hours. This is evidence of behavior modification due to the rate schedule.

The average load reduction, or difference between the Control comparison group and each of the other customer groups, was calculated for each CPP day during the critical period. The average load reductions, or differences, for each hour are shown in the table below for each customer group. Hours 15 through 18 show load reductions and hour 19 is negative, indicating bounce-back from the critical rate, for the June and August events. Both hours 18 and 19 are negative for the July CPP events because the duration of these two events was three hours.

Average Load Reductions for Summer 2010 Each Group as Compared to Control Group					
June and August Events - 4 Hours of CPP					
Group	Hour				
	15	16	17	18	19
SmartRate	0.96	0.89	0.57	0.57	-0.42
GE	1.83	1.59	1.04	1.25	-0.07
Information Only	0.79	0.44	0.14	0.13	-0.49
*Display Only	-	-	-	-	-
Demand Conservation	0.66	0.13	0.18	0.38	-0.77
Average Load Reductions for Summer 2010 Each Group as Compared to Control Group					
July Events - 3 Hours of CPP					
Group	Hour				
	15	16	17	18	19
SmartRate	0.98	0.91	0.55	-0.27	-0.24
GE	1.46	1.02	1.05	-0.14	-0.46
Information Only	0.91	0.58	0.22	-0.38	-0.62
*Display Only	-	-	-	-	-
Demand Conservation	1.01	0.38	0.18	-0.68	-0.53
*The Display Only group showed no load reductions during CPP in 2010					

GoodCents adjusted for the differences in daily use between each group and its Control comparison group to obtain the average load reductions for the two different types of CPP days in the table above. Each of the customer groups, other than the Display Only group, showed load reduction during the CPP periods. The GE Group showed the largest reductions during the CPP periods during the summer of 2010. The combination of smart appliances with the SmartRate allows the customer to significantly reduce demand on the LG&E system during peak hours.

The Information Only group's largest single-hour load reduction was 1.03 kW, which occurred on July 20th at hour 14. This demand response could be because customers in the Information Only group are responding to the visual signals they receive on their thermostat and programming it to increase by a few degrees at the onset of the 'High' pricing period, or because their thermostats are programmed for them upon installation. As shown in the table above, on days when CPP events were called, the Information Only group showed load reductions almost as large as the SmartRate group during the first hour of CPP (hour 15).

The Display Only group showed no load reductions on CPP days during the summer of 2010. GoodCents discovered June 27th had the largest load reduction of 0.371 kW occurring at hour 17. Analysis of the average energy usage during each tier of the SmartRate pricing schedule for the Display Only customers found that over half of the customer's energy usage occurs in the low tier of the rate schedule (52%).

Overall the SmartRate load reductions were greatest in the first hour of the critical peak pricing period across all CPP events and decreased throughout the evening. Much of the load reduction is because the customers' thermostats are programmed to increase their setting during the CPP period. This first hour shows the largest load reduction because the home is being allowed to warm up, reducing air conditioning demand. Once the temperature in the home has reached the new setting, the HVAC system still has to work to maintain that new setting. This explains why load reductions decrease as the CPP period goes on. After the CPP period, the thermostat is programmed to drop its temperature setting and the HVAC system has to work to achieve this new setting, creating the bounce-back effect.

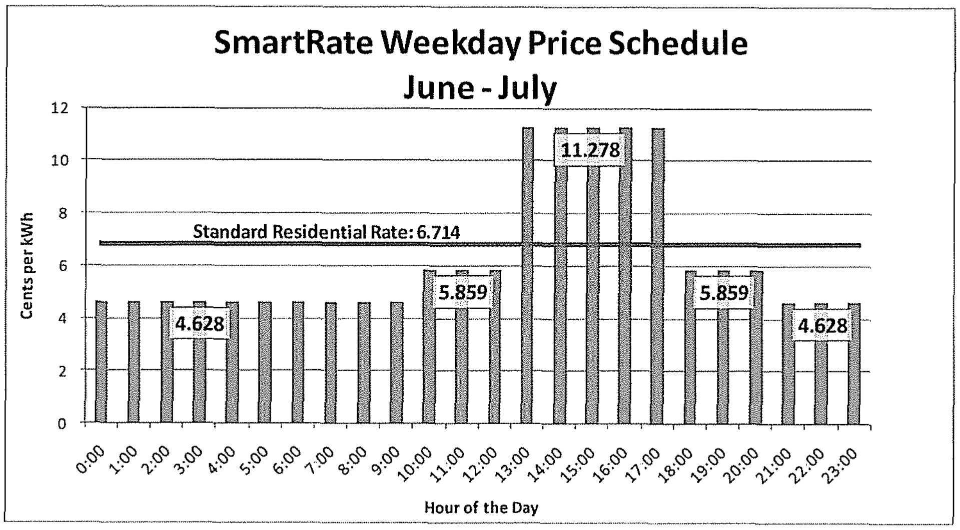
Introduction

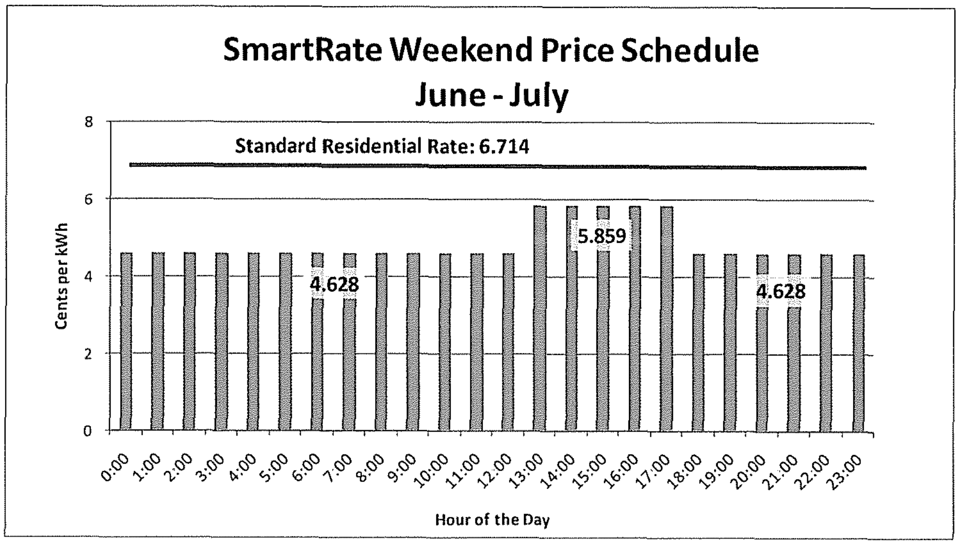
In 2008, LG&E began installing smart meters on 2,000 homes and businesses across various regions of their service territory. Those 2,000 customers with smart meters became eligible for a Responsive Pricing program, called SmartRate, designed to provide residential customers a variable rate schedule for their energy usage during the summers of 2008, 2009 and 2010. SmartRate energy costs were lower than the typical energy cost for most hours throughout the year. However, the costs for SmartRate are higher during peak energy usage hours. During peak energy usage hours a critical peak pricing (CPP) rate was initiated on 8 occasions. The participating SmartRate customers were provided SmartStat and SmartView equipment, as well as professional energy management advice and the ability to pre-program their thermostats settings to respond to the various pricing rates. Most thermostats were programmed for a 2-degree increase at the beginning of the high price tier of the rate (1:00 pm) and the thermostat was increased an additional degree if a CPP event was called.

There were five main customer groups in addition to one subgroup in the program. The first group is the SmartRate Group as discussed above. Within this group there were 10 customers with smart GE appliances which were labeled as the GE group. The second group is the Information Only group, which contained 79 customers. This group received a thermostat, display device, and no rate control. The third group is the Demand Conservation group, which contained 13 customers. This group of customers received a thermostat, water heater control, and no rate control. The fourth group is the Display Only group containing 89 customers who received a display device and no rate control. The last group is the Control group which is the remaining customers that have no special equipment or rate control. There are approximately 1,400 customers in this group.

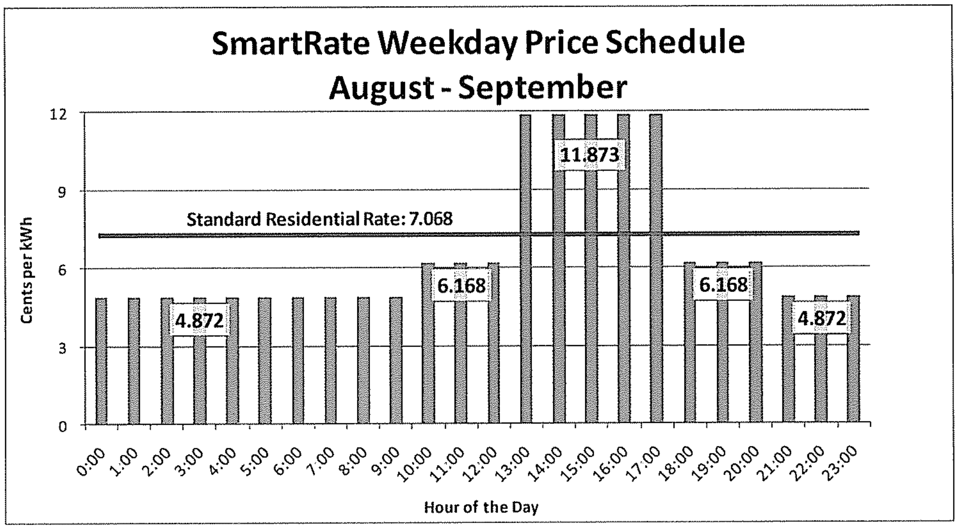
The SmartRate participant group was a self-selection convenience sample resulting from recruitment by LG&E staff from the smart meter population. The smart meter allowed energy usage data to be collected on an hourly basis for the entire length of the SmartRate pilot. GoodCents received energy usage data for ninety-four SmartRate customers and approximately 1,400 residential customers beginning with the date that the smart meter equipment was installed. Energy usage data including both critical priced days and non-critical priced days were available for all customers and were used in load impact analysis and model development for the SmartRate pilot. GoodCents will compare the SmartRate customers' usage to the residential customers on the Smart Meter pilot program throughout the summers of 2008, 2009 and 2010 on hot days and CPP days. We will use the SmartRate customers' load data on CPP days and non-CPP days to model the load reductions during the 'High' and 'Critical' price tiers of the SmartRate pricing schedule.

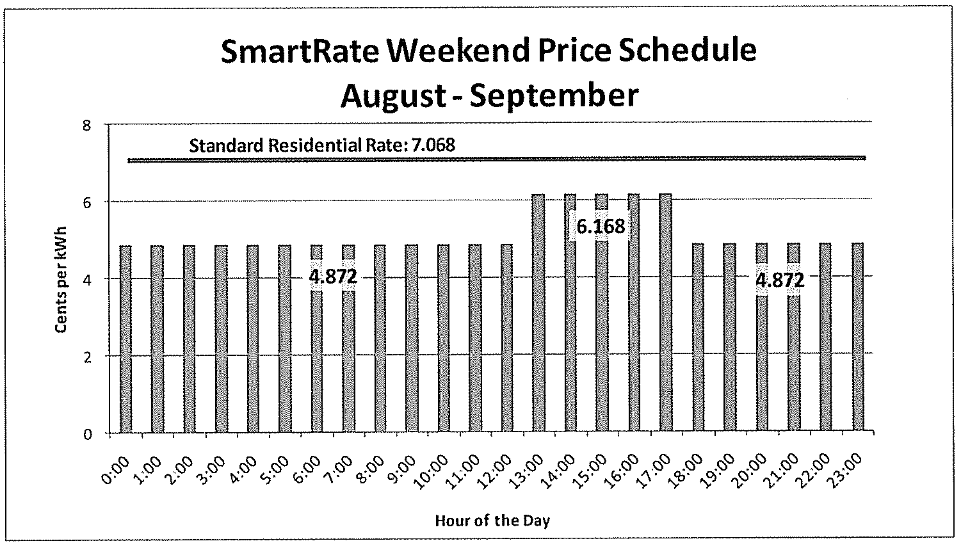
The following graphs outline the three tiered pricing structure during June and July of 2010. These rate schedules do not include the critical peak rate since the critical peak rate is only initiated during peak hours. The critical peak rate is 30.743¢ per kWh.





New rates took effect August 1, 2010. There were no changes to the hourly assignment of the pricing tiers, however customers were charged slightly more per kWh under each tier. The critical peak rate also increased from 30.743¢ to 32.364¢ per kWh. The following figures outline the hourly energy prices for SmartRate customers during August and September of 2010.



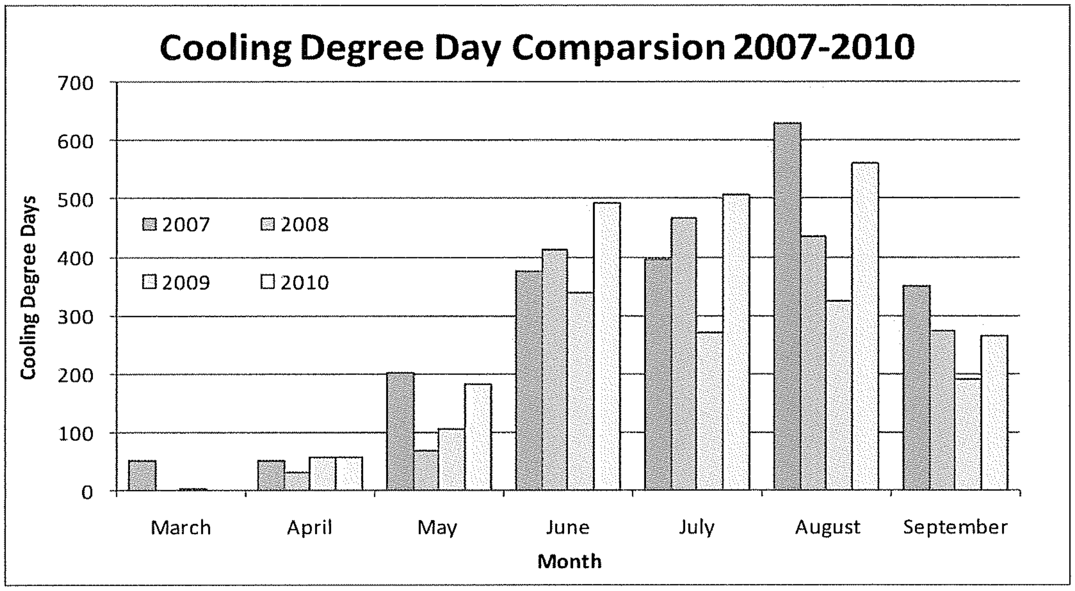


As the preceding graphs show, SmartRate customers pay less for energy than the standard residential rate during 148 of the 168 hours each week. This report finds that, during the summer of 2010, SmartRate customers used slightly more energy than a comparable group of standard residential customers. However, SmartRate customers showed significantly lower consumption during the hours when their rates were above the standard residential rate.

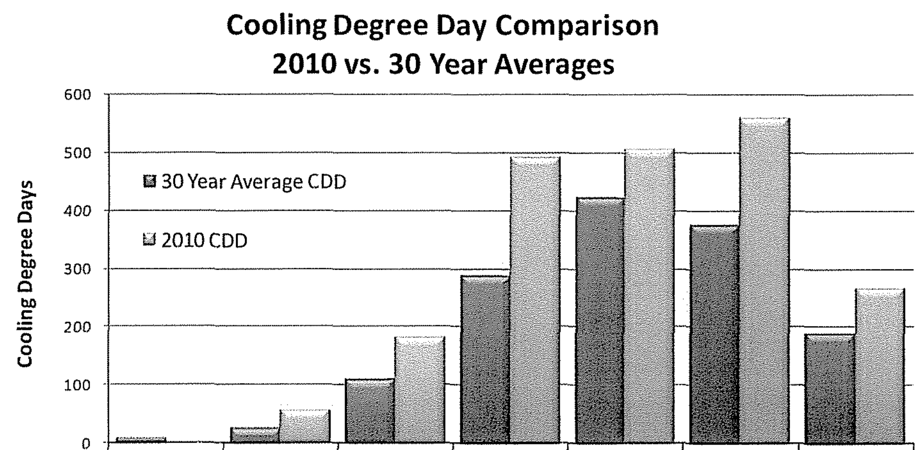
Weather Review

Summer 2010 Review

The summer of 2010 was considerably warmer than 2008 or 2009, making it the hottest summer since the inception of the SmartRate program. The graph below shows the number of cooling degree days (CDD) for the summers of 2007, 2008, 2009, and 2010 by month.



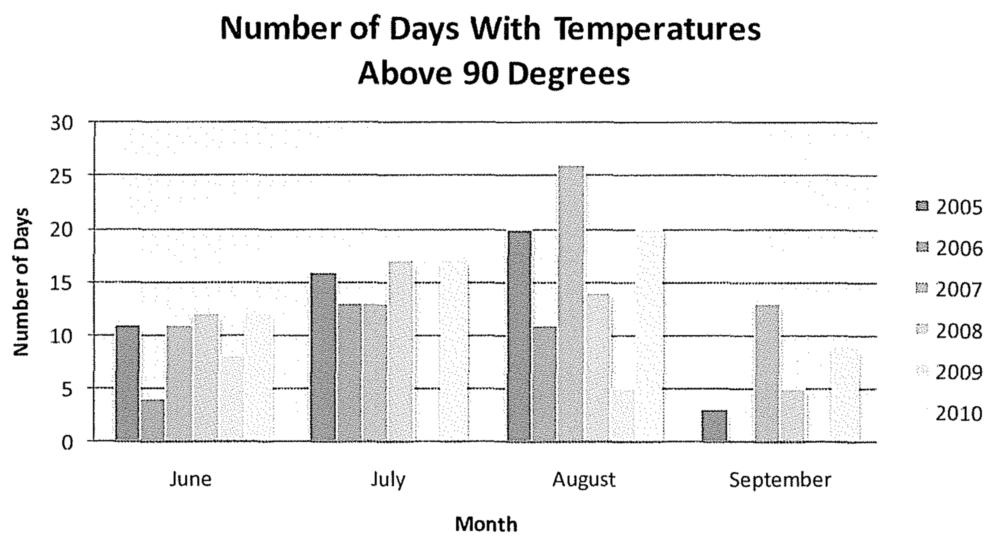
The following graph compares the summer of 2010 to the 30 year averages for the Louisville area. Each month, April through September, was warmer than average.



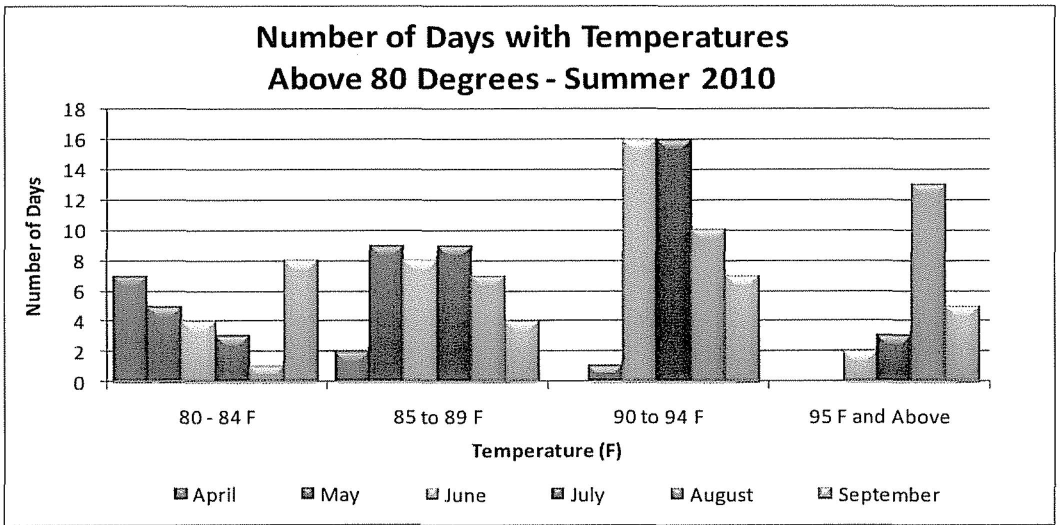
	March	April	May	June	July	August	September
30 Year Average CDD	6	24	109	287	421	374	189
2010 CDD	0	56	181	492	507	560	266

Month

There were 58 total days with temperatures over 90 degrees for the summer of 2010. The following graph shows the number of recorded days with high temperatures of 90 degrees or above for the summers of 2005 through 2010. If a monthly bar is missing, there were no days above 90 degrees during the month for that year.

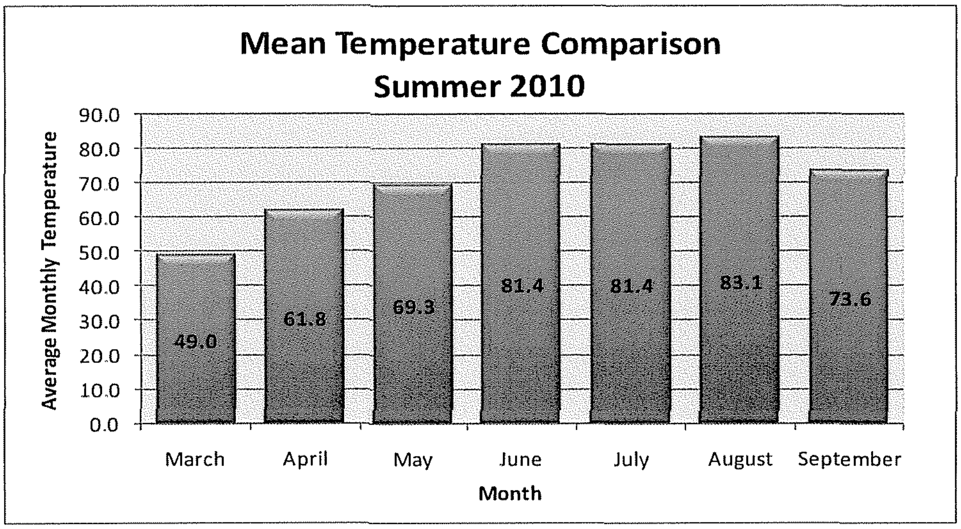


The histogram below displays the number of days where the high temperature was above 80 Degrees (F) by month.

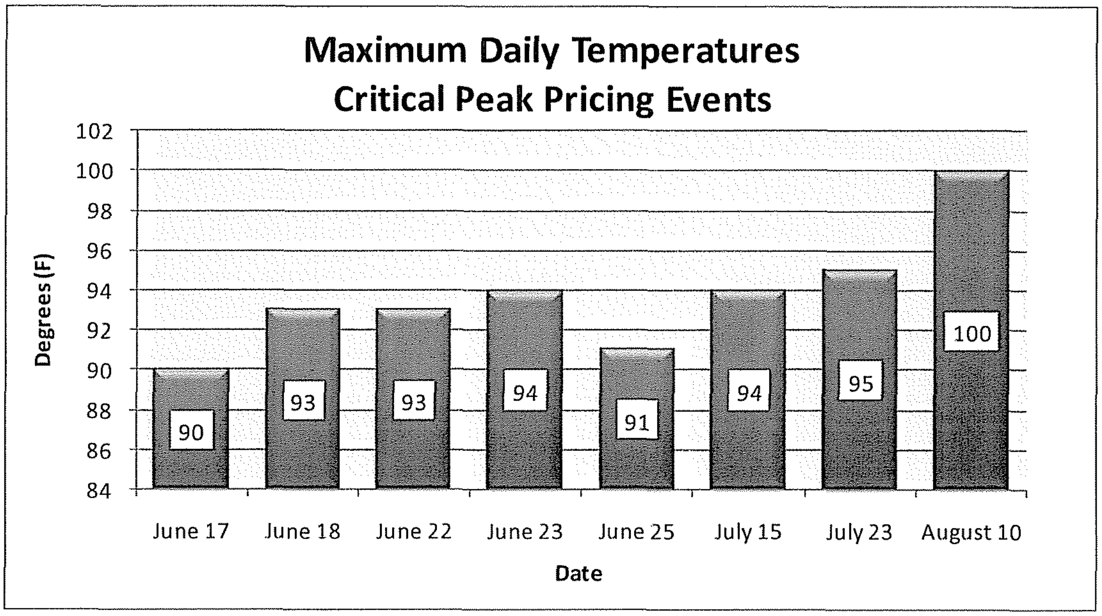


The maximum daily temperature was above 80 Degrees (F) every day of June, July, and August. August had the highest concentration of days with maximum temperatures 95 Degrees (F) or higher.

The following chart shows the average air temperatures, by month, from March 2010 to September 2010.



August was the warmest month of the season with a mean air temperature 1.7 Degrees (F) higher than June and July. The following table provides temperature statistics on the eight summer days when critical peak pricing events were called.



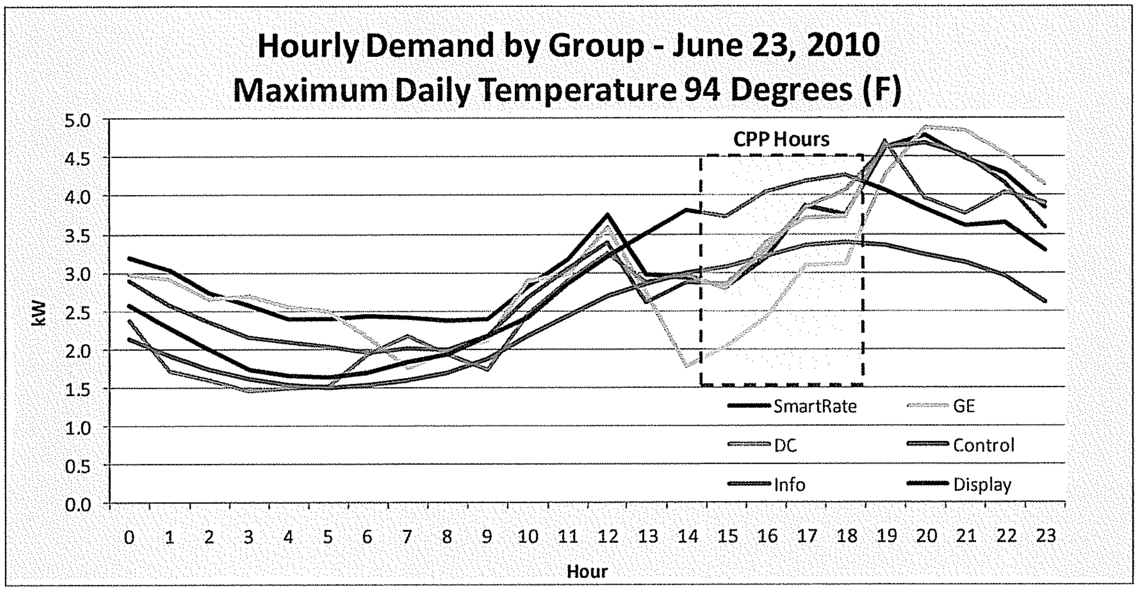
The warmest CPP day was August 10th and the coolest was June 17th.

Impact Analysis

As mentioned in the introduction, customers with smart meters were divided into five groups and one subgroup. The table below shows each of the customer groups and subgroups, as well as the number of customers within each group and the program features. Random samples of 500 customers were selected from the Control group for comparison to each of the other groups. These are referred to as 'Residential Customers' in this report.

LG&E RRP Customer Groups - Summer 2010					
Customer Group	SmartRate	Information Only	Demand Conservation	Display Only	Control Group
Number of Customers	90	79	13	89	1409
Program Features	Thermostat, Display Device, Water Heater Control, and CPP Rate	Thermostat and Display Device	Thermostat and Water Heater Control	Display Device	
Sub Group	GE				
Number of Customers	10				
Program Features	Smart GE Appliances				

GoodCents developed an average load shape for each day that the critical peak rate was initiated for all of the customer groups. The plot below shows the usage of all customer groups on the CPP day of June 23rd.



There is a considerable drop in usage for the SmartRate customers. The GE group is also on the responsive rate pricing pilot and shows an even greater drop in usage than the SmartRate customers.

GoodCents will discuss each pilot group in further detail in the following sections.

SmartRate Impact Analysis

The SmartRate customers received all of the possible equipment choices: a thermostat, display device and water heater control. There were approximately 90 customers participating in this group. GoodCents divided the SmartRate customers' monthly usages into 3 strata based on total monthly kWh. Next, a random sample of 500 customers was selected from the Control group using the strata breakpoints to produce a Control comparison group. This Control comparison group is what is referred to as 'Residential Customers' in the following charts and tables. The methodology for selecting the Control Comparison group is explained in more detail in Appendix A. Strata breakpoints are provided in Appendix B.

CPP Implementation

The critical peak rate was implemented on eight days by LG&E throughout the summer of 2010. Thirty minutes prior to the initiation of the critical peak rate, a red light would flash on each participant's SmartView and SmartStat notifying each customer of the critical peak pricing rate. The SmartStat was programmed to adjust the customer's heating or cooling thermostat settings during these critical peak periods. However, the customer was able to bypass the settings to manually control their temperature during these critical peak periods. The customer's response to the critical peak rates, as well as the response to other variable rates, will be presented from a load reduction and energy reduction perspective in the following report.

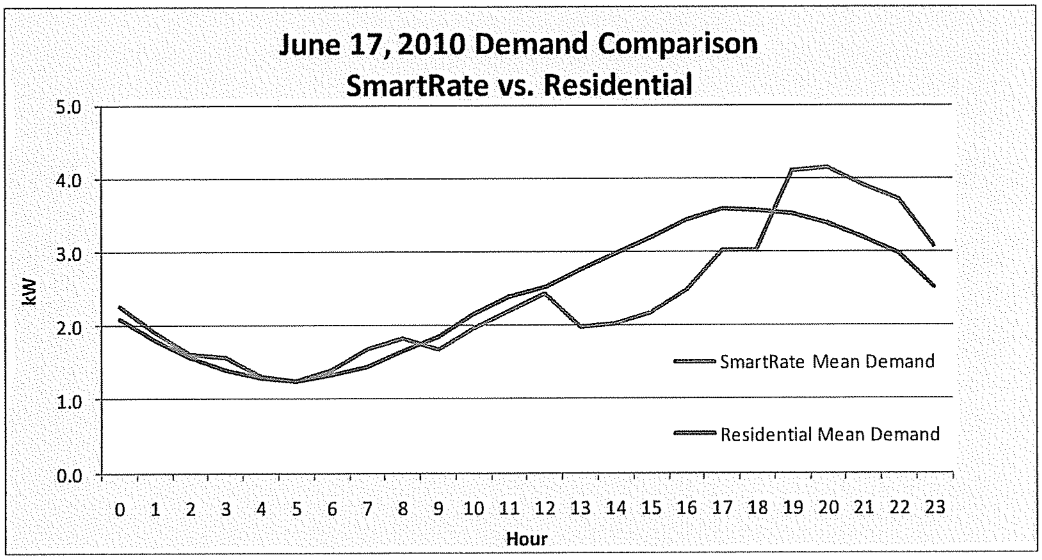
LG&E notified GoodCents when critical rate prices were in effect throughout the summer of 2010. The critical rate price schedule, including the start time and end time of each critical rate period, and the maximum daily temperature gathered from the local National Weather Service weather station are shown below in the following table.

Reference Table - Critical Peak Pricing Events			
Month	**Day**	**Max Daily Temperature (F)**	**Time**
June	17	90	3 - 7 PM EDT
June	18	93	3 - 7 PM EDT
June	22	93	3 - 7 PM EDT
June	23	94	3 - 7 PM EDT
June	25	91	3 - 7 PM EDT
July	15	94	3 - 6 PM EDT
July	23	95	3 - 6 PM EDT
August	10	100	3 - 7 PM EDT

Each time the critical peak price was initiated temperatures were greater than or equal to 90 degrees. One CPP day, August 10th, had a maximum temperature of 100 Degrees (F). Surprisingly, load reductions on this day, were among the smallest of the eight CPP events. This suggests that there may be a point where customers begin to ignore the critical rate and use their air conditioning regardless of what it costs.

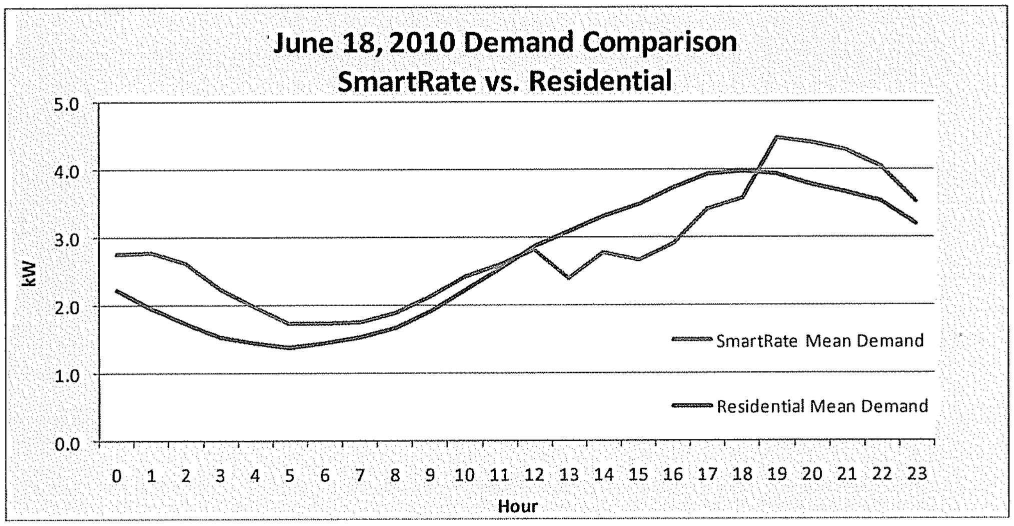
Comparison of Energy Usage on CPP Implementation Days

GoodCents also developed average load shapes for all days that the critical peak rate was initiated for both the SmartRate customers and the standard rate residential customers. Each critical peak pricing day is examined in detail below.



SmartRate vs. Residential Load Comparison - June 17, 2010			
Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	2.27	2.09	0.18
1	1.92	1.81	0.11
2	1.62	1.58	0.05
3	1.56	1.40	0.16
4	1.32	1.28	0.04
5	1.25	1.24	0.01
6	1.40	1.32	0.08
7	1.69	1.44	0.25
8	1.83	1.66	0.17
9	1.68	1.85	-0.17
10	1.97	2.16	-0.19
11	2.20	2.39	-0.18
12	2.44	2.52	-0.08
13	1.98	2.76	-0.78
14	2.03	2.97	-0.95
15	2.18	3.20	-1.02
16	2.48	3.44	-0.96
17	3.02	3.58	-0.56
18	3.03	3.56	-0.53
19	4.11	3.51	0.60
20	4.15	3.39	0.76
21	3.90	3.20	0.70
22	3.70	2.98	0.72
23	3.09	2.53	0.56
Total kWh	56.84	57.87	-1.03

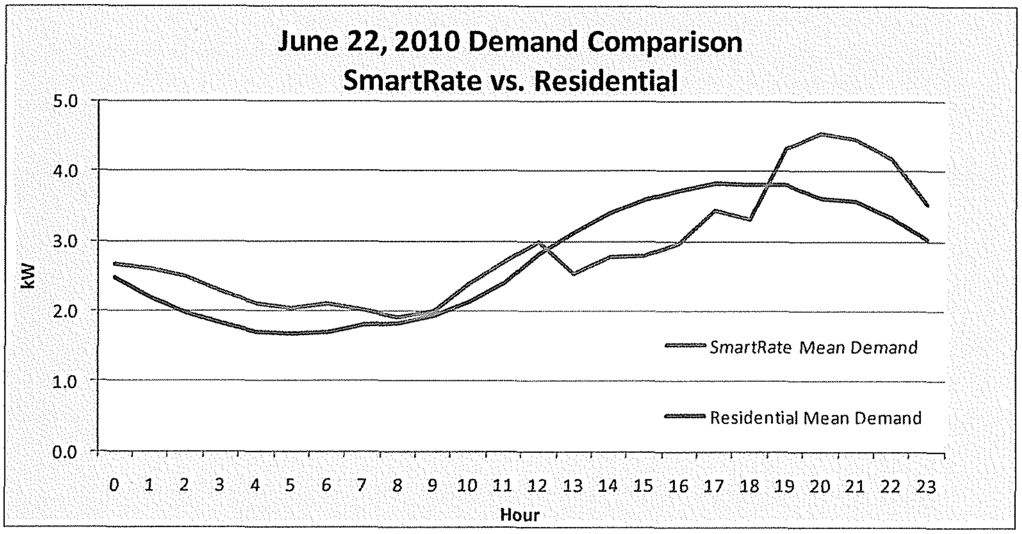
The table to the left shows the premise mean for SmartRate customers and the premise mean for the standard rate residential customers, as well as the difference between the two values. The daily premise energy usage is calculated for both the SmartRate customers and standard rate residential customers. Hours when the CPP rate was in effect are highlighted. Over the four hours the critical rate was in place, the SmartRate customers used 3.07 fewer kWh of energy than the residential customers.



The graph above and the figure to the right compare the SmartRate customers to residential customers on June 18th, 2010. The maximum daily temperature was 93 Degrees (F). Even though temperatures were warmer than the previous day, load reductions were not as large. Over the four hours the critical rate was in place, the SmartRate customers used 2.56 fewer kWh of energy than the residential customers.

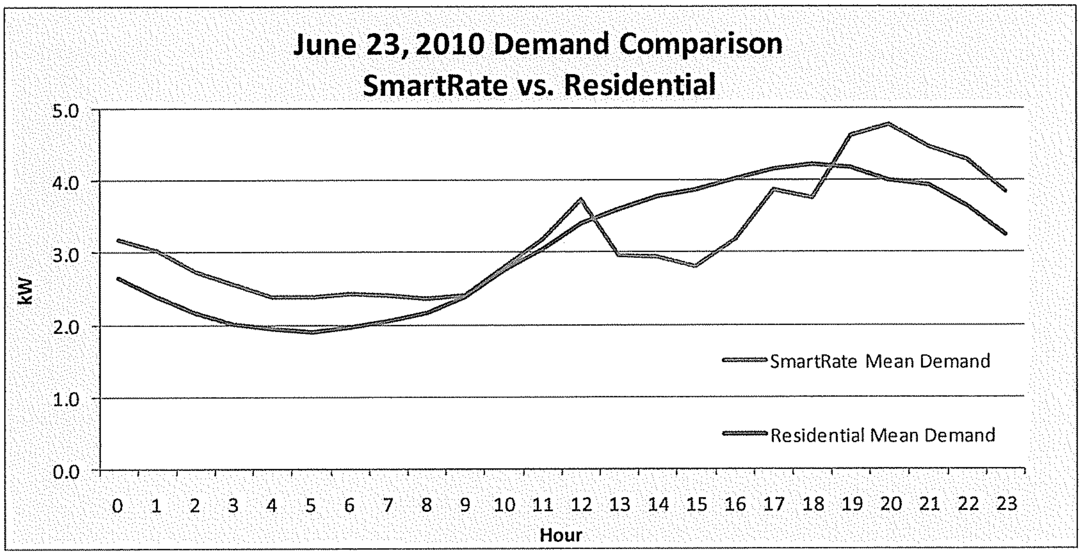
SmartRate vs. Residential Load Comparison - June 18, 2010

Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	2.75	2.23	0.52
1	2.77	1.95	0.83
2	2.62	1.73	0.89
3	2.24	1.54	0.70
4	1.97	1.44	0.53
5	1.74	1.38	0.36
6	1.74	1.45	0.29
7	1.75	1.54	0.21
8	1.88	1.68	0.20
9	2.13	1.91	0.23
10	2.42	2.22	0.20
11	2.59	2.53	0.06
12	2.82	2.86	-0.04
13	2.40	3.09	-0.69
14	2.78	3.32	-0.53
15	2.67	3.49	-0.83
16	2.91	3.73	-0.82
17	3.42	3.92	-0.50
18	3.57	3.98	-0.41
19	4.47	3.92	0.54
20	4.39	3.78	0.62
21	4.29	3.67	0.61
22	4.05	3.53	0.53
23	3.53	3.19	0.34
Total kWh	**67.92**	**64.09**	**3.83**



SmartRate vs. Residential Load Comparison - June 22, 2010			
Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	2.68	2.47	0.21
1	2.60	2.19	0.40
2	2.51	1.98	0.53
3	2.29	1.82	0.47
4	2.12	1.70	0.42
5	2.04	1.67	0.37
6	2.10	1.71	0.39
7	2.01	1.80	0.22
8	1.90	1.83	0.08
9	1.99	1.93	0.06
10	2.40	2.14	0.26
11	2.72	2.41	0.31
12	3.00	2.83	0.17
13	2.54	3.12	-0.58
14	2.77	3.39	-0.63
15	2.81	3.61	-0.80
16	2.98	3.71	-0.74
17	3.44	3.83	-0.39
18	3.31	3.80	-0.49
19	4.32	3.80	0.52
20	4.55	3.62	0.93
21	4.45	3.57	0.88
22	4.18	3.35	0.84
23	3.54	3.03	0.51
Total kWh	**69.23**	**65.29**	**3.94**

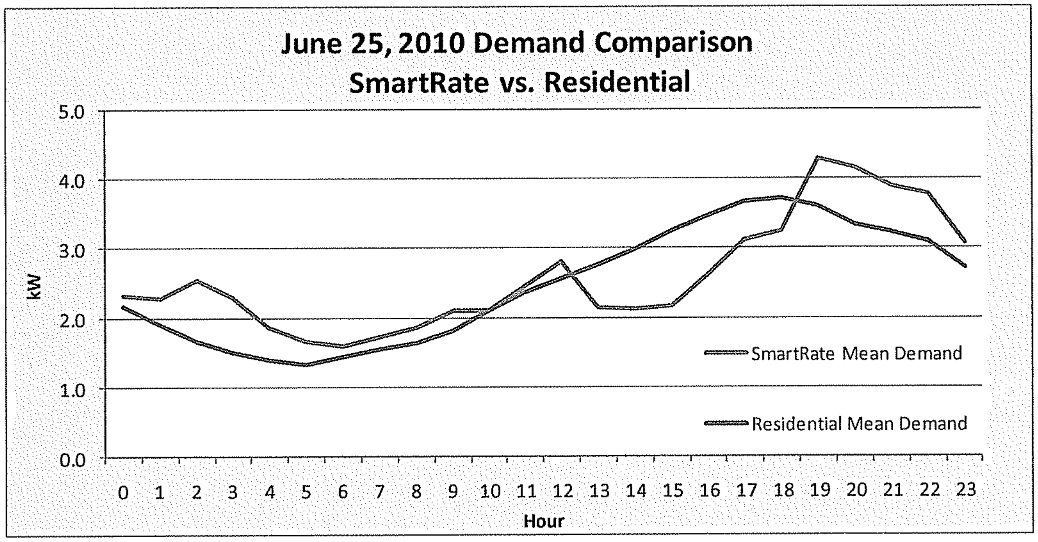
June 22nd, 2010 was the third CPP event called in 2010. The maximum air temperature recorded in the Louisville area was 93 Degrees (F). Load reductions were largest during the first hour of the CPP event. Over the four hours the critical rate was in place, the SmartRate customers used 2.42 fewer kWh of energy than the residential customers.



In the graph above and the table to the right, average hourly loads of the SmartRate group are compared to the average hourly loads of its Control comparison group for June, 23rd, 2010. Hour 15 shows the second largest load reduction of 2010. The SmartRate customers' average demand was 1.07 kW lower than the average demand of the residential customers. Over the four hours that CPP was in place, the SmartRate group averaged 2.69 fewer kWh than the residential group.

SmartRate vs. Residential Load Comparison - June 23, 2010

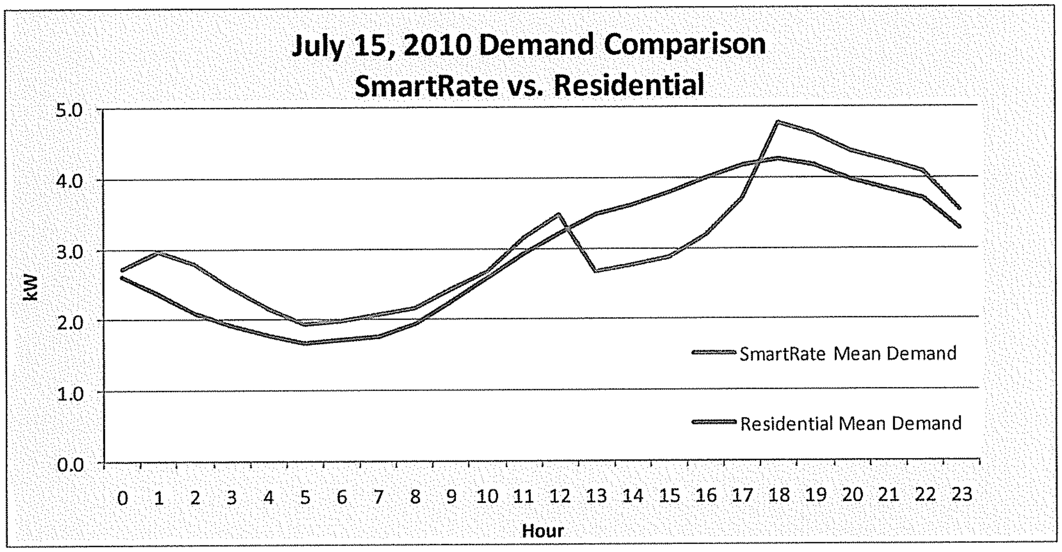
Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	3.19	2.66	0.52
1	3.04	2.39	0.65
2	2.74	2.16	0.58
3	2.57	2.01	0.56
4	2.39	1.94	0.45
5	2.38	1.90	0.48
6	2.43	1.96	0.47
7	2.41	2.05	0.36
8	2.37	2.17	0.20
9	2.40	2.38	0.02
10	2.80	2.77	0.04
11	3.18	3.06	0.12
12	3.74	3.41	0.33
13	2.97	3.60	-0.63
14	2.94	3.79	-0.85
15	2.80	3.87	-1.07
16	3.18	4.02	-0.83
17	3.86	4.17	-0.31
18	3.76	4.24	-0.48
19	4.63	4.18	0.46
20	4.78	4.01	0.77
21	4.48	3.95	0.53
22	4.28	3.65	0.64
23	3.84	3.25	0.59
Total kWh	**77.19**	**73.57**	**3.61**



SmartRate vs. Residential Load Comparison - June 25, 2010

Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	2.32	2.17	0.15
1	2.28	1.91	0.37
2	2.54	1.67	0.88
3	2.31	1.50	0.81
4	1.86	1.39	0.47
5	1.66	1.34	0.33
6	1.59	1.44	0.15
7	1.73	1.55	0.18
8	1.86	1.65	0.21
9	2.11	1.82	0.29
10	2.10	2.10	-0.01
11	2.46	2.38	0.08
12	2.81	2.56	0.26
13	2.14	2.76	-0.61
14	2.12	2.99	-0.87
15	2.16	3.26	-1.10
16	2.63	3.47	-0.84
17	3.12	3.66	-0.54
18	3.25	3.71	-0.46
19	4.28	3.62	0.67
20	4.17	3.34	0.82
21	3.90	3.22	0.67
22	3.78	3.10	0.68
23	3.07	2.73	0.34
Total kWh	**62.26**	**59.33**	**2.93**

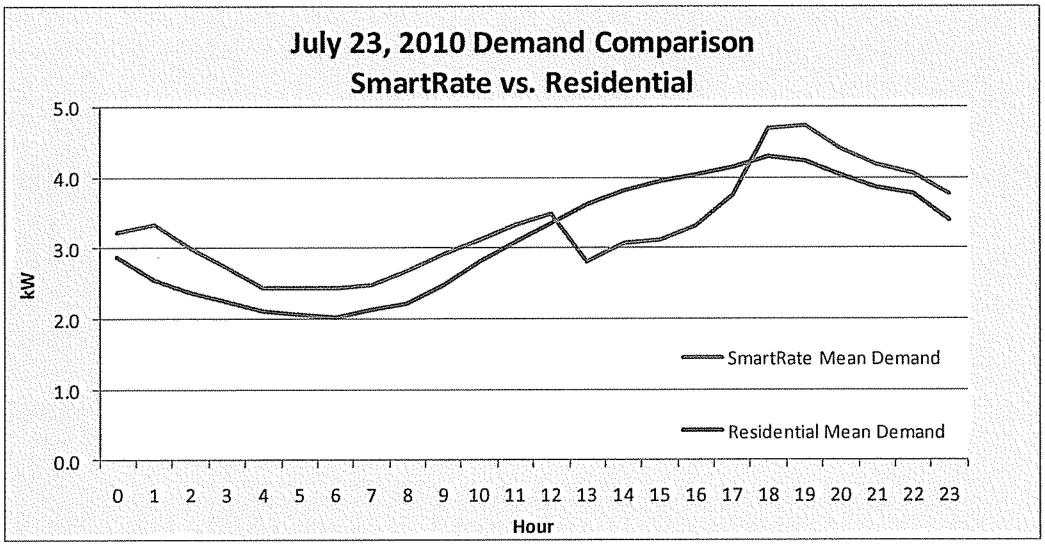
In the graph above and the table to the right, average hourly loads of the SmartRate group are compared to the average hourly loads of its Control comparison group for June, 25th, 2010. The largest hourly load reduction of the summer of 2010 occurred during the first hour of CPP on this day. Over the four hours the critical rate was in place, the SmartRate customers used 2.94 fewer kWh of energy than the residential customers.



The two CPP events called in July began at 3:00 PM and concluded at 6:00 PM. The first, July 15th, is shown in the graph above and the table to the right. Hours that the critical rate was in place are highlighted in the table. SmartRate customers showed significant load reductions during the first two hours of CPP. During the last hour, load reductions were less dramatic. Over the three hours the critical rate was in place, the SmartRate customers used 2.18 fewer kWh of energy than the residential customers.

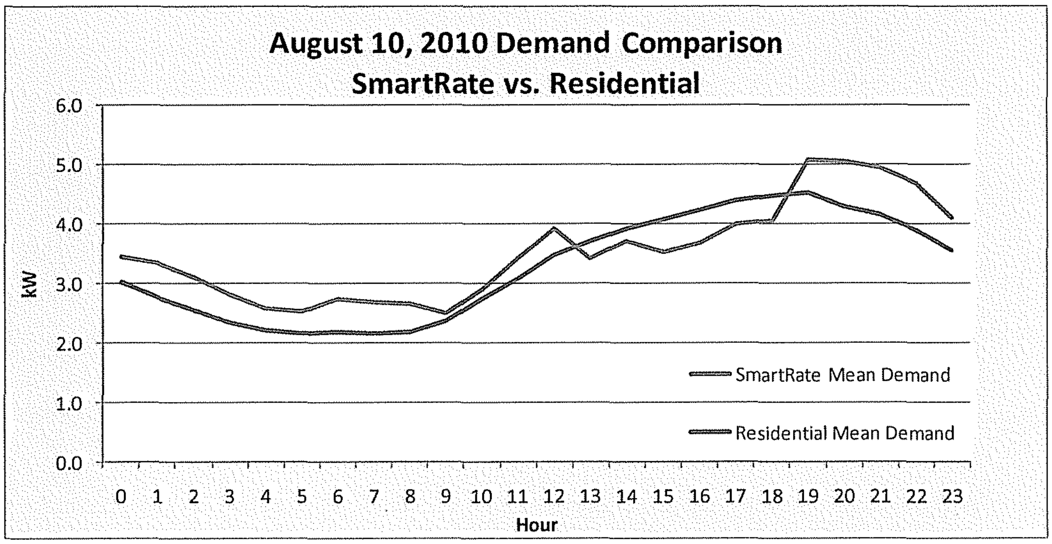
SmartRate vs. Residential Load Comparison - July 15, 2010

Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	2.73	2.62	0.11
1	2.97	2.36	0.61
2	2.78	2.10	0.68
3	2.44	1.92	0.52
4	2.15	1.78	0.37
5	1.95	1.66	0.29
6	1.98	1.73	0.25
7	2.07	1.77	0.30
8	2.16	1.94	0.22
9	2.43	2.25	0.18
10	2.67	2.59	0.08
11	3.14	2.92	0.21
12	3.48	3.22	0.26
13	2.67	3.48	-0.81
14	2.77	3.61	-0.84
15	2.87	3.79	-0.92
16	3.18	3.98	-0.80
17	3.71	4.18	-0.46
18	4.78	4.26	0.51
19	4.61	4.18	0.43
20	4.37	3.97	0.39
21	4.23	3.84	0.39
22	4.09	3.70	0.39
23	3.55	3.29	0.27
Total kWh	**73.78**	**71.14**	**2.63**



SmartRate vs. Residential Load Comparison - July 23, 2010			
Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	3.24	2.87	0.37
1	3.34	2.56	0.78
2	3.02	2.38	0.64
3	2.72	2.25	0.47
4	2.45	2.12	0.34
5	2.45	2.06	0.38
6	2.44	2.03	0.41
7	2.48	2.14	0.33
8	2.68	2.22	0.45
9	2.93	2.50	0.43
10	3.12	2.82	0.30
11	3.35	3.11	0.24
12	3.50	3.35	0.14
13	2.82	3.61	-0.80
14	3.07	3.82	-0.75
15	3.12	3.95	-0.83
16	3.31	4.03	-0.72
17	3.76	4.16	-0.40
18	4.70	4.30	0.40
19	4.73	4.23	0.50
20	4.41	4.04	0.38
21	4.19	3.87	0.32
22	4.06	3.77	0.28
23	3.77	3.41	0.37
Total kWh	79.65	75.60	4.04

The maximum air temperature in Louisville, Kentucky on the day examined in the accompanying figures was 95 Degrees (F). Load reductions were not as large as those observed earlier in the season on days when temperatures were not as high. Over the three hours the critical rate was in place, the SmartRate customers used 1.95 fewer kWh of energy than the residential customers.



August 10th, 2010 was the hottest of the eight CPP events. The maximum daily temperature was 100 Degrees. It also showed the smallest load reductions of the summer. Over the four hours the critical rate was in place, the SmartRate customers used 1.91 fewer kWh of energy than the residential customers.

SmartRate vs. Residential Load Comparison - August 10, 2010

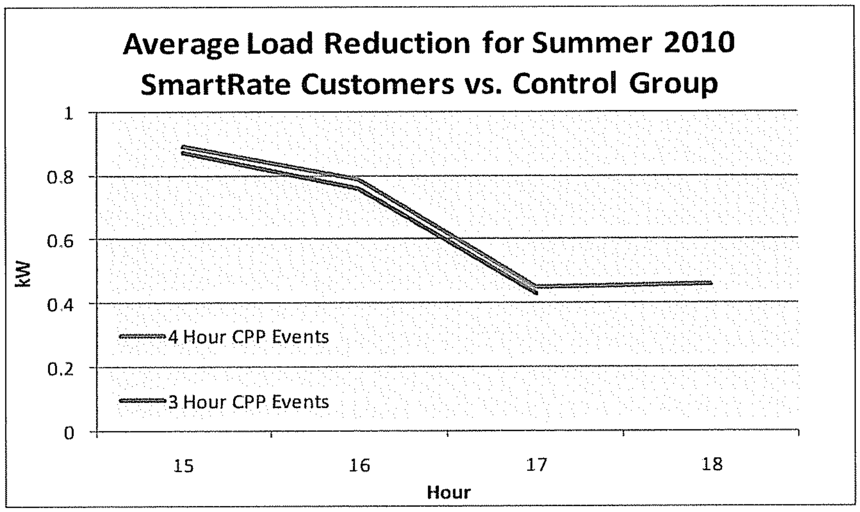
Hour	SmartRate Mean Demand	Residential Mean Demand	Difference
0	3.43	3.01	0.42
1	3.35	2.76	0.58
2	3.10	2.54	0.56
3	2.80	2.33	0.47
4	2.57	2.21	0.37
5	2.51	2.16	0.35
6	2.74	2.18	0.56
7	2.69	2.16	0.53
8	2.66	2.19	0.47
9	2.51	2.36	0.14
10	2.89	2.74	0.15
11	3.43	3.06	0.37
12	3.92	3.47	0.45
13	3.43	3.70	-0.28
14	3.69	3.91	-0.22
15	3.53	4.08	-0.55
16	3.69	4.24	-0.56
17	4.01	4.40	-0.39
18	4.06	4.47	-0.41
19	5.07	4.51	0.56
20	5.06	4.28	0.78
21	4.93	4.15	0.78
22	4.68	3.89	0.78
23	4.11	3.55	0.56
Total kWh	**84.84**	**78.36**	**6.49**

The following table is a summary of the tables found on the previous pages. This table displays the difference between energy usage for the SmartRate customers and standard rate residential customers (also referred to as the Control comparison group) for each CPP period.

CPP Day Comparison 2010 - SmartRate Customers							
Day	**Max Temperature**	**Group**	**15**	**16**	**17**	**18**	**19**
17-Jun	90	SmartRate	2.18	2.48	3.02	3.03	4.11
17-Jun	90	Control	3.20	3.44	3.58	3.56	3.51
17-Jun	90	**Difference**	**-1.02**	**-0.96**	**-0.56**	**-0.53**	**0.60**
18-Jun	93	SmartRate	2.67	2.91	3.42	3.57	4.47
18-Jun	93	Control	3.49	3.73	3.92	3.98	3.92
18-Jun	93	**Difference**	**-0.83**	**-0.82**	**-0.50**	**-0.41**	**0.54**
22-Jun	93	SmartRate	2.81	2.98	3.44	3.31	4.32
22-Jun	93	Control	3.61	3.71	3.83	3.80	3.80
22-Jun	93	**Difference**	**-0.80**	**-0.74**	**-0.39**	**-0.49**	**0.52**
23-Jun	94	SmartRate	2.80	3.18	3.86	3.76	4.63
23-Jun	94	Control	3.87	4.02	4.17	4.24	4.18
23-Jun	94	**Difference**	**-1.07**	**-0.83**	**-0.31**	**-0.48**	**0.46**
25-Jun	91	SmartRate	2.16	2.63	3.12	3.25	4.28
25-Jun	91	Control	3.26	3.47	3.66	3.71	3.62
25-Jun	91	**Difference**	**-1.10**	**-0.84**	**-0.54**	**-0.46**	**0.67**
15-Jul	94	SmartRate	2.87	3.18	3.71	4.78	4.61
15-Jul	94	Control	3.79	3.98	4.18	4.26	4.18
15-Jul	94	**Difference**	**-0.92**	**-0.80**	**-0.46**	**0.51**	**0.43**
23-Jul	95	SmartRate	3.12	3.31	3.76	4.70	4.73
23-Jul	95	Control	3.95	4.03	4.16	4.30	4.23
23-Jul	95	**Difference**	**-0.83**	**-0.72**	**-0.40**	**0.40**	**0.50**
10-Aug	100	SmartRate	3.53	3.69	4.01	4.06	5.07
10-Aug	100	Control	4.08	4.24	4.40	4.47	4.51
10-Aug	100	**Difference**	**-0.55**	**-0.56**	**-0.39**	**-0.41**	**0.56**

The maximum load reductions occurred during the first hour of CPP, hour 15.

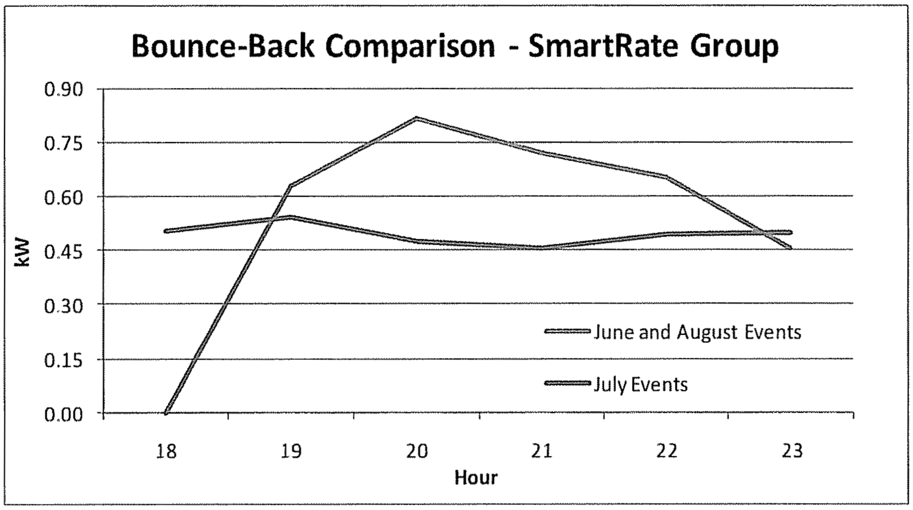
The following graph shows the average load reductions for each hour over all CPP days that were shown above.



The average load reduction is greatest during the first hour of the critical rate but then decreases throughout the critical peak pricing period.

Bounce-Back after Release of CPP

The customer's load rebounds as CPP is released. In 2010, CPP was called for 3-hour periods in July and 4-hour periods in June and August. The bounce-back effect is largest for both durations during the second hour after CPP. Average bounce-back was larger on days when the critical rate was in effect for 4 hours than on the days when the critical rate was in place for 3 hours. In the following graph, the bounce-back period is examined for both types of events.



The following table examines the hourly demand differences between the SmartRate group and its Control comparison group on each of the eight CPP days. The June and August CPP events lasted until 7:00 pm; therefore, hour 18 is not a part of the bounce-back period. The largest observed difference between the two groups occurred on June 22nd during hour 20. The SmartRate group averaged 0.93 kW more demand than residential customers during this hour.

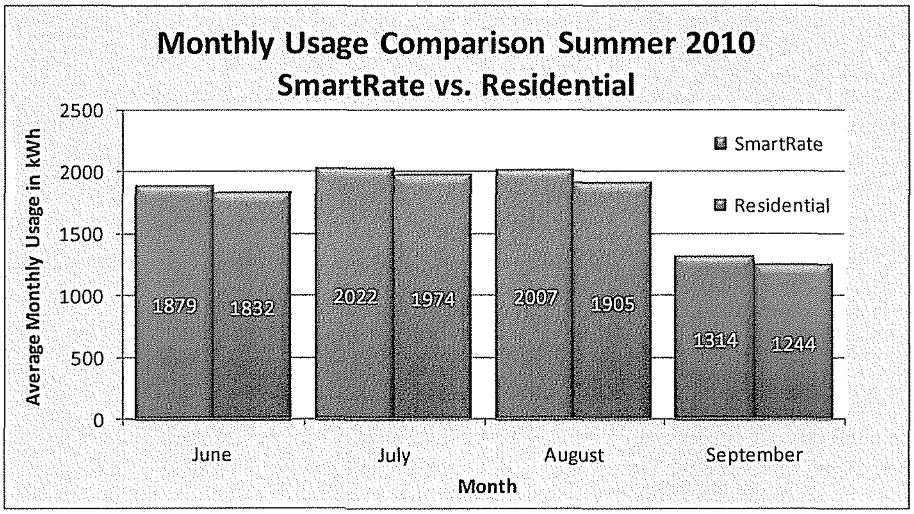
Average Bounce-Back in kW by Hour - 2010 CPP Days							
Date	**Rate**	**18**	**19**	**20**	**21**	**22**	**23**
17-Jun	SmartRate	-	4.11	4.15	3.90	3.70	3.09
17-Jun	Residential	-	3.51	3.39	3.20	2.98	2.53
17-Jun	**Difference**	-	**0.60**	**0.76**	**0.70**	**0.72**	**0.56**
18-Jun	SmartRate	-	4.47	4.39	4.29	4.05	3.53
18-Jun	Residential	-	3.92	3.78	3.67	3.53	3.19
18-Jun	**Difference**	-	**0.54**	**0.62**	**0.61**	**0.53**	**0.34**
22-Jun	SmartRate	-	4.32	4.55	4.45	4.18	3.54
22-Jun	Residential	-	3.80	3.62	3.57	3.35	3.03
22-Jun	**Difference**	-	**0.52**	**0.93**	**0.88**	**0.84**	**0.51**
23-Jun	SmartRate	-	4.63	4.78	4.48	4.28	3.84
23-Jun	Residential	-	4.18	4.01	3.95	3.65	3.25
23-Jun	**Difference**	-	**0.46**	**0.77**	**0.53**	**0.64**	**0.59**
25-Jun	SmartRate	-	4.28	4.17	3.90	3.78	3.07
25-Jun	Residential	-	3.62	3.34	3.22	3.10	2.73
25-Jun	**Difference**	-	**0.67**	**0.82**	**0.67**	**0.68**	**0.34**
15-Jul	SmartRate	4.78	4.61	4.37	4.23	4.09	3.55
15-Jul	Residential	4.26	4.18	3.97	3.84	3.70	3.29
15-Jul	**Difference**	**0.51**	**0.43**	**0.39**	**0.39**	**0.39**	**0.27**
23-Jul	SmartRate	4.70	4.73	4.41	4.19	4.06	3.77
23-Jul	Residential	4.30	4.23	4.04	3.87	3.77	3.41
23-Jul	**Difference**	**0.40**	**0.50**	**0.38**	**0.32**	**0.28**	**0.37**
10-Aug	SmartRate	-	5.07	5.06	4.93	4.68	4.11
10-Aug	Residential	-	4.51	4.28	4.15	3.89	3.55
10-Aug	**Difference**	-	**0.56**	**0.78**	**0.78**	**0.78**	**0.56**

The load increase after CPP is released is substantial and should be taken into account by system planning if the CPP program is offered to significant numbers of customers. The demand comparison for the SmartRate group shows that the average bounce-back for the SmartRate customers will approach 0.9 kW on hot afternoons if CPP is called for four hours and approximately 0.5 kW if CPP is called for three hours on a hot afternoon. This indicates that limiting the duration of CPP will decrease the size of the bounce-back. The specific needs of the utility should be considered when deciding how to best manage this load increase.

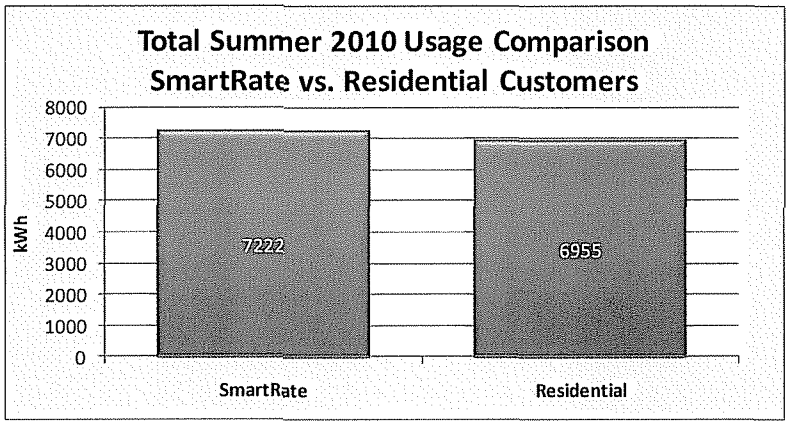
Regression models were developed to compare the SmartRate customers' weekday usage patterns with members of the Control comparison group. This model was run using three separate subsets of summer data to generate load impact estimates under different conditions. The parameters produced by these models assume the hourly rate structure that was present during the summer of 2010. Appendix C contains the regression methodology, parameter estimates and calculations of load reduction based on these estimates. Appendix D contains the regression output.

Summer Monthly Energy Usage Comparison

The following graph shows the average monthly consumption for the SmartRate customers and its Control comparison groups from June to September.



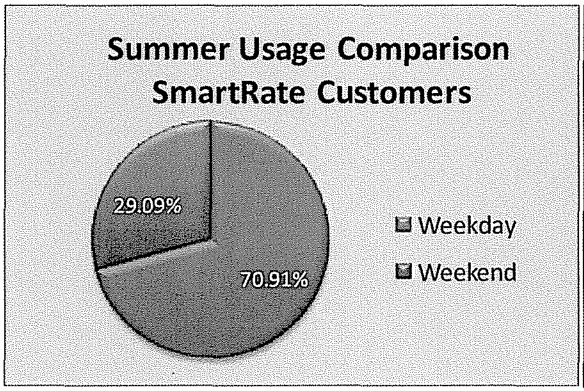
The SmartRate customers use more energy during most summer months. However, the graph above shows that there is only a small difference in energy usage between the two customer groups. The month of August shows the largest difference in energy usage, with a difference of 102 kWh.

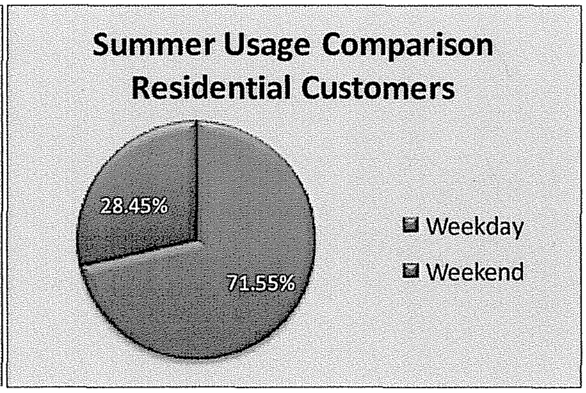


The graph above shows the difference in total energy usage between the SmartRate customers and the residential customers during the summer of 2010. Overall, SmartRate customers did not appear to make significant changes to their usage even though their daily usage patterns show significant differences especially on CPP days as compared to residential customers throughout the summer of 2010.

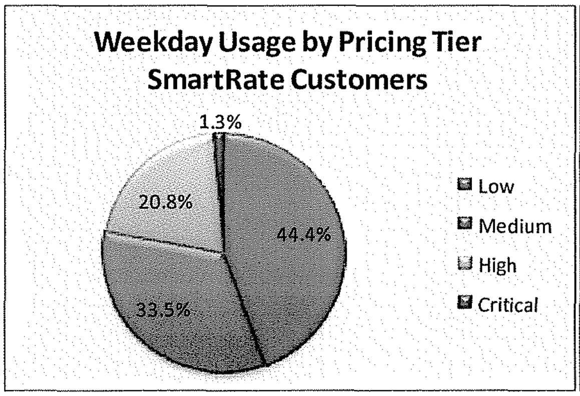
SmartRate customers are subjected to both 'High' and 'Critical' pricing on weekdays. They receive visual signals on their thermostat and in-home display (IHD) device when these pricing tiers are in effect. This occurs from 1:00 pm to 6:00 pm during June, July, August, and September. 'High' and 'Critical' rates are not in effect on weekends under either the winter or summer rate schedules.

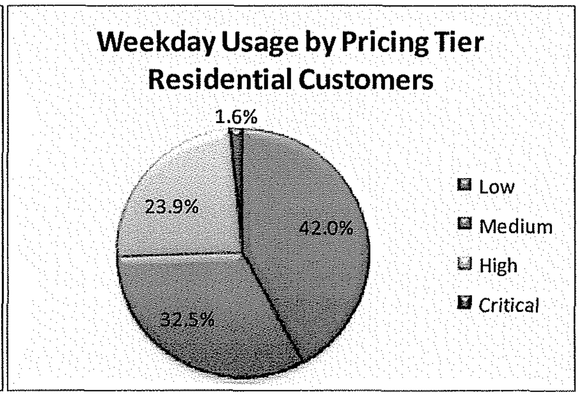
The two pie charts below compare weekday and weekend consumption levels during these months and show that SmartRate customers use a smaller percentage of their summer power on weekdays than standard residential customers. Because the kWh usages of the two groups are not identical, it is important to use percentages of seasonal usage when comparing the two.





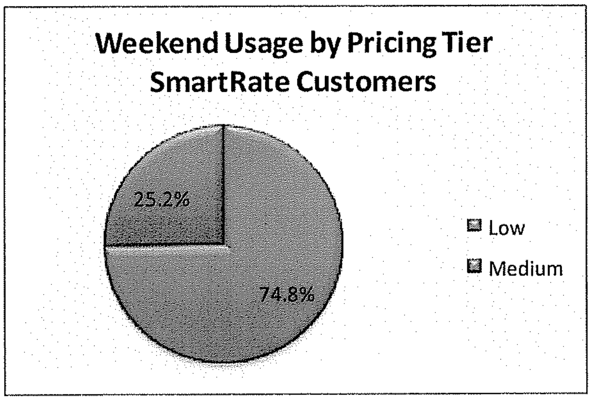
The next two pie charts show how the two groups differ on weekdays during the different pricing periods.

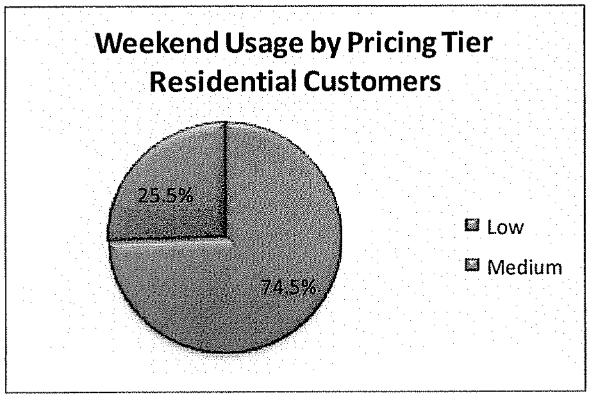




SmartRate customers use 3.4% less weekday energy than residential customers during 'Critical' and 'High' pricing periods. This is exactly what the SmartRate program is designed to accomplish. Customers are given financial incentives to shift their loads away from peak hours and they are responding.

The final pair of pie charts compares these groups on weekends. There are no 'High' or 'Critical' periods on weekends, so the differences between the two groups on weekends should be much less dramatic than on weekdays.

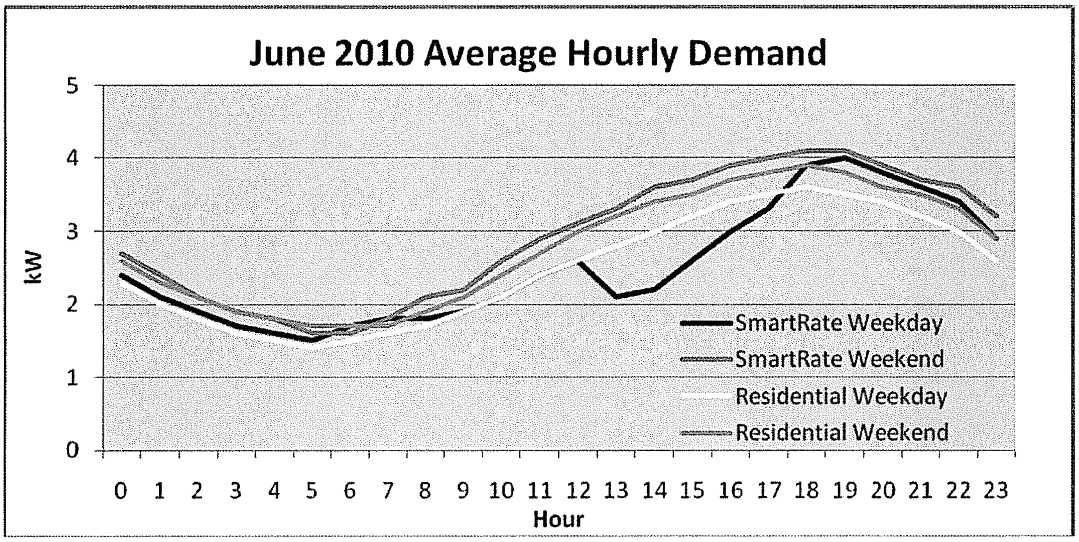




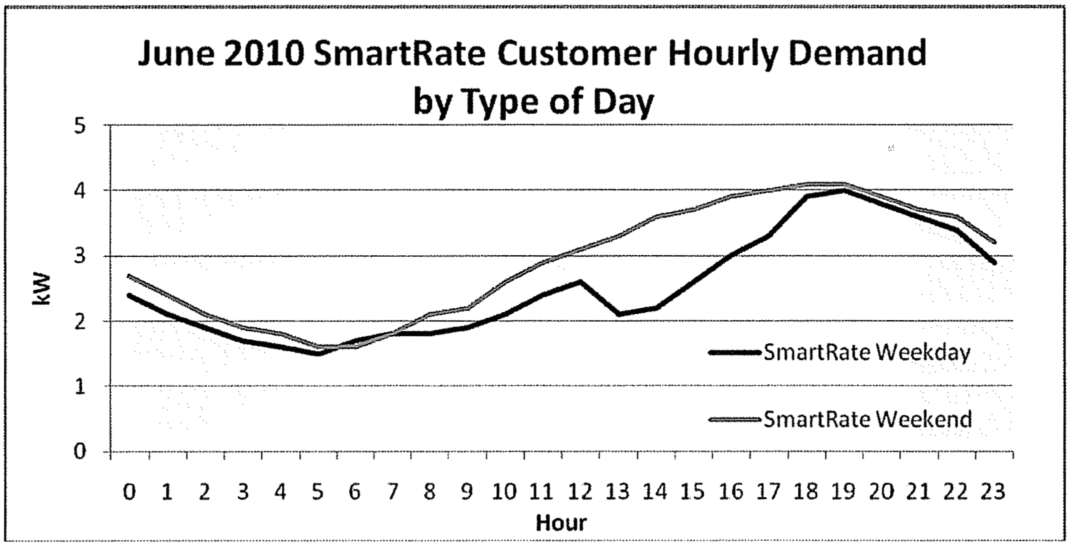
The 'Medium' pricing period gives participants some incentive to shift loads away from peak afternoon hours. The SmartRate customers use 25.2% of their summer weekend energy during the 'Medium' pricing tier, while the Control comparison group uses 25.5%.

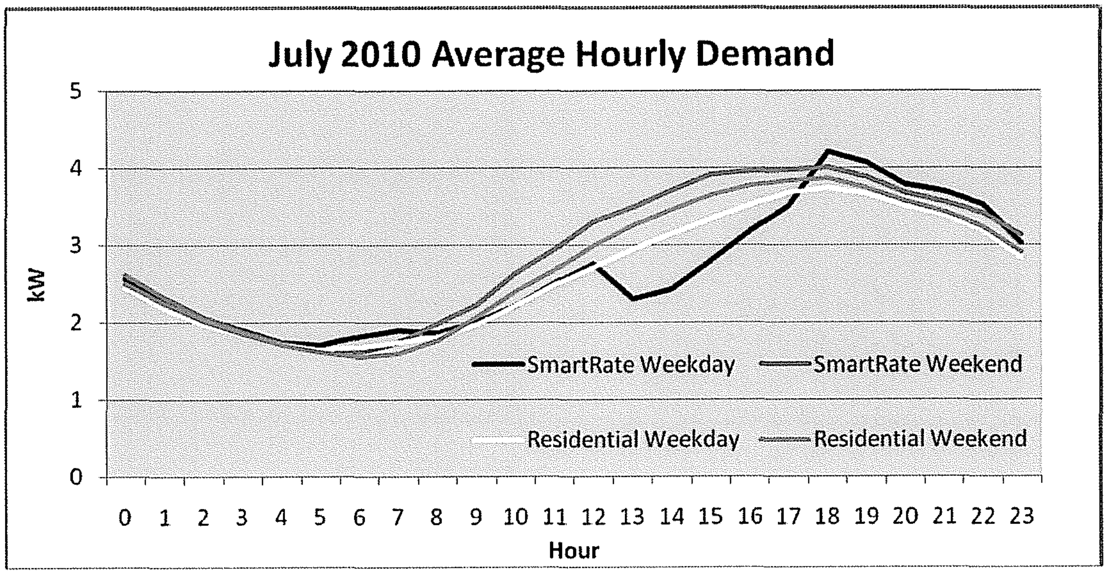
Summer Weekday Weekend Energy Usage Comparison

The following graph shows weekday and weekend demand for both groups.

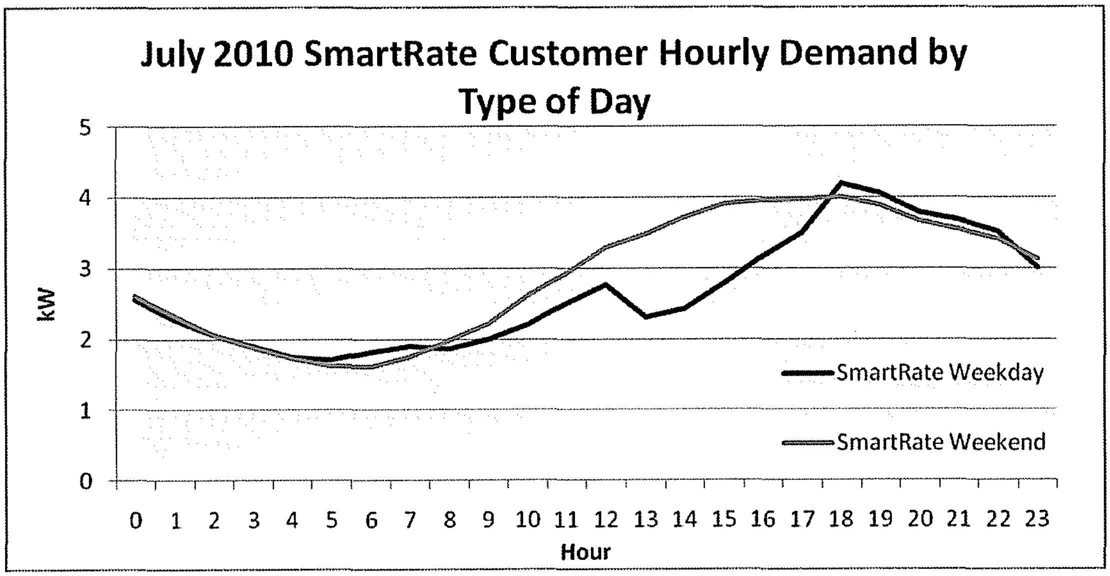


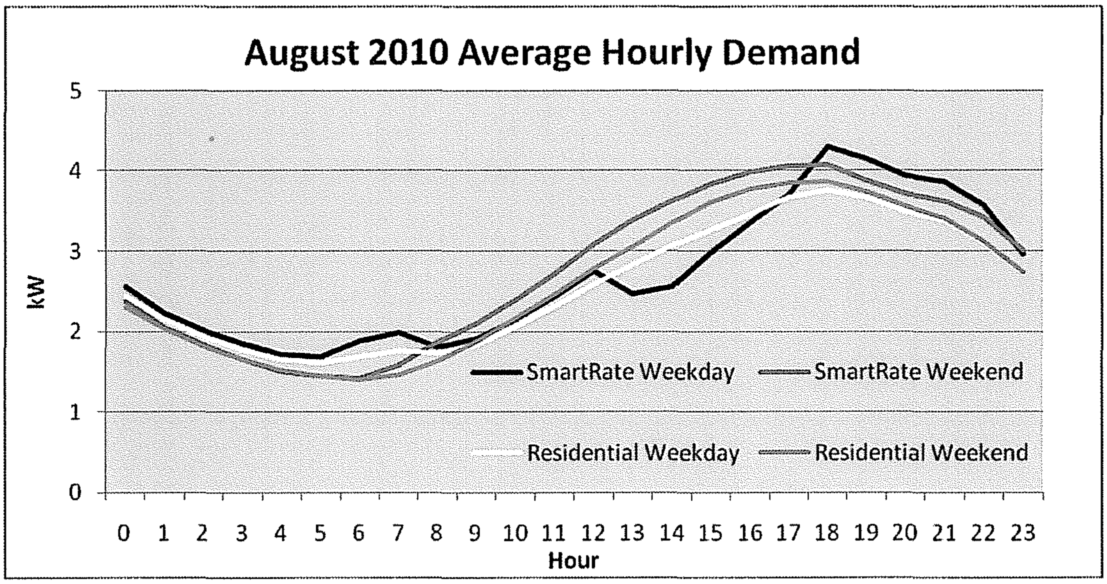
The SmartRate customers exhibit the expected behavior during this period. Demand plummets during hour 13 and then gradually increases through the afternoon hours. The SmartRate customers' average demand becomes higher than its Control comparison group's weekday demand during hour 18.



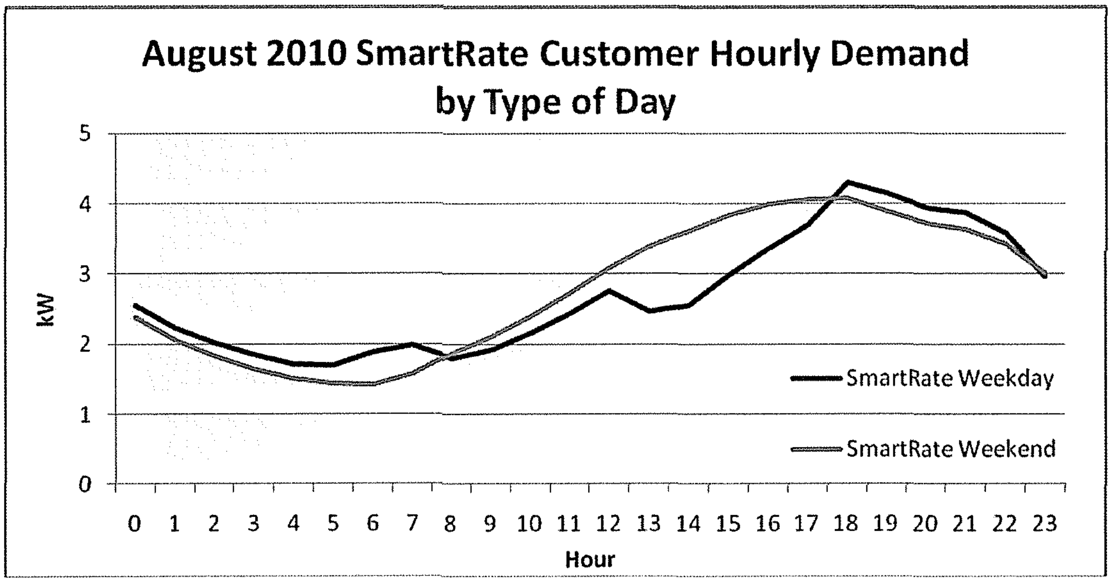


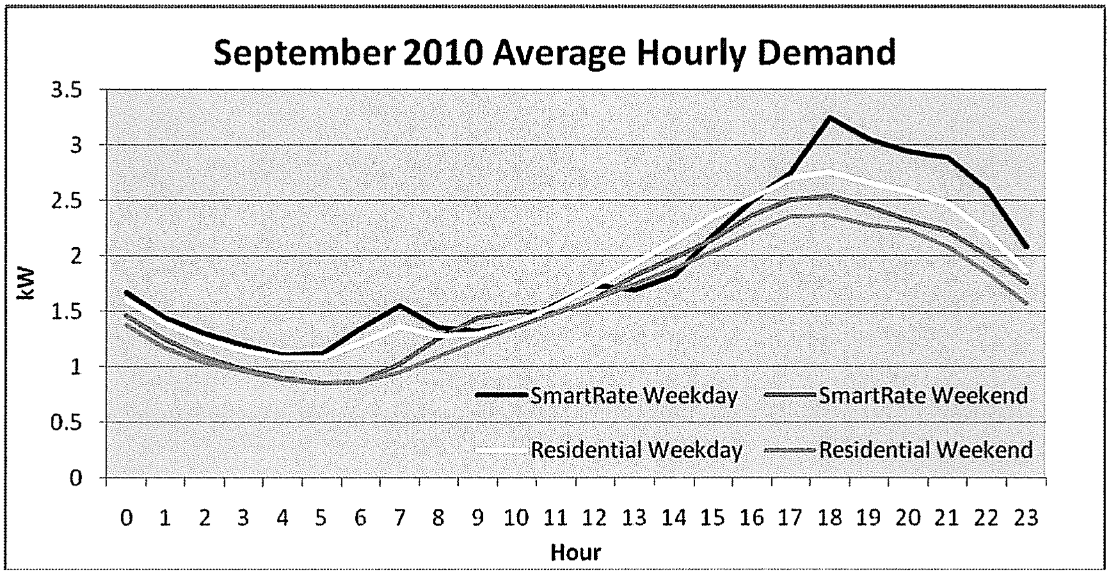
During summer peak months the 'High' pricing period occurs from 1:00 pm to 6:00 pm on weekdays. During this period, on weekdays, the SmartRate group's average demand is lower than its Control comparison group. The difference is most pronounced from 2:00 pm to 3:00 pm, when the SmartRate group's average demand is 0.71 kW lower than the average demand of its Control comparison group. Once the 'High' pricing period ends, the SmartRate group's demand spikes and is 0.46 kW higher than residential customers.



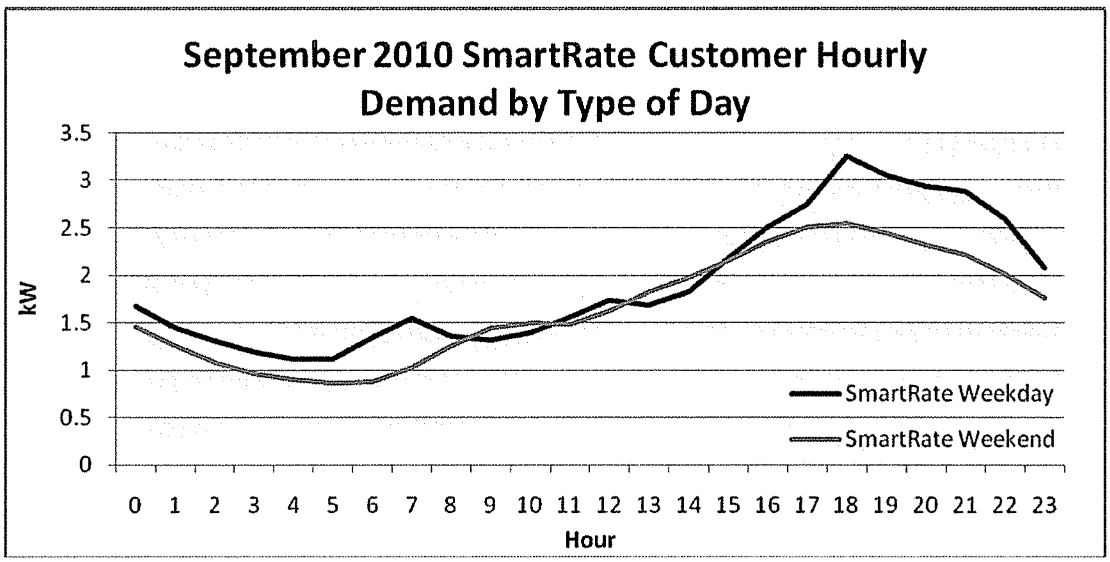


The largest difference between SmartRate customer average hourly weekday demand and residential customer average hourly weekday demand in August occurred during the second hour of the 'High' pricing period, from 2:00 pm EDT to 3:00 pm EDT. The average load reduction during this hour was 0.51 kW. When SmartRate customers' weekday demand is compared to its weekend demand, the difference is 1.06 kW.





Load reductions during the 'High' pricing period were less dramatic for the SmartRate group in September than in previous summer months. September had only 266 cooling degree days, compared to 492 in June, 507 in July, and 560 in August. Milder temperatures reduce demand on a home's air conditioning unit, which reduces the impact of altered thermostat settings during the 'High' pricing period. Average SmartRate weekday demand was 0.24 kW lower than residential customers during Hour 13 (1:00 pm – 2:00 pm) and 0.32 kW lower in Hour 14.



The following table provides a breakdown of how an average SmartRate customer's summer energy bills would look under the responsive pricing structure and the standard residential rate.

Summer Billing Comparison -SmartRate Customers						
SmartRate				**Residential Rate**		
Service Fees	Months	Total		Service Fees	Months	Total
Electric No. 7 - $10 per month	2	$20		Electric No. 7 - $5 per month	2	$10
Electric No. 8 - $13.50 per month	2	$27		Electric No. 8 - $8.50 per month	2	$17
Total kWh = 7222.19				Total kWh = 7222.19		
Rate	kWh	Bill		Rate	kWh	Bill
$0.04628	2143.80	$99.21		kWh at $.06714	3901.65	$261.96
$0.05859	1140.94	$66.85		kWh at $.07068	3320.54	$234.70
$0.11278	535.68	$60.41		Total Bill		$523.66
$0.30743	81.23	$24.97		Savings = $7.58		
$0.04872	1766.52	$86.06		Assumes that the average SmartRate customer was billed on SmartRate and Residential Rate		
$0.06168	982.73	$60.62				
$0.11873	556.01	$66.01				
$0.32364	15.28	$4.95				
Total Bill		$516.08				

As the table shows, average customer savings are minimal on the SmartRate program. Based on this information a typical customer can expect to save approximately $2 per month during the summer months by participating in the SmartRate program.

Billed Energy Comparison for SmartRate Customers

GoodCents was supplied SmartRate (including GE customers) customers' summer billed energy usage before the rate was implemented in 2007. From this information, a comparison of summer behavior before and after the SmartRate implementation was developed. Not all of the energy use in a home is weather dependent; therefore, a baseline load was subtracted from each month's mean energy use to calculate an average weather dependent load for each month. The summers of 2007 and 2010 were considerably warmer than the summer of 2009; therefore, the data is weather normalized.

The following chart shows the monthly comparisons for 2007, 2009 and 2010.

LG&E SmartRate Billing Comparison Before and After Rate Implementation							
Month	Year	Number of Customers	Mean Monthly Billed Energy	Baseline kWh	Weather Dependent kWh	CDD	Weather Dependent Energy per CDD
June	2007	98	1503	870	633	376	1.684
June	2009	97	1296	870	426	338	1.260
June	2010	90	1879	870	1009	492	2.051
July	2007	98	1657	899	758	396	1.914
July	2009	97	1565	899	666	271	2.458
July	2010	90	2022	899	1123	507	2.215
August	2007	98	1923	899	1024	629	1.628
August	2009	97	1395	899	496	325	1.526
August	2010	90	2007	899	1108	560	1.979
September	2007	98	1829	870	959	350	2.740
September	2009	97	1427	870	557	192	2.901
September	2010	90	1314	870	444	266	1.669
Total 2007		98	6912	3538	3374	1751	1.927
Total 2009		97	5683	3538	2145	1126	1.905
Total 2010		90	7222	3538	3684	1825	2.019

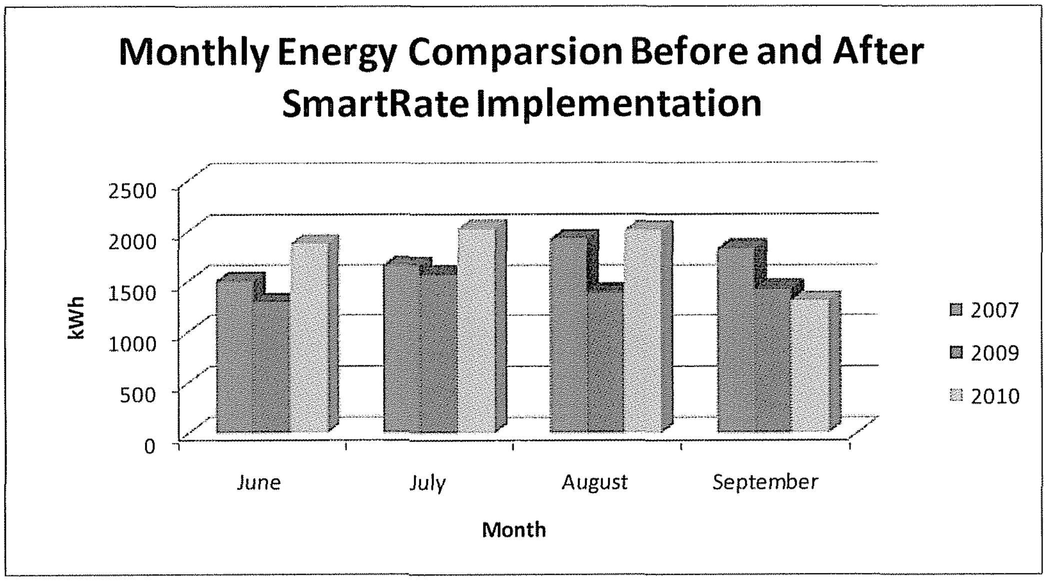
-2007 CDD values are from Louisville International Airport. 2009 and 2010 CDD values are from Bowman Field
-2008 billing data was omitted because not all SmartRate customers had been installed by June 2008
-Baseline level of 29 kWh per day is the average SmartRate daily use when the Number of Degree Days < 5

Based on the information presented in the table above, it does not appear that participation in the SmartRate program affects the amount of energy customers use per CDD. Each year SmartRate customers use a little over 2 kWh, above baseline, per CDD. The major impact of the SmartRate program is when customers use energy, not how much energy they use. The following table compares each year's weather dependent usage based on the 30 year average number of summer CDD in Louisville.

LG&E SmartRate Billing Data Comparison Before and After Rate Implementation Weather Normalized Summer Energy Comparison				
	Weather Dependent Energy per CDD	Normal CDD	Weather Normalized Energy in kWh	Difference from 2007
Summer 2007	1.927	1271	2449	-
Summer 2009	1.905	1271	2421	-28
Summer 2010	2.019	1271	2566	117

SmartRate customer behavior in 2009 indicates that they would use slightly less weather dependent energy than they would have in 2007. This was reversed in 2010. Based on these results, the effects of this program would be better described as load-shifting, rather than load-reducing. The main focus of this report is to examine the size and scale of these shifts.

In the graph below, the average monthly consumption of the SmartRate customers before program implementation, 2007, is compared to the average monthly consumption since implementation.

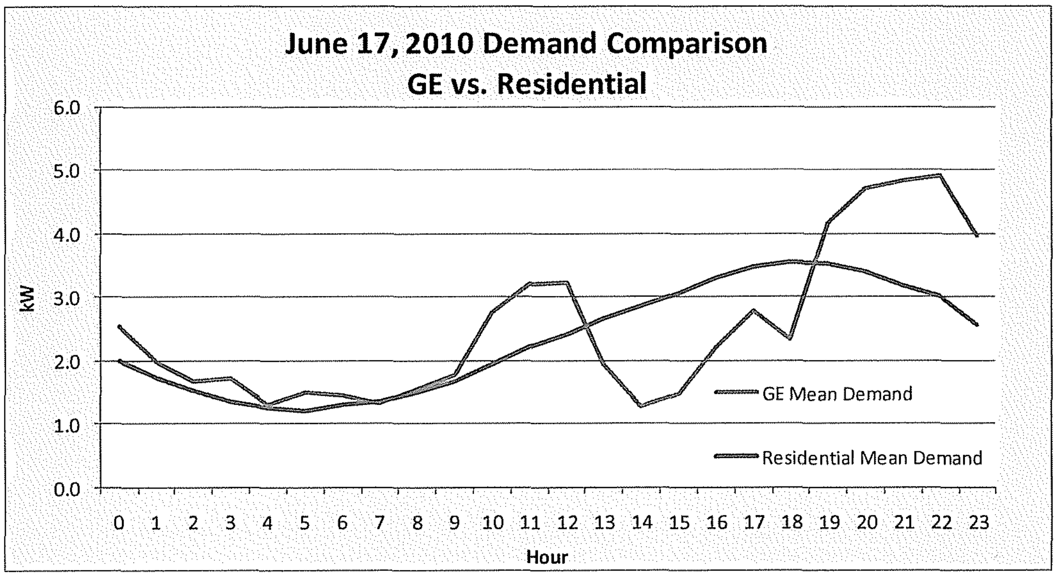


GE Impact Analysis

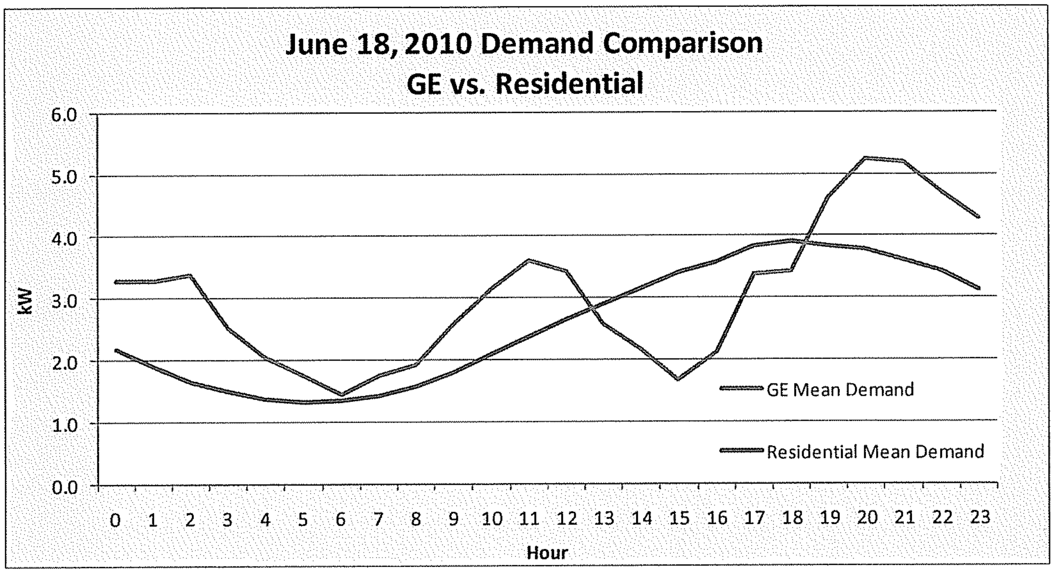
The GE group is a subgroup of the SmartRate group made up of GE employees. These customers received all of the equipment choices: a thermostat, display device and water heater control, along with GE smart appliances. These customers also received the CPP rate and were notified of CPP implementation. There were 10 customers participating in this group. GoodCents divided the GE customers' monthly usages into 3 strata based on total monthly kWh. Next, a random sample of 500 customers was selected from the Control group using the strata breakpoints to produce a Control comparison group. This Control comparison group is what is referred to as 'Residential Customers' in the following charts and tables. The methodology for selecting the Control comparison group is explained in more detail in Appendix A. Strata breakpoints are provided in Appendix B.

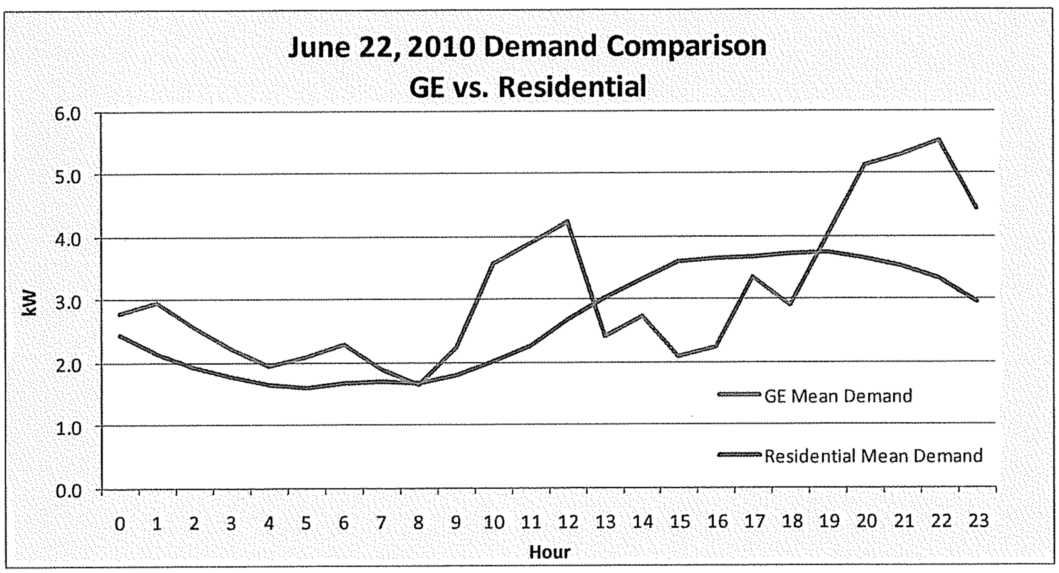
Comparison of GE Customer's Energy Usage on CPP Days

GoodCents developed average load shapes for all days that the critical peak rate was initiated for both the GE customers and the GE Control comparison group. Each critical peak pricing day is examined in detail below. In the graph below, the average hourly loads of the two groups are compared on the first CPP day of 2010, June 17^{th}.

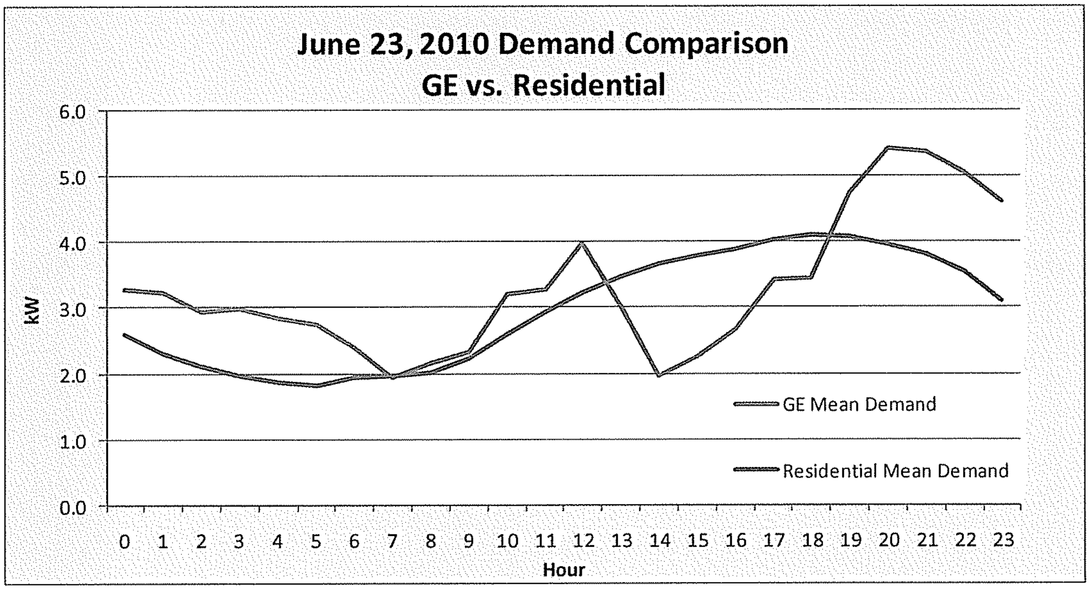


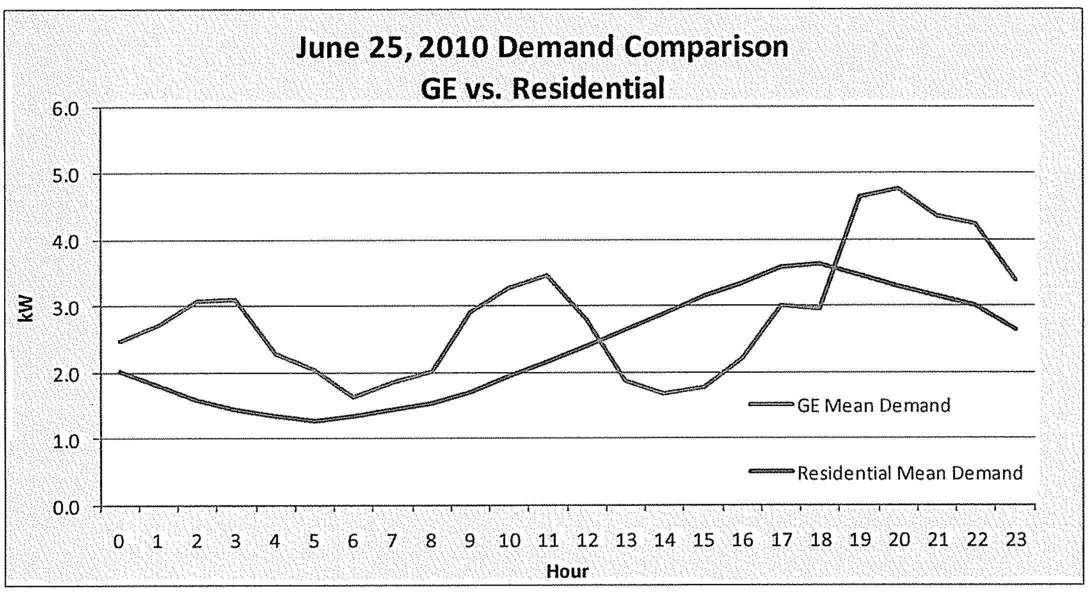
The following plots show the comparison for the CPP days June 18th and June 22nd. Notice that the average hourly load of the GE group is considerably higher than that of the residential customers for all hours that the 'High' and 'Critical' tiers are not in place. On June 18th, the GE customers used an average of 11.84 more kWh than residential customers. On June 22nd, the difference was 11.03 kWh. The result of this discrepancy is that load reductions are diminished and bounce-back effects are inflated.



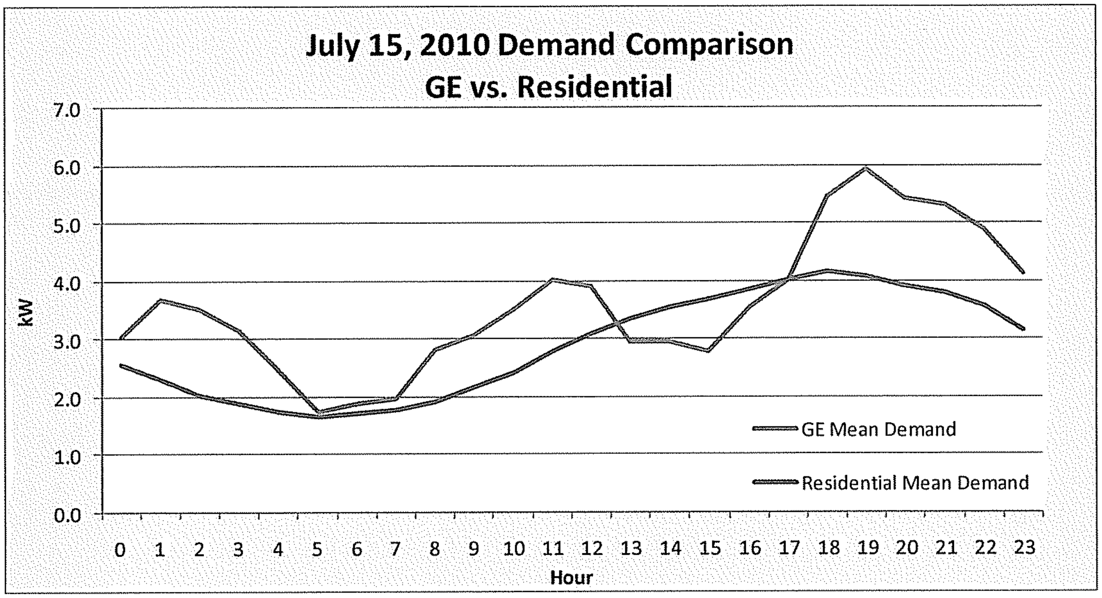


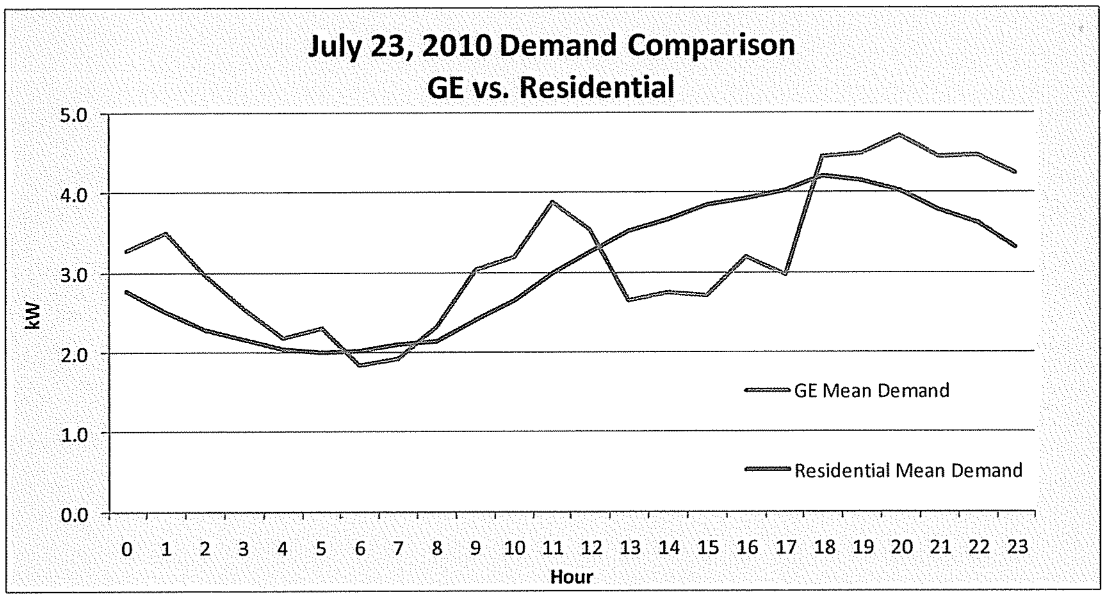
Below is the comparison for the CPP days June 23rd and June 25th. The differences in the average energy used by the two groups were 8.26 kWh on June 23rd and 11.72 kWh on June 25th. This uneven matching of the test group and the Control comparison group is a consequence of the small sample size of the GE group.



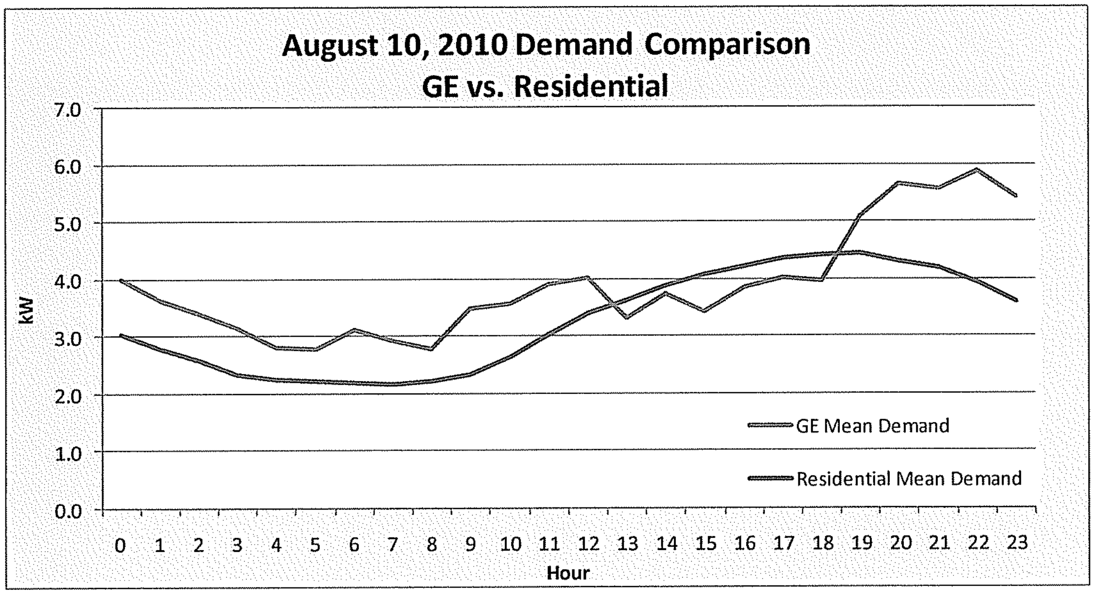


Below is the comparison for the CPP days July 15th and July 23rd. The 'Critical' rate was in place from 3:00 pm to 6:00 pm for these two events. On July 15th, the GE customers averaged 86.24 kWh, while the residential customers only averaged 69.22 kWh. This makes load reductions appear small and bounce-back effects appear very large. Average daily use was much closer on July 23rd, with the GE customers averaging only 4.20 kWh more than its Control comparison group.





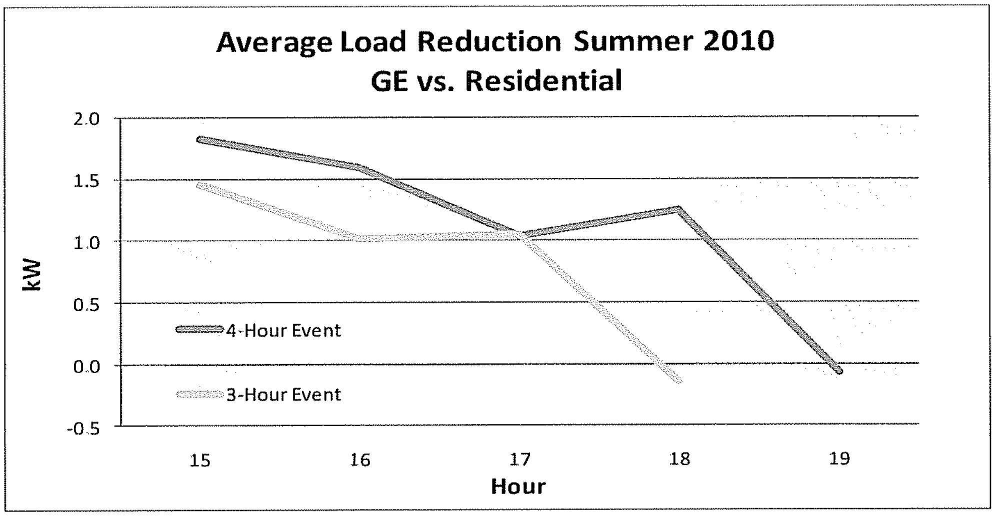
Last, the CPP day August 10th is displayed below. This was the hottest CPP day of 2010 and the dramatic load reductions that were observed on previous CPP days are not present.



The following table shows the difference in energy usage by CPP day for the GE group versus the Control comparison group. Recall from the previous graphs that the GE group used more energy than its Control comparison group on many of the CPP days. This diminishes the size of the load reductions and inflates the load impact during the bounce-back period.

CPP Day Comparison 2010 - GE Customers							
Day	**Max Temperature**	**Group**	**15**	**16**	**17**	**18**	**19**
17-Jun	90	GE	1.484	2.223	2.786	2.345	4.156
17-Jun	90	Control	3.049	3.313	3.480	3.545	3.520
17-Jun	90	**Difference**	**-1.565**	**-1.090**	**-0.694**	**-1.201**	**0.637**
18-Jun	93	GE	1.667	2.128	3.375	3.424	4.599
18-Jun	93	Control	3.397	3.585	3.824	3.907	3.835
18-Jun	93	**Difference**	**-1.730**	**-1.457**	**-0.448**	**-0.483**	**0.764**
22-Jun	93	GE	2.090	2.232	3.352	2.913	4.021
22-Jun	93	Control	3.590	3.638	3.677	3.726	3.758
22-Jun	93	**Difference**	**-1.500**	**-1.405**	**-0.325**	**-0.813**	**0.263**
23-Jun	94	GE	2.249	2.680	3.428	3.448	4.740
23-Jun	94	Control	3.789	3.890	4.033	4.111	4.068
23-Jun	94	**Difference**	**-1.540**	**-1.210**	**-0.605**	**-0.663**	**0.672**
25-Jun	91	GE	1.777	2.212	2.995	2.947	4.645
25-Jun	91	Control	3.151	3.351	3.578	3.630	3.476
25-Jun	91	**Difference**	**-1.374**	**-1.140**	**-0.583**	**-0.682**	**1.169**
15-Jul	94	GE	2.793	3.556	4.030	5.465	5.931
15-Jul	94	Control	3.697	3.866	4.036	4.158	4.079
15-Jul	94	**Difference**	**-0.904**	**-0.310**	**-0.006**	**1.307**	**1.853**
23-Jul	95	GE	2.716	3.193	2.966	4.443	4.501
23-Jul	95	Control	3.843	3.922	4.034	4.202	4.144
23-Jul	95	**Difference**	**-1.127**	**-0.728**	**-1.068**	**0.241**	**0.357**
10-Aug	100	GE	3.444	3.861	4.034	3.978	5.091
10-Aug	100	Control	4.084	4.217	4.350	4.409	4.443
10-Aug	100	**Difference**	**-0.639**	**-0.356**	**-0.316**	**-0.431**	**0.648**

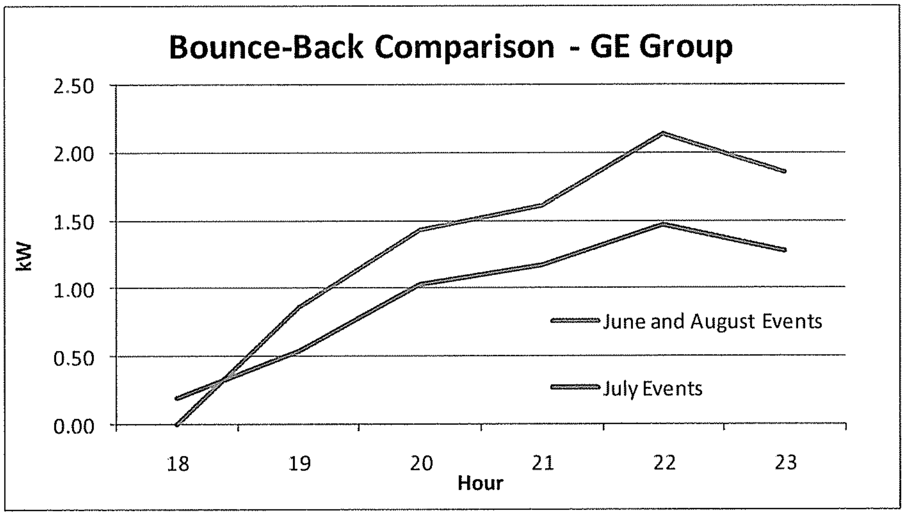
The following graph shows the adjusted average load reductions for each hour over all CPP days. This adjustment takes into consideration the differences in average daily usage between the GE group and its Control comparison group by comparing differences in the percent of daily load which occur during each hour and applying these differences to the average load of the GE group. This technique accounts for the reduced demand differences observed during CPP due to the GE group's higher usage.



The average load reduction is greatest during the first hour of the critical rate but then decreases throughout the critical peak pricing period. It is apparent from the graph that customers begin to use their appliances during the last hour of the critical rate. Customers could be preparing dinner or watching the news, etc.

Bounce-Back after Release of CPP

The customer's load rebounds as CPP is released. We begin to see this effect in the hour immediately following CPP, but loads remain higher than the Control comparison group for several hours after control is released. The highest bounce-back after release of the CPP signal occurs in hour 22.



The following table compares the hours following CPP for the eight days when 'Critical' pricing was enacted in 2010. Remember that these observed differences inflate the bounce-back effect because GE customers are using more energy than residential customers on these days.

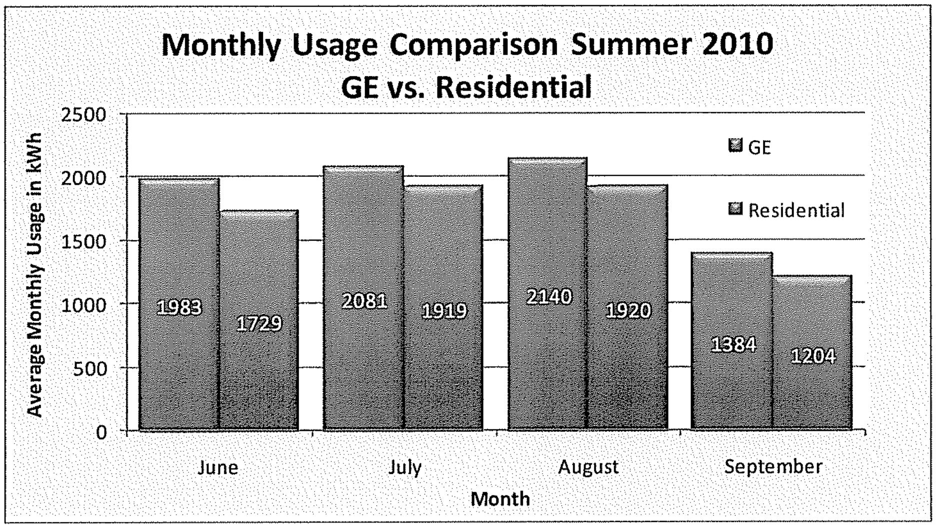
Observed Differences Between GE and Residential During Bounce-Back Period on CPP Days							
Date	Group	Hour					
		18	19	20	21	22	23
17-Jun	GE kW	-	4.156	4.706	4.832	4.908	3.968
17-Jun	Residential kW	-	3.520	3.406	3.189	3.000	2.565
17-Jun	**Difference kW**	-	**0.637**	**1.301**	**1.643**	**1.908**	**1.404**
18-Jun	GE kW	-	4.599	5.234	5.191	4.710	4.279
18-Jun	Residential kW	-	3.835	3.780	3.618	3.420	3.121
18-Jun	Difference kW	-	**0.764**	**1.453**	**1.574**	**1.290**	**1.158**
22-Jun	GE kW	-	4.021	5.135	5.303	5.522	4.430
22-Jun	Residential kW	-	3.758	3.654	3.513	3.334	2.955
22-Jun	**Difference kW**	-	**0.263**	**1.480**	**1.790**	**2.187**	**1.475**
23-Jun	GE kW	-	4.740	5.414	5.370	5.045	4.604
23-Jun	Residential kW	-	4.068	3.968	3.804	3.537	3.102
23-Jun	**Difference kW**	-	**0.672**	**1.445**	**1.566**	**1.509**	**1.502**
25-Jun	GE kW	-	4.645	4.764	4.346	4.242	3.400
25-Jun	Residential kW	-	3.476	3.293	3.156	3.001	2.639
25-Jun	**Difference kW**	-	**1.169**	**1.472**	**1.191**	**1.241**	**0.761**
15-Jul	GE kW	5.465	5.931	5.426	5.314	4.898	4.148
15-Jul	Residential kW	4.158	4.079	3.914	3.800	3.560	3.156
15-Jul	**Difference kW**	**1.307**	**1.853**	**1.512**	**1.514**	**1.338**	**0.993**
23-Jul	GE kW	4.443	4.501	4.720	4.460	4.471	4.257
23-Jul	Residential kW	4.202	4.144	4.018	3.784	3.631	3.328
23-Jul	**Difference kW**	**0.241**	**0.357**	**0.702**	**0.676**	**0.840**	**0.929**
10-Aug	GE kW	-	5.091	5.644	5.572	5.880	5.425
10-Aug	Residential kW	-	4.443	4.314	4.201	3.934	3.587
10-Aug	**Difference kW**	-	**0.648**	**1.330**	**1.371**	**1.946**	**1.838**

The load increase after CPP is released is substantial and should be taken into account by system planning if the CPP program is offered to significant numbers of customers. The demand comparison for the GE group shows that the average bounce-back for the GE customers will be approximately 2.0 kW on hot afternoons if CPP is called for four hours and approximately 1.5 kW if CPP is called for three hours on a hot afternoon. This indicates that limiting the duration of CPP will decrease the size of the bounce-back. The specific needs of the utility should be considered when deciding how to best manage this load increase.

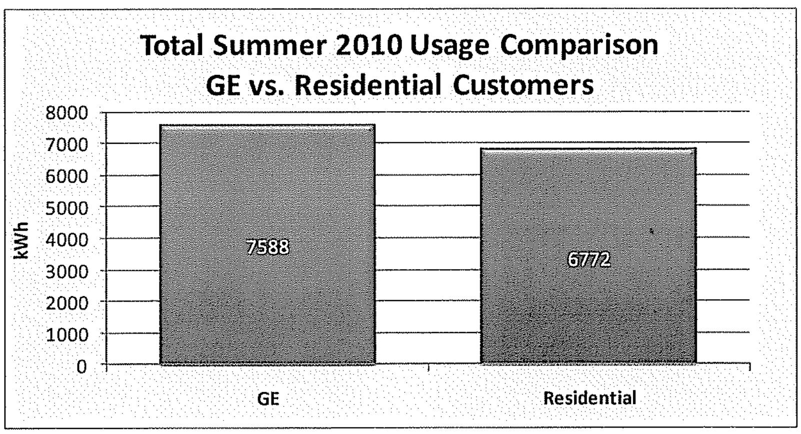
Regression models were developed to compare the GE customers' weekday usage patterns with members of the Control comparison group. This model was run using three separate subsets of summer data to generate load impact estimates under different conditions. The parameters produced by these models assume the hourly rate structure that was present during the summer of 2010. Appendix C contains the regression methodology, parameter estimates and calculations of load reduction based on these estimates.

Summer Energy Use and Cost Comparison for the GE Group

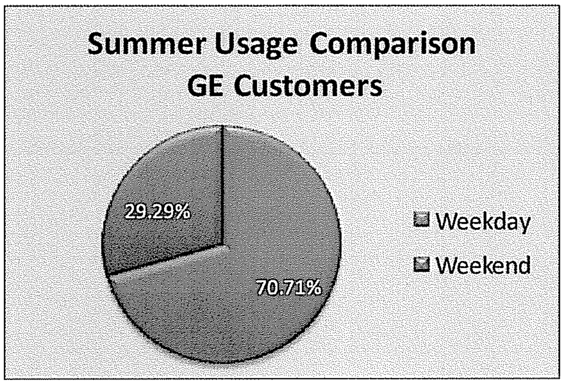
The following graph shows the average monthly consumption for the GE customers and its Control comparison groups from June to September. Each month, the GE customers used more energy than the residential customers. Load reduction and bounce-back estimates must be adjusted to account for this difference.

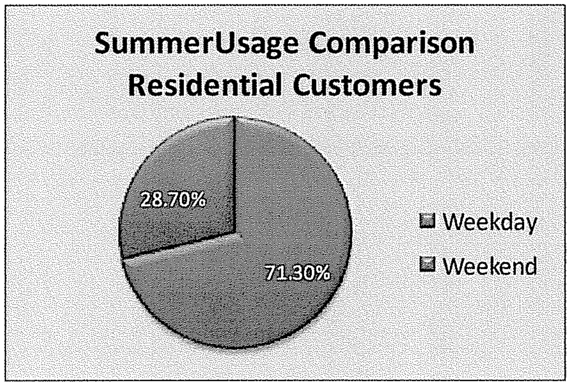


The GE customers use more energy during the summer months. As the graph above shows, the difference is greater than 150 kWh each month. The month of June shows the largest difference in energy usage, with a difference of 254 kWh.

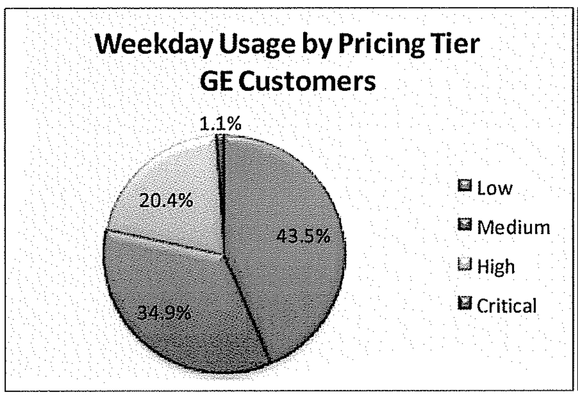


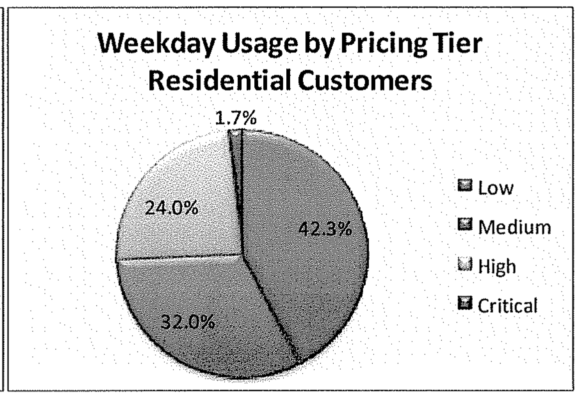
GE customers are subjected to both 'High' and 'Critical' pricing on weekdays. They receive visual signals on their thermostat and IHD device and can program their GE Smart appliances not to run when these pricing tiers are in effect. This occurs from 1:00 pm to 6:00 pm during June, July, August and September. 'High' and 'Critical' rates are not in effect on weekends under either the winter or summer rate schedules. The two pie charts below compare weekday and weekend consumption levels during these months and show that GE customers use a smaller percentage of their summer power on weekdays than standard residential customers. Because the kWh usages of the two groups are not identical, it is important to use percentages of seasonal usage when comparing the two.





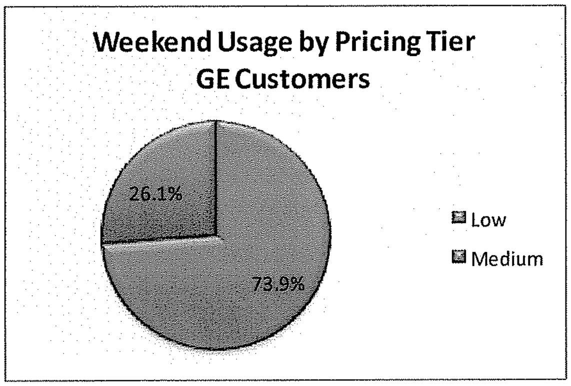
The next two pie charts show how the two groups differ on weekdays during the different pricing periods.

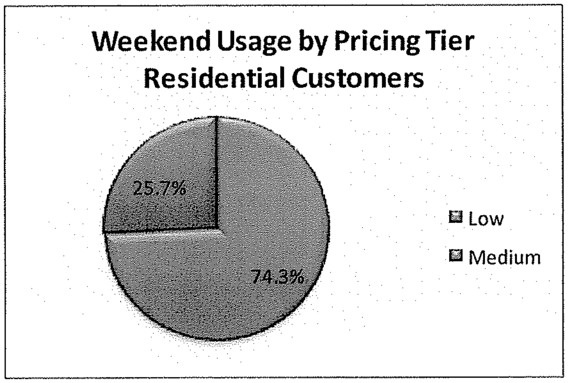




GE customers use significantly less energy than residential customers during 'Critical' and 'High' pricing periods. GE customers use an even smaller percentage of their weekday energy than the SmartRate group as a whole during these hours. This is exactly what the GE program is designed to accomplish, enhance the load reductions produced by the SmartRate program.

The final pair of pie charts compares these groups on weekends. There are no 'High' or 'Critical' periods on weekends, so differences between the two groups on weekends should be much less dramatic than on weekdays.





However, the 'Medium' pricing period gives participants some incentive to shift loads away from peak afternoon hours. The GE customers do not appear to respond to this weekend incentive because they are using a larger percentage of their weekend energy during the 'Medium' pricing period than residential customers.

The following table provides a breakdown of how an average GE customer's summer energy bills would look under the responsive pricing structure and the standard residential rate.

Summer Billing Comparison -GE Customers

GE

Service Fees	Months	Total
Electric No. 7 - $10 per month	2	$20
Electric No. 8 - $13.50 per month	2	$27
Total kWh = 7588.62		
Rate	**kWh**	**Bill**
$0.04628	2207.57	$102.17
$0.05859	1259.89	$73.82
$0.11278	525.76	$59.30
$0.30743	71.01	$21.83
$0.04872	1868.53	$91.03
$0.06168	1086.83	$67.04
$0.11873	553.71	$65.74
$0.32364	15.32	$4.96
Total Bill		$532.89

Residential Rate

Service Fees	Months	Total
Electric No. 7 - $5 per month	2	$10
Electric No. 8 - $8.50 per month	2	$17
Total kWh = 7588.62		
Rate	**kWh**	**Bill**
kWh at $.06714	4064.23	$272.87
kWh at $.07068	3524.38	$249.10
Total Bill		$548.97
Savings = $16.09		
Assumes that the average GE customer was billed on SmartRate and Residential Rate		

As the table shows, average customer savings are about $4 per month on the GE program. This is a slightly larger savings than was observed with the SmartRate group as a whole.

GE Impact Analysis Conclusions

The GE group was a sub-group of the SmartRate group that was given 'Smart' appliances that could be programmed in accordance with the rate schedule. Based on an examination of hourly load shapes and regression modeling of load reductions during 'High' and 'Critical' pricing periods, the GE subgroup shows even more response to the responsive pricing structure and accompanying equipment than the SmartRate group as a whole. In order to better analyze how the GE customers' behavior compares to residential customers, a monthly subsection of the Control group was selected whose monthly usage was distributed similarly to the GE customers.

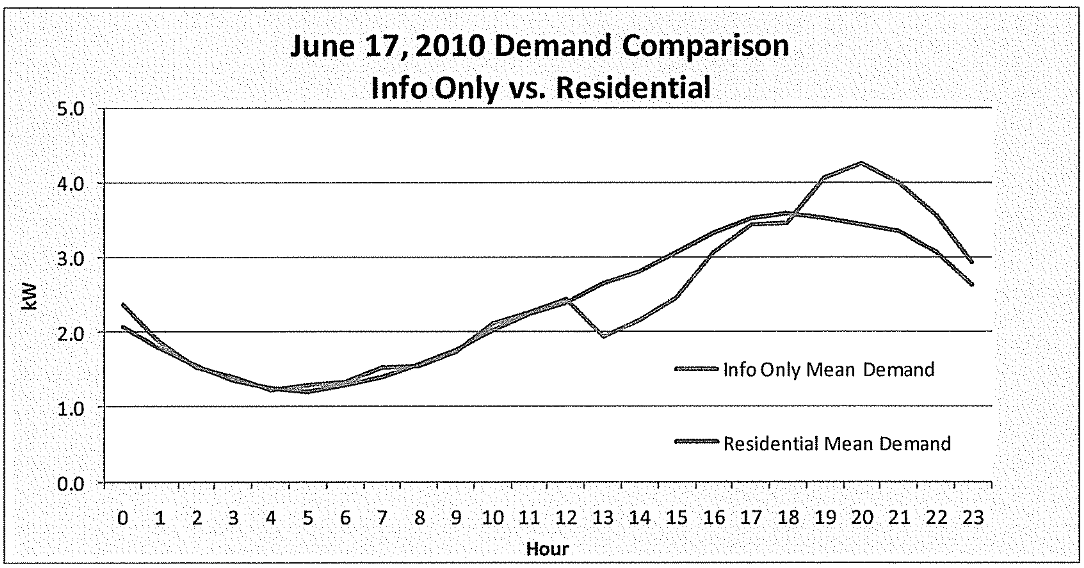
The 'High' Pricing period under the summer rate schedule occurs on weekdays from 1:00 pm to 6:00 pm. The GE customers used 20.4% of their weekday energy during this period, while the residential customers used 24.0%. Eight critical peak pricing events were called during the summer of 2010. Each of these events began at 3:00 pm. GE customers used an even smaller percentage of their weekday energy than SmartRate customers, as a whole, during 'Critical' and 'High' pricing periods. While peak rates reduce demand while they are in effect, they do little to decrease a customer's overall demand. A bounce-back period occurs during the first few hours after the peak rates end. For example, there were five CPP events called during June. On two days, June 17th and 23rd, residential customers used a larger percentage of their monthly energy than the GE customers. On the other three event days, June 18th, 22nd and 25th, the pattern was reversed and the GE customers used a larger percentage of their monthly energy. The purpose of the responsive pricing system isn't to reduce overall consumption, but to shift demand away from peak hours. The addition of GE Smart appliances to the other equipment and pricing features of the SmartRate program increased the load shifting capabilities of the program during the summer of 2010.

Information Only Impact Analysis

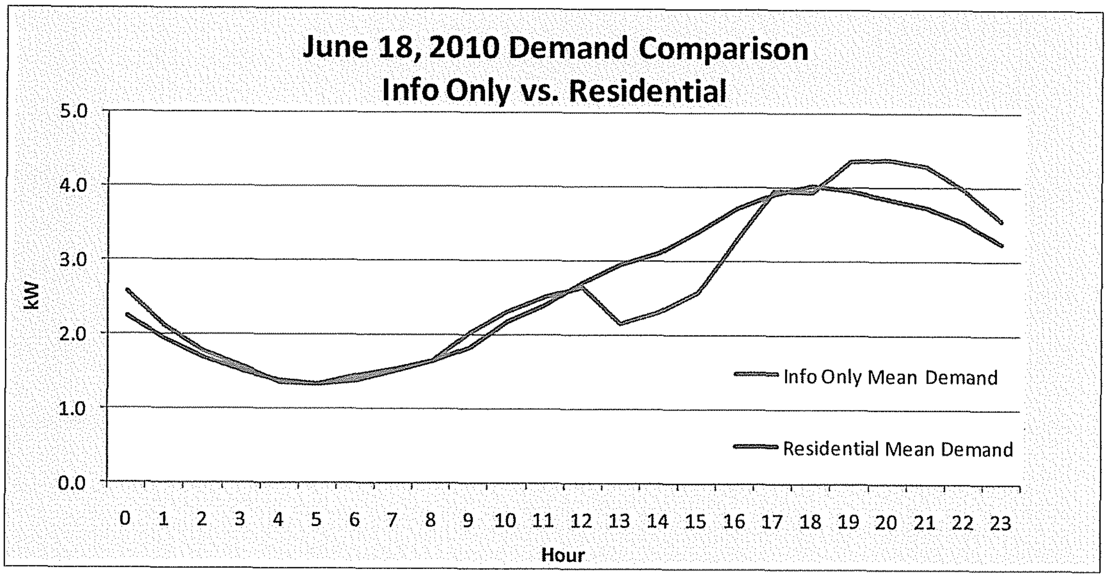
The Information Only group received a thermostat and a display device, but no rate control. There were 79 customers participating in this group during the summer of 2010. GoodCents divided the Information Only customers' monthly usages into 3 strata based on total monthly kWh. Next, a random sample of 500 customers was selected from the Control group using the strata breakpoints to produce a Control comparison group. This Control comparison group is what is referred to as 'Residential Customers' in the following charts and tables. The methodology for selecting the Control comparison group is explained in more detail in Appendix A. Strata breakpoints are provided in Appendix B.

Comparison of Information Only Energy Usage on CPP Days

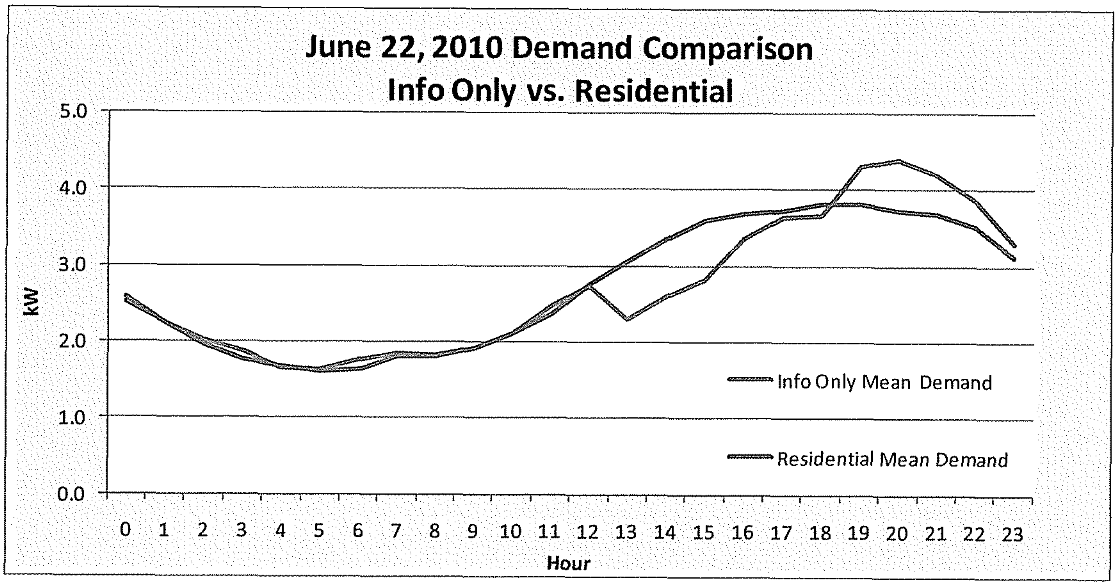
GoodCents developed average load shapes for all days that the critical peak rate was initiated for both the Information Only customers and its Control comparison groups. In the graph below, the average hourly loads of the two groups are compared on June 17th, when the maximum daily temperature was 90 Degrees (F). The Information Only customers used approximately 0.65 kW less energy each hour from 1:00 pm to 4:00 pm.

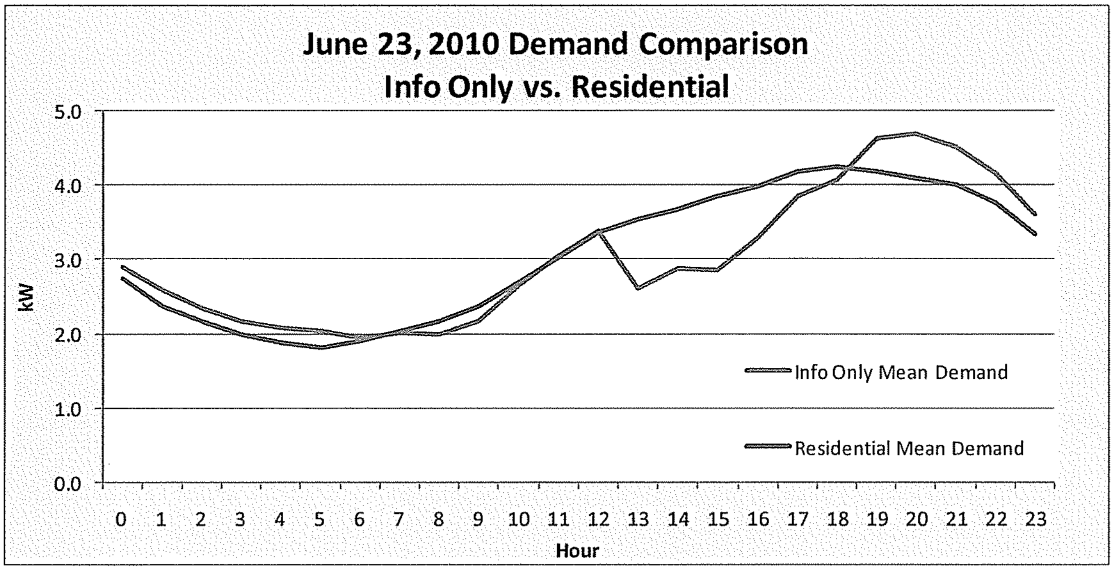


The maximum daily temperature in the Louisville area was 93 Degrees (F) on both June 18th and June 22nd. These graphs compare the average demand of the Information Only customers to its Control comparison group on these days. The average load comparisons on these two days are shown in the graphs below. The five CPP events called in June all lasted from 3:00 pm to 7:00 pm.

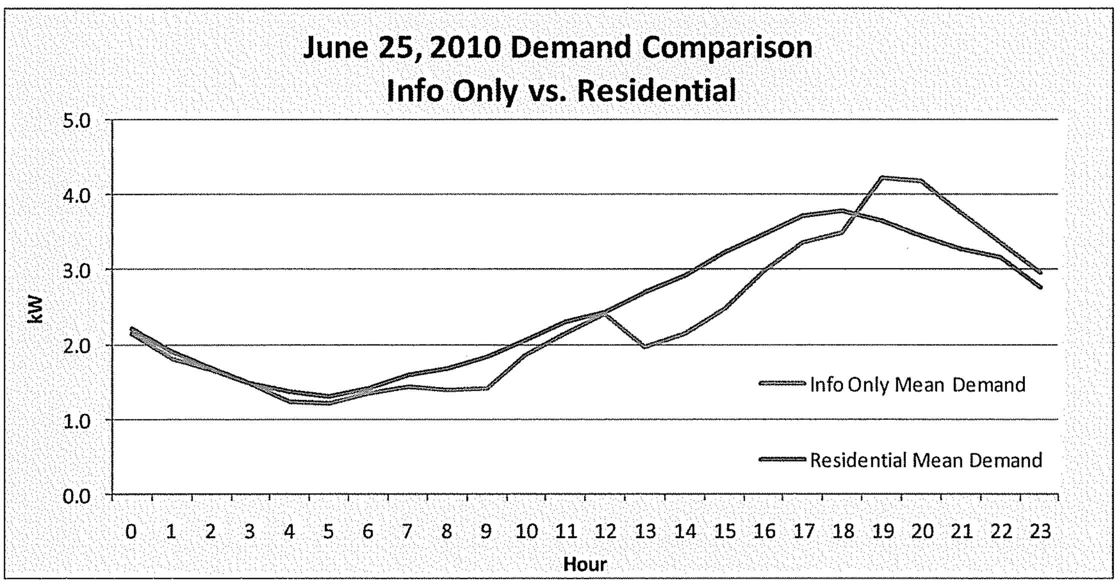


The Information Only group shows significant load reduction on both of these days, followed by the expected bounce-back beginning at 7:00 pm.

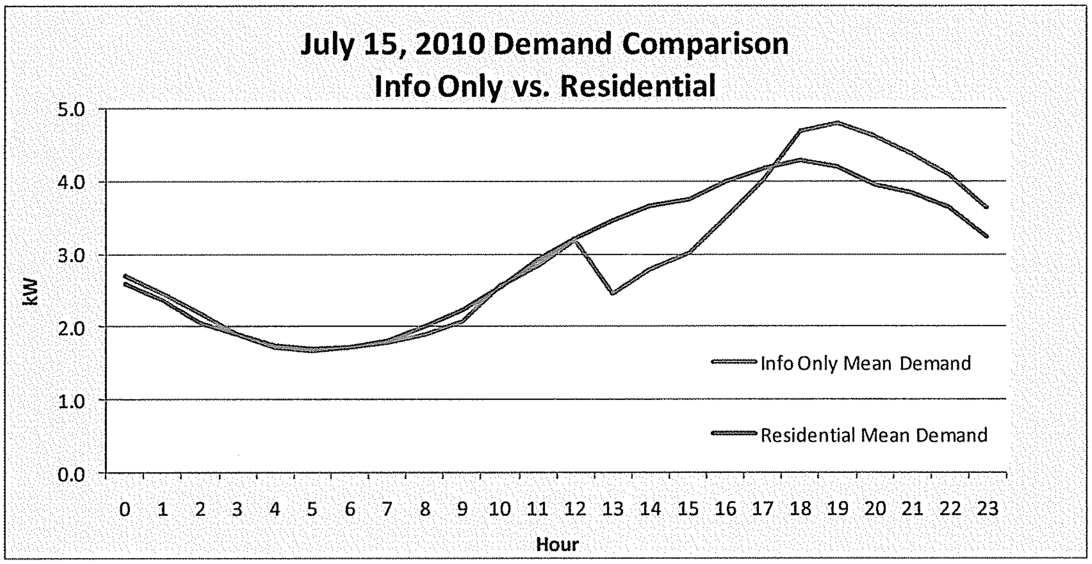




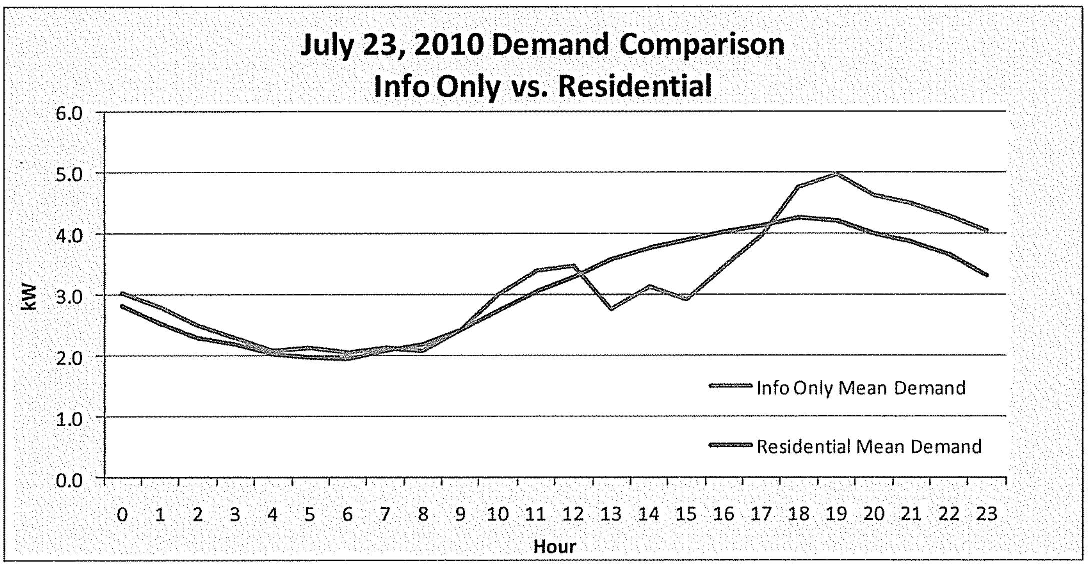
The maximum daily temperature in the Louisville area was 94 Degrees (F) on June 23rd and 91 Degrees (F) on June 25th. These graphs compare the average demand of the Information Only customers to its Control comparison group on these days. During hour 15 on June 23rd, the Information Only customers average 0.99 kW less demand than residential customers.



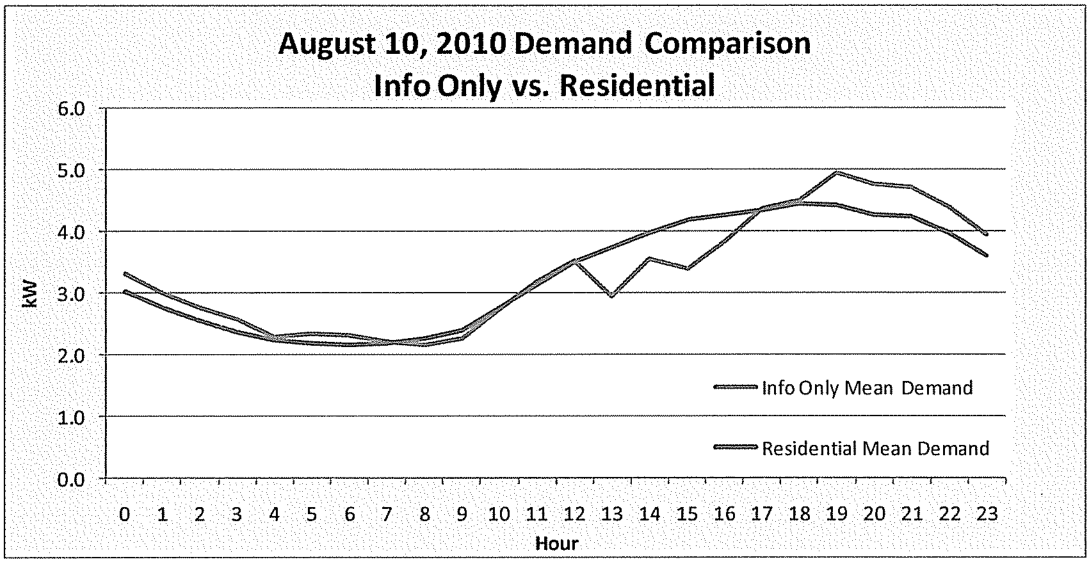
The two CPP events called in July lasted from 3:00 pm to 6:00 pm. The maximum daily temperature in the Louisville area was 94 Degrees (F) on July 15th and 95 Degrees (F) on July 23rd. The graphs below compare the average demand of the Information Only customers to its Control comparison group on these days.



The demand difference during hour 13 on July 15th was over 1 kW.



The CPP event called on August 10th lasted from 3:00 pm to 7:00 pm. This was the hottest CPP event of 2010, with a maximum daily temperature of 100 Degrees (F). It is interesting that the CPP day with the warmest temperatures showed some of the smallest load reductions.



The following table shows the difference by CPP day for the Information Only group versus the Control comparison group for each CPP period. June 23rd had the largest difference of 0.99 kW occurring at hour 15. The load reduction during hour 13 on July 15th was 1.01 kW. It is noteworthy that the an hourly load reduction occurred during a 'High' pricing period that was larger than any occurring during 'Critical' pricing.

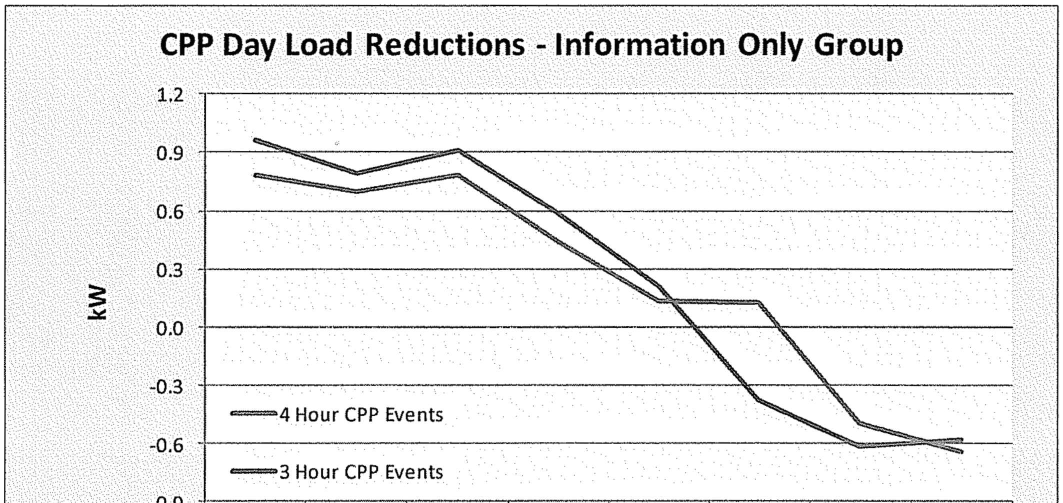
CPP Day Comparison 2010 - Information Only Customers							
Day	Max Temperature	Group	15	16	17	18	19
17-Jun	90	Info Only	2.46	3.06	3.43	3.45	4.06
17-Jun	90	Control	3.07	3.32	3.52	3.59	3.53
17-Jun	90	**Difference**	**-0.60**	**-0.26**	**-0.10**	**-0.15**	**0.53**
18-Jun	93	Info Only	2.59	3.28	3.96	3.94	4.35
18-Jun	93	Control	3.39	3.70	3.91	4.02	3.96
18-Jun	93	**Difference**	-0.81	-0.43	0.05	-0.08	0.40
22-Jun	93	Info Only	2.82	3.35	3.64	3.66	4.31
22-Jun	93	Control	3.59	3.69	3.73	3.80	3.81
22-Jun	93	**Difference**	**-0.78**	**-0.33**	**-0.09**	**-0.14**	**0.50**
23-Jun	94	Info Only	2.86	3.30	3.84	4.08	4.62
23-Jun	94	Control	3.85	3.98	4.18	4.26	4.19
23-Jun	94	**Difference**	**-0.99**	**-0.68**	**-0.33**	**-0.18**	**0.43**
25-Jun	91	Info Only	2.48	2.99	3.36	3.50	4.23
25-Jun	91	Control	3.23	3.48	3.72	3.79	3.65
25-Jun	91	**Difference**	**-0.75**	**-0.49**	**-0.36**	**-0.29**	**0.57**
15-Jul	94	Info Only	3.01	3.51	4.01	4.68	4.79
15-Jul	94	Control	3.76	3.99	4.16	4.28	4.19
15-Jul	94	**Difference**	**-0.75**	**-0.47**	**-0.15**	**0.40**	**0.60**
23-Jul	95	Info Only	2.92	3.46	3.99	4.77	4.98
23-Jul	95	Control	3.89	4.04	4.15	4.27	4.21
23-Jul	95	**Difference**	**-0.97**	**-0.58**	**-0.16**	**0.50**	**0.78**
10-Aug	100	Info Only	3.39	3.83	4.36	4.50	4.95
10-Aug	100	Control	4.18	4.27	4.35	4.43	4.42
10-Aug	100	**Difference**	**-0.79**	**-0.45**	**0.01**	**0.07**	**0.52**

The average total summer weekday load reduction of the Information Only group from 1:00 pm to 6:00 pm was 1.41 kWh. This is almost 70% as large as the SmartRate group, which averaged 2.03 kWh over the same period. This is noticeable because the Information Only group was not subjected to the SmartRate pricing schedule. The following tables show the average hourly differences between the Information Only group and its *Control comparison* group during weekday afternoon hours on non-CPP event days.

Average Summer Weekday Loads - Information Only Group - 1:00 pm to 8:00 pm							
Group	Hour						
	13	14	15	16	17	18	19
Information Only	2.097	2.283	2.694	3.159	3.422	3.830	3.797
Control	2.600	2.813	3.024	3.226	3.403	3.473	3.387
Load Impact	-0.503	-0.530	-0.330	-0.067	0.019	0.356	0.409

The Information Only group begins to show some significant load impacts during the summer months as temperatures rise and air conditioning demands increase. The effects of extreme temperatures are evident in the size of the average hourly loads in the preceding table. The load reductions of 0.50 kW, 0.53 kW and 0.33 kW during the first three hours of the peak period are substantial considering that the Information Only group pays a flat-rate for electricity. This reduced demand is likely the result of customers having their thermostats programmed to increase several degrees at the beginning of the peak period, even though they have no financial incentive to do so.

The Information Group also showed increased response on the eight days when CPP events were called. These load reductions are almost as large as the SmartRate group's. Notice that the bounce-back period begins at 6:00 pm for the 3-hour events, but not until 7:00 pm for 4-hour events.

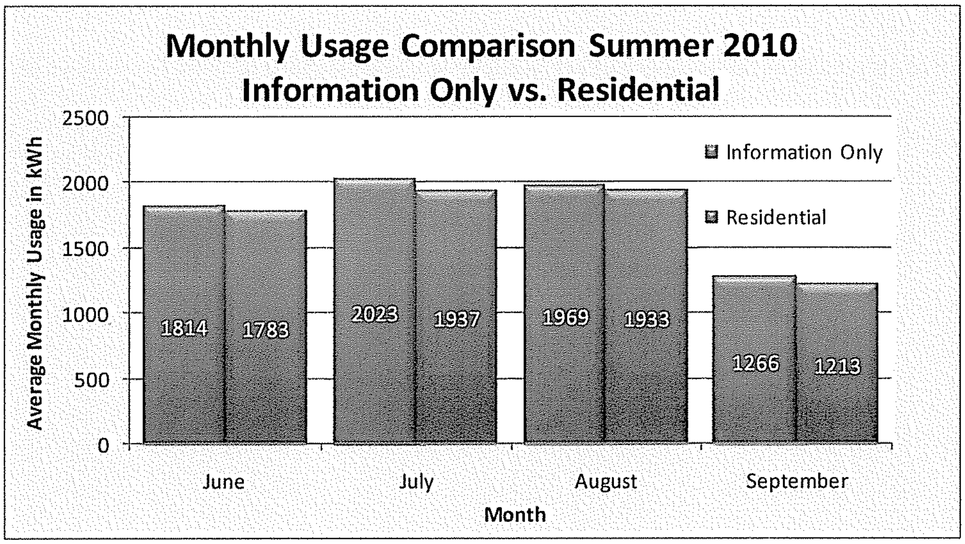


	13	14	15	16	17	18	19	20
4 Hour CPP Events	0.787	0.702	0.786	0.441	0.137	0.129	-0.494	-0.644
3 Hour CPP Events	0.965	0.793	0.913	0.586	0.216	-0.380	-0.618	-0.578

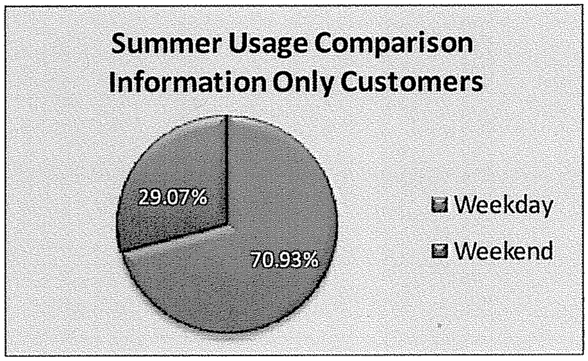
The two days when 3-hour CPP events were called were slightly warmer than the six days when 4-hour CPP events were called. This explains why the observed load reductions during hours 13 through 17 are consistently larger for 3-hour events. The shapes of the two plots are virtually identical. Information Only customers show an impressive load reduction during hour 13, followed by a slightly smaller load reduction during hour 14. A second drop occurs during hour 15. This is when the 'Critical' period begins for SmartRate customers. On non-event weekdays, this second drop was not present. The difference between Information Only customers and residential customers is larger during the second hour of the bounce-back period than during the hour immediately following the event.

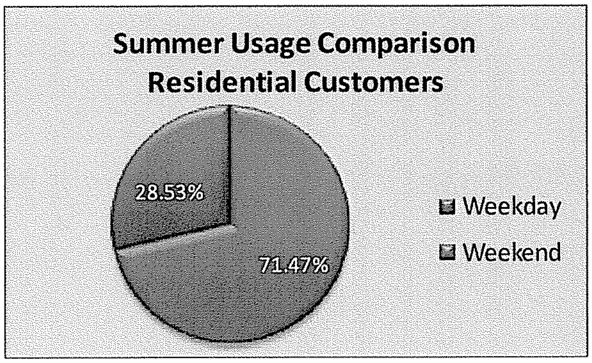
Summer Energy Use Comparison for the Information Only Group

A separate Control comparison group was selected each month for the summer of 2010. Differences between the Information Only and residential customers over the course of the summer were minimized by mimicking the stratification of the experimental group. The following graph shows the average monthly consumption for the Information Only customers and its Control comparison groups from June to September.



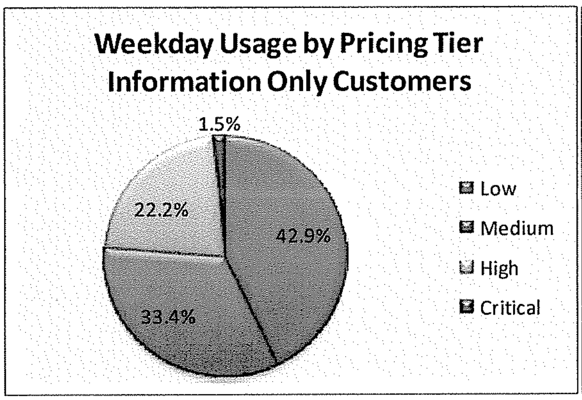
Information Only customers receive visual thermostat and IHD signals during 'High' and 'Critical' pricing periods even though they pay a flat-rate. This occurs from 6:00 pm to 10:00 pm on weekdays during March, April, and May and 1:00 pm to 6:00 pm during June, July, August, and September. 'High' and 'Critical' rates are not in effect on weekends under either the winter or summer rate schedules. The two pie charts below compare weekday and weekend consumption levels during these months.

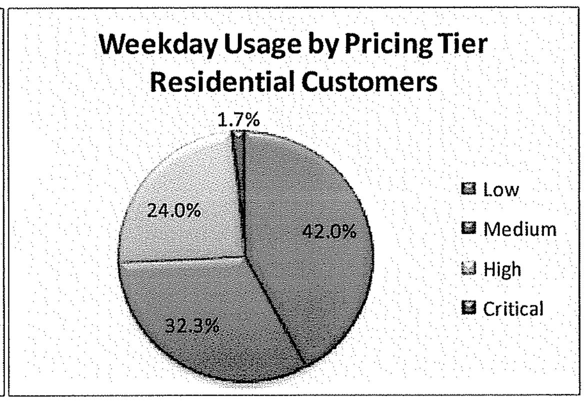




The charts above show that Information Only customers use a smaller percentage of their summer power on weekdays than standard residential customers. Because kWh usage of the two groups is not identical, it is important to use percentages of seasonal usage when comparing the two.

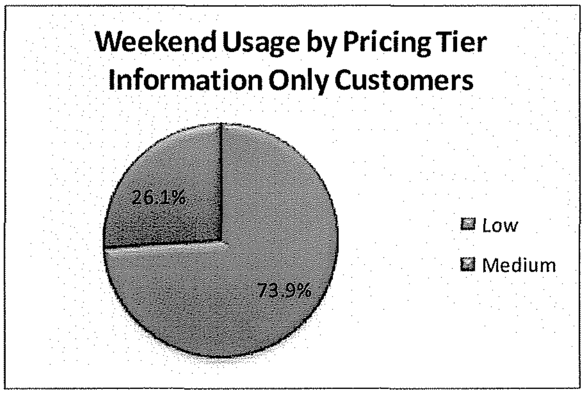
The next two pie charts show how the two groups differ on weekdays during the different pricing periods. It is important to remember that both groups pay the same price per kWh around-the-clock. The difference between the two groups is that Information Only group can program their thermostat to scale back during the 'High' and 'Critical' periods.

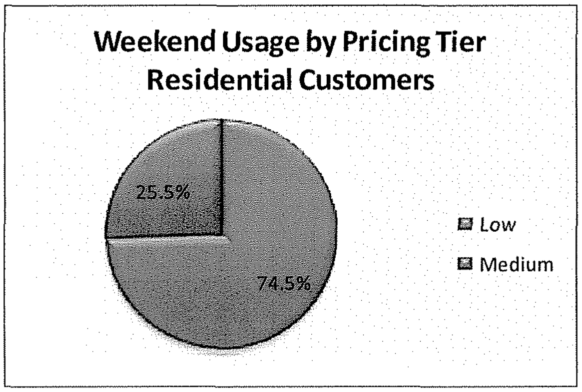




Customers are acquiescing even though they have no financial motivation to do so. Information Only customers use a smaller percentage of their weekday energy during both of the periods when they receive signals.

The final pair of pie charts compares these groups on weekends. There are no 'High' or 'Critical' periods on weekends, so differences between the two groups should be minimal.





The Information Only group uses slightly more of its weekend energy during the afternoon hours, but the difference is likely due to customer behavior patterns.

Information Only Impact Analysis Conclusions

Information Only customers receive visual thermostat and IHD signals during 'High' and 'Critical' pricing periods even though they pay a flat-rate. This occurs from 1:00 pm to 6:00 pm during June, July, August, and September. 'High' and 'Critical' rates are not in effect on weekends. Examination of the Information Only group's average hourly demand during summer months reveals that it is about 0.5 kW lower than residential customers for the first three hours that the 'High' rate is in effect. There is also an approximately 0.5 kW bounce-back period beginning at 6:00 pm, when the 'High' pricing period signals end.

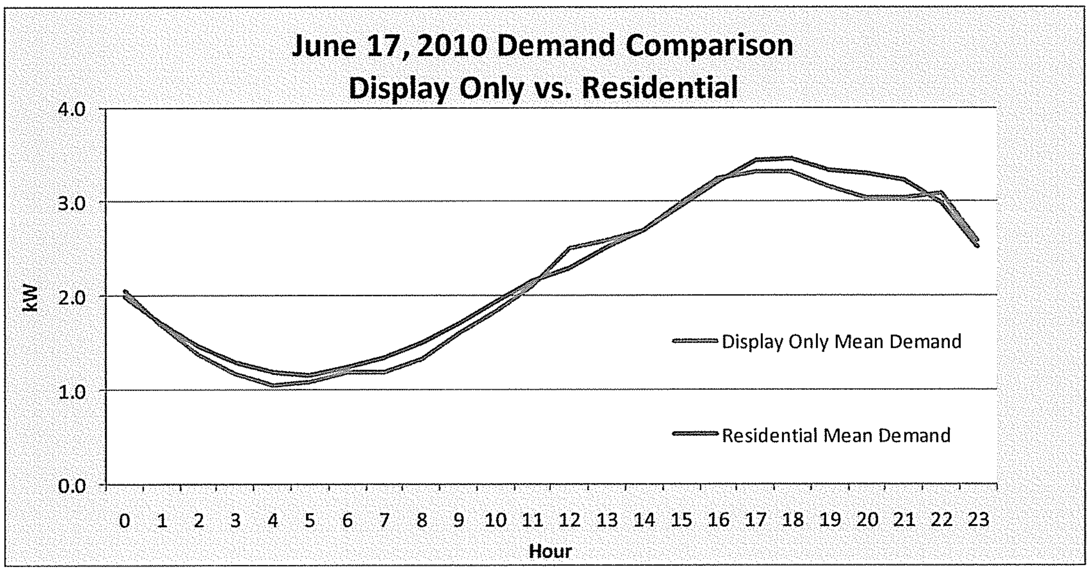
The response of the Information Only group to the peak rates is largest during June, July, and August. These are the months when HVAC demand is highest due to the hot temperatures. It appears that the Information Only customers have their thermostats programmed to respond to rate increases in the same way that SmartRate customers do. It is unlikely that these customers are programming these devices in this manner of their own volition because there is no reward in it for them. These are probably the settings that are recommended to them upon installation.

Display Only Group Impact Analysis

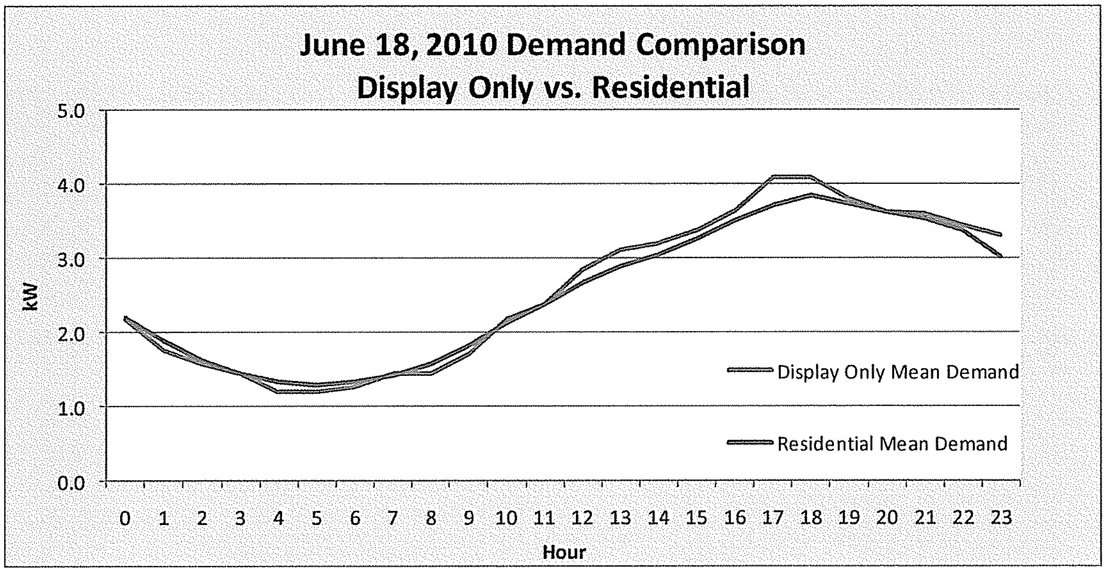
The Display Only group received an in-home display device (IHD), but no rate control. There were 89 customers participating in this group during the summer of 2010. GoodCents divided the Display Only customers' monthly usages into 3 strata based on total monthly kWh. Next, a random sample of 500 customers was selected from the Control group using the strata breakpoints to produce a Control comparison group. This Control comparison group is what is referred to as 'Residential Customers' in the following charts and tables. The methodology for selecting the Control comparison group is explained in more detail in Appendix A. Strata breakpoints are provided in Appendix B.

Comparison of Display Only Customer's Energy Usage on CPP Days

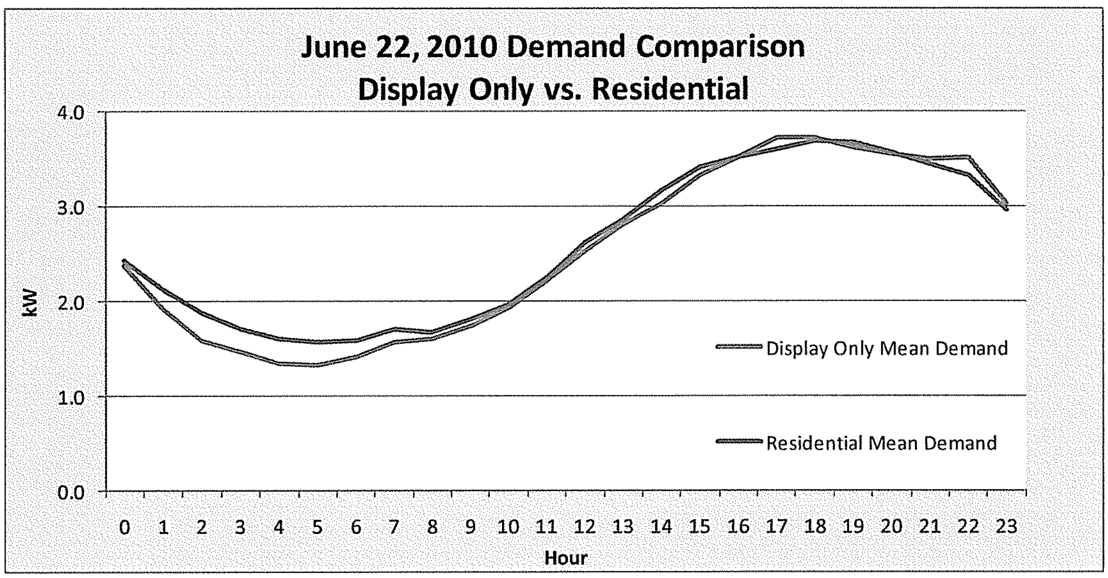
GoodCents developed average load shapes for all days that the critical peak rate was initiated for both the Display group customers and its control comparison group. Each critical peak pricing day is examined in detail below. The maximum daily temperature on June 17th was 90 Degrees (F). As the graph below shows, the largest difference between the two groups on this CPP day occurred in the early evening when the Display Only customers used approximately 0.2 kW less energy than residential customers for several consecutive hours.



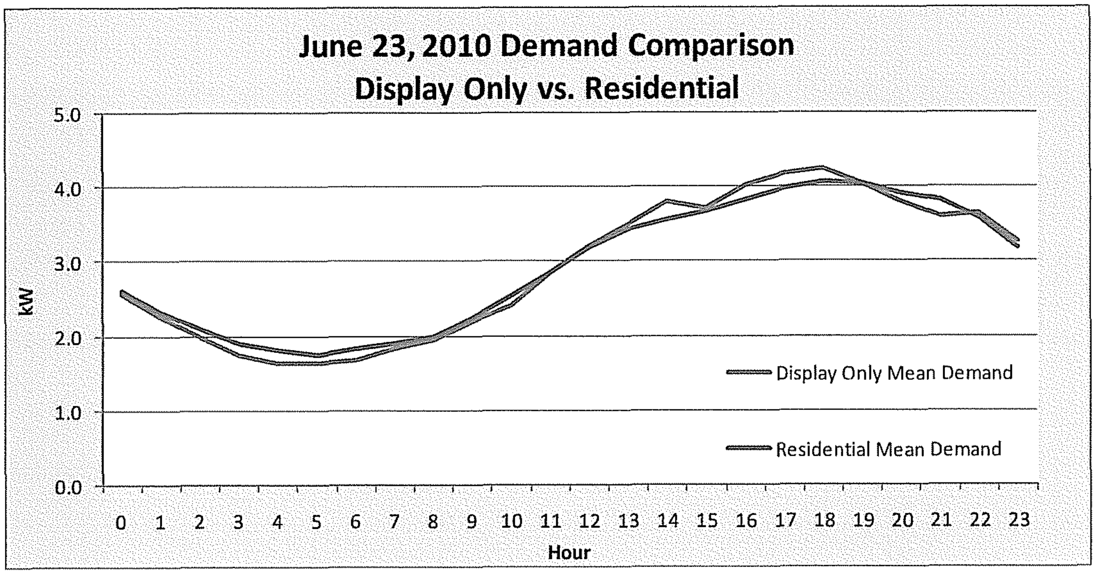
The next CPP days were June 18th and 22nd. The maximum temperature on these two days was 93 Degrees (F).



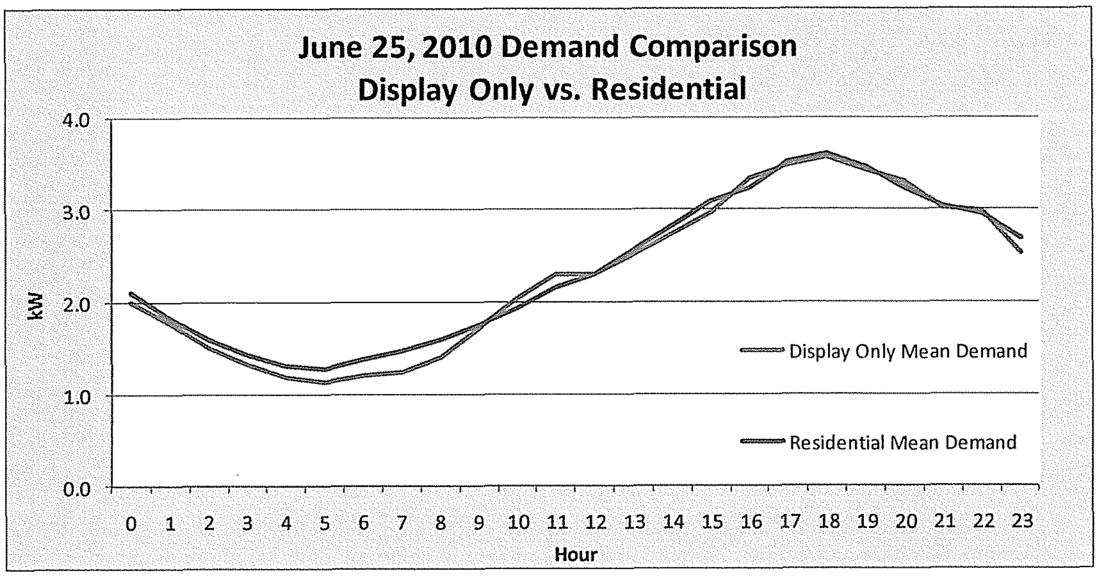
The load shapes of the Display Only customers and their Control comparison group are very similar on these two days. The in-home display device did not appear to lead to any behavior modifications from 3:00 pm to 7:00 pm.



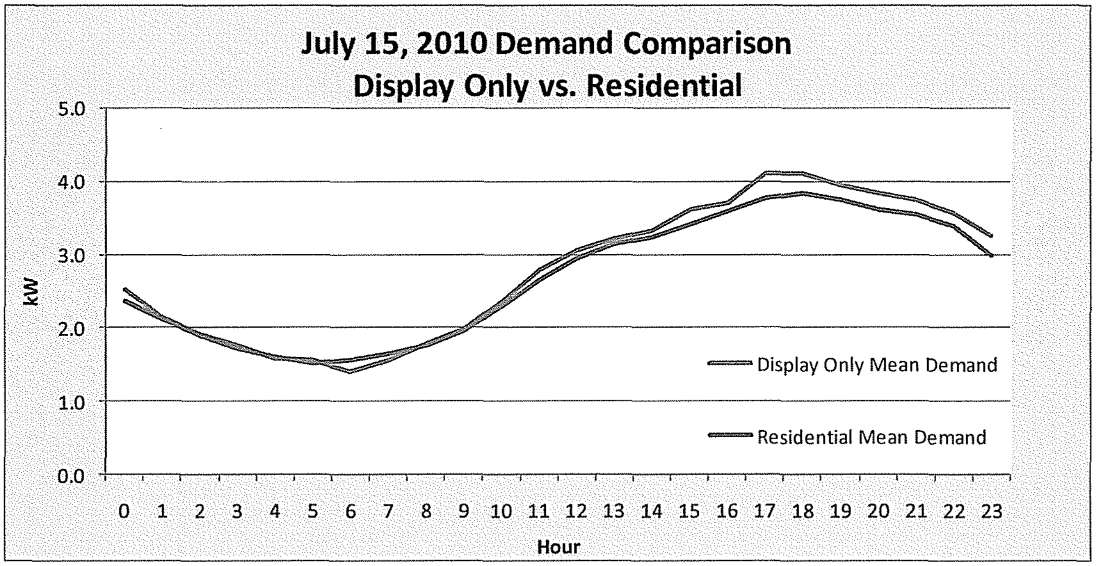
Below are the plots displaying the CPP days of June 23rd and June 25th. The maximum temperatures were 94 and 91 Degrees (F) respectively.



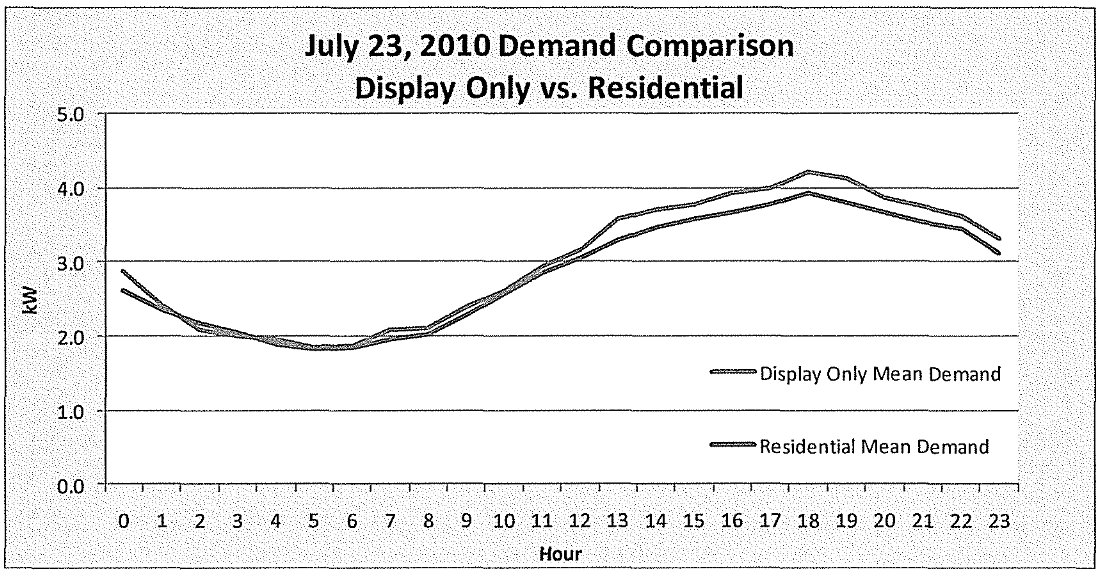
The only difference between the Display Only customers and a standard residential customer is an in-home display device. As these load shapes show, this does not seem to be producing significant demand response as a result of the IHD on these two CPP days.



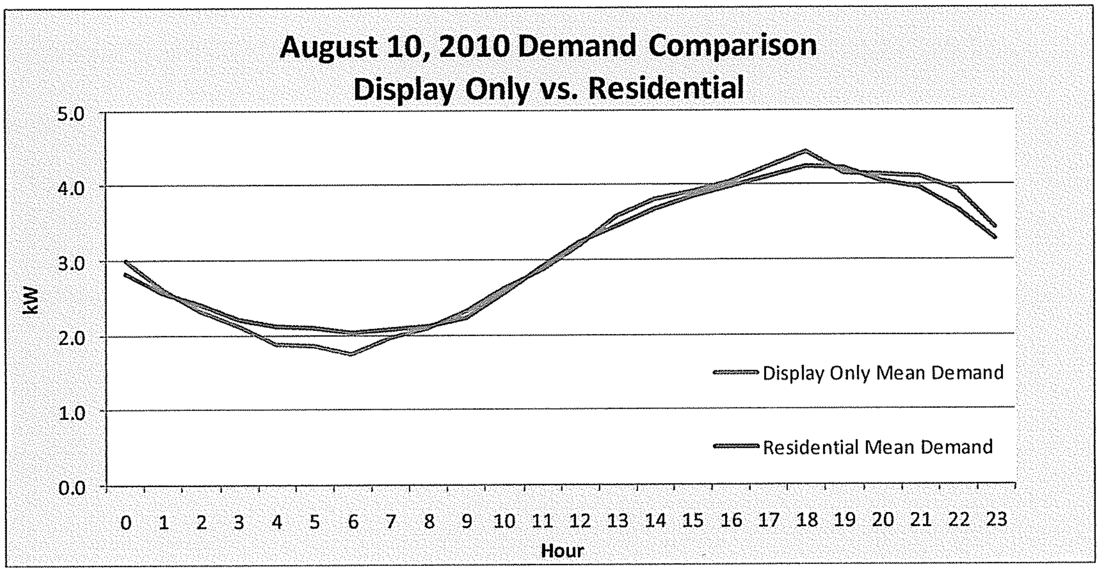
The two CPP events called in July lasted from 3:00 pm to 6:00 pm. The maximum temperatures on these two days were 94 and 95 Degrees (F) respectively.



Afternoon and evening demand was slightly higher for the Display Only customers on both of the July CPP days.



The warmest CPP day in 2010 was August 10th, when temperatures in the Louisville area reached 100 Degrees (F). The 'Critical' pricing period lasted from 3:00 pm to 7:00 pm. The IHD device does not appear to be leading to reduced demand during these hours.

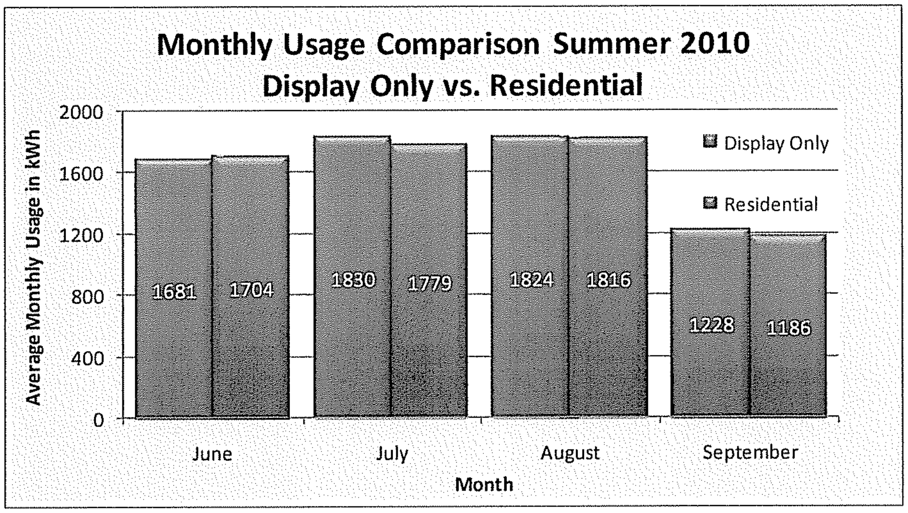


The following table shows the difference by CPP day for the Display Only group versus the Control comparison group for each CPP period.

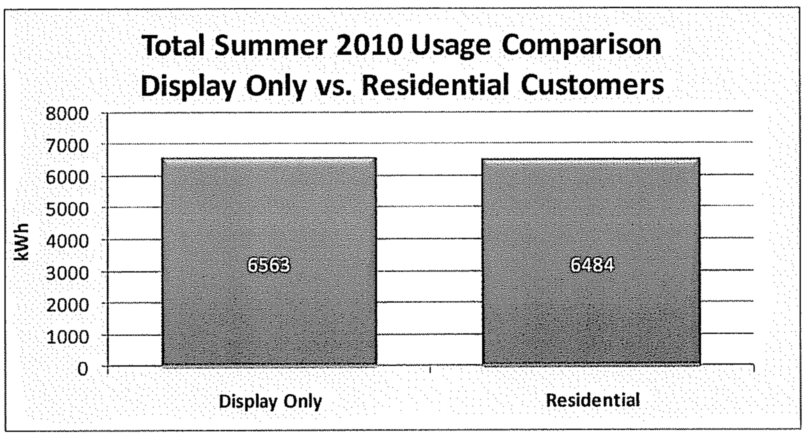
CPP Day Comparison 2010 - Display Only Customers							
Day	**Max Temperature**	**Group**	**15**	**16**	**17**	**18**	**19**
17-Jun	90	Display Only	2.98	3.25	3.32	3.31	3.16
17-Jun	90	Control	2.95	3.21	3.43	3.45	3.34
17-Jun	90	**Difference**	**0.03**	**0.03**	**-0.11**	**-0.14**	**-0.18**
18-Jun	93	Display Only	3.38	3.65	4.09	4.08	3.79
18-Jun	93	Control	3.27	3.52	3.71	3.85	3.73
18-Jun	93	**Difference**	**0.12**	**0.13**	**0.38**	**0.23**	**0.06**
22-Jun	93	Display Only	3.33	3.52	3.71	3.73	3.62
22-Jun	93	Control	3.41	3.52	3.61	3.68	3.67
22-Jun	93	**Difference**	**-0.08**	**0.00**	**0.10**	**0.05**	**-0.06**
23-Jun	94	Display Only	3.71	4.03	4.18	4.24	4.06
23-Jun	94	Control	3.68	3.82	3.98	4.08	4.06
23-Jun	94	**Difference**	**0.03**	**0.21**	**0.20**	**0.16**	**0.00**
25-Jun	91	Display Only	2.98	3.34	3.48	3.57	3.43
25-Jun	91	Control	3.09	3.25	3.52	3.61	3.47
25-Jun	91	**Difference**	**-0.11**	**0.09**	**-0.04**	**-0.04**	**-0.04**
15-Jul	94	Display Only	3.62	3.71	4.11	4.11	3.95
15-Jul	94	Control	3.42	3.59	3.78	3.83	3.75
15-Jul	94	**Difference**	**0.19**	**0.12**	**0.34**	**0.28**	**0.20**
23-Jul	95	Display Only	3.78	3.94	4.00	4.22	4.14
23-Jul	95	Control	3.58	3.67	3.78	3.93	3.81
23-Jul	95	**Difference**	**0.21**	**0.27**	**0.22**	**0.29**	**0.33**
10-Aug	100	Display Only	3.93	4.06	4.26	4.46	4.17
10-Aug	100	Control	3.86	3.98	4.13	4.26	4.24
10-Aug	100	**Difference**	**0.07**	**0.08**	**0.13**	**0.20**	**-0.07**

Summer Energy Use Comparison for the Display Only Group

A separate Control comparison group was selected each month for the summer of 2010. The following graph shows the average monthly consumption for the Display Only customers and its Control comparison groups from June to September.

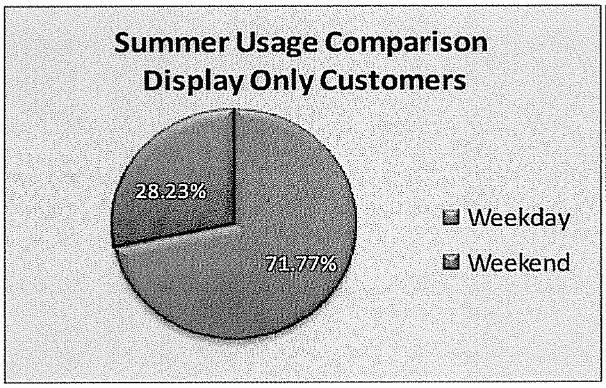


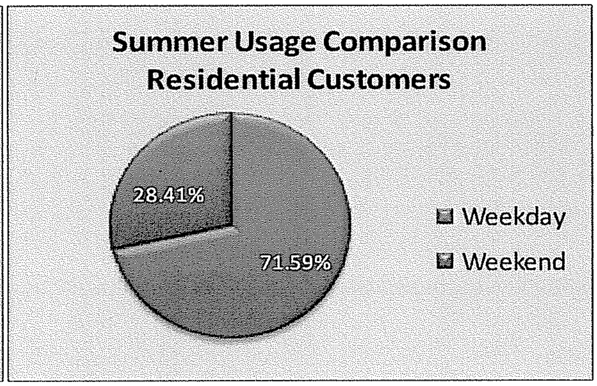
The graph below compares the average total usage of the two groups for the entire summer. The Display Only customers averaged just 79 more kWh than its Control comparison group customers over this four month period.



Display Only customers receive visual signals on their in-home display device (IHD) during 'High' and 'Critical' pricing periods even though they pay a flat-rate. This occurs from 1:00 pm to 6:00 pm during June, July, August, and September. 'High' and 'Critical' rates are not in effect on weekends under either the winter or summer rate schedules.

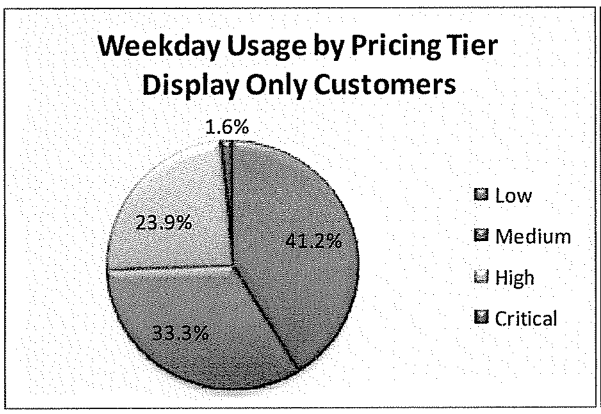
The two pie charts below compare weekday and weekend consumption levels during these months and show that Display Only customers use virtually the same proportion of their summer energy on weekdays as residential customers.

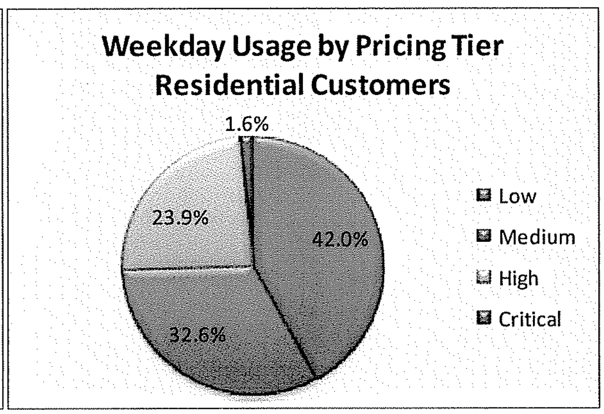




This indicates that the response that was observed in the Information Only group was not likely a result of the IHD device.

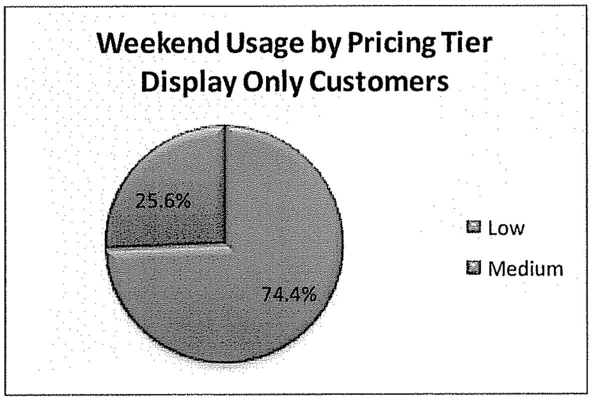
The next two pie charts show how the two groups differ on weekdays during the different pricing periods. It is important to remember that both groups pay the same price per kWh around-the-clock. The difference between the two groups is that Display Only group receives visual signals on their in-home display device during the 'High' and 'Critical' periods.

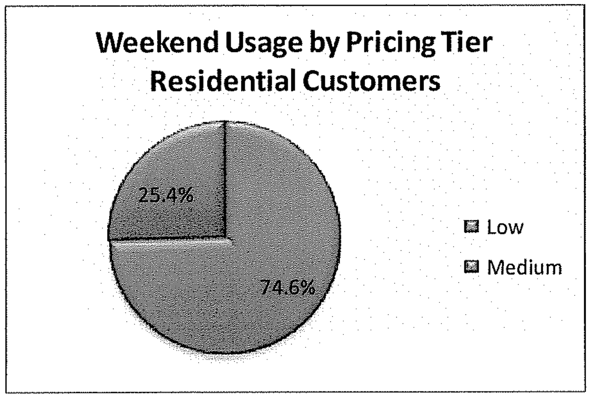




The percentage of weekday energy used during these periods is virtually identical between Display Only customers and residential customers. This indicates that participants do not shift their loads away from peak hours as a result of IHD installation. Other equipment or rate measures must be used in conjunction with the IHD device in order to shift their load.

The final pair of pie charts compares these groups on weekends. There are no 'High' or 'Critical' periods on weekends, so differences between the two groups should be minimal.





As expected, the Display Only group distributes its weekend energy in a very similar fashion to the traditional residential customers.

Display Only Impact Analysis Conclusions

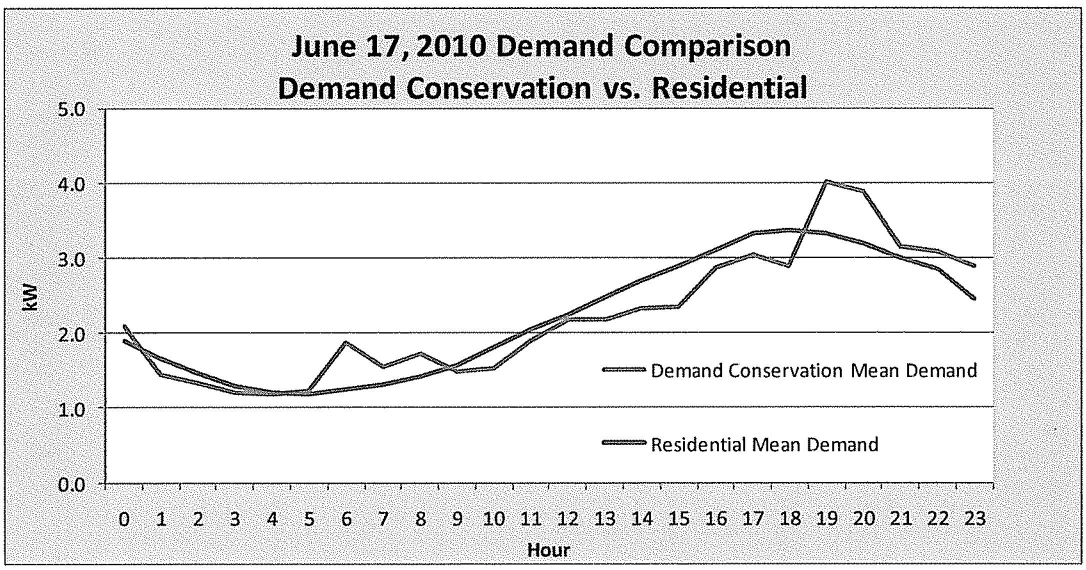
The Display Only test group was given a display device, but was otherwise no different from the Control group. As expected, the distribution of weekday to weekend usage and the hourly load shapes between the Display Only group and the residential group are very similar. The Information Only group showed some significant demand response during peak hours. This was from 1:00 pm to 6:00 pm on weekdays in June, July, August, and September. The Display Only customers don't show any decreased demand during this period. Both groups have in-home display devices, but only the Information Only group has programmable thermostats, so it appears that the load reduction seen in the Information Only group is the product of programmable thermostat rather than the in-home display device.

Demand Conservation Group Impact Analysis

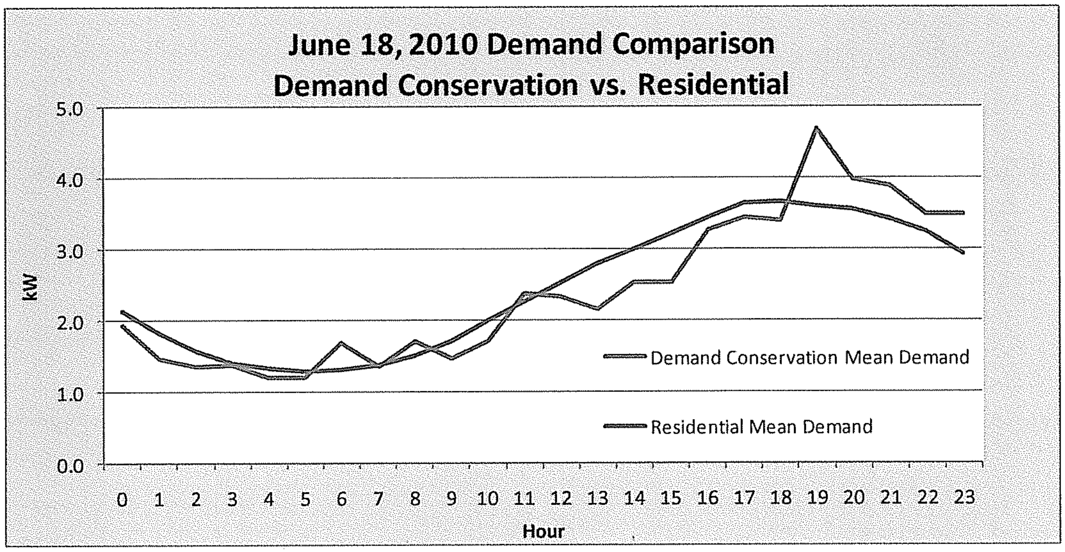
The Demand Conservation group received both thermostat signals and water heater control, but no rate control. The number of customers in this group increased from 1 to 13 prior to the 2010 summer analysis period. GoodCents divided the Demand Conservation customers' monthly usages into 3 strata based on total monthly kWh. Next, a random sample of 500 customers was selected from the Control group using the strata breakpoints to produce a Control comparison group. This Control comparison group is what is referred to as 'Residential Customers' in the following charts and tables. The methodology for selecting the Control comparison group is explained in more detail in Appendix A. Strata breakpoints are provided in Appendix B.

Comparison of Demand Conservation Customer's Energy Usage on CPP Days

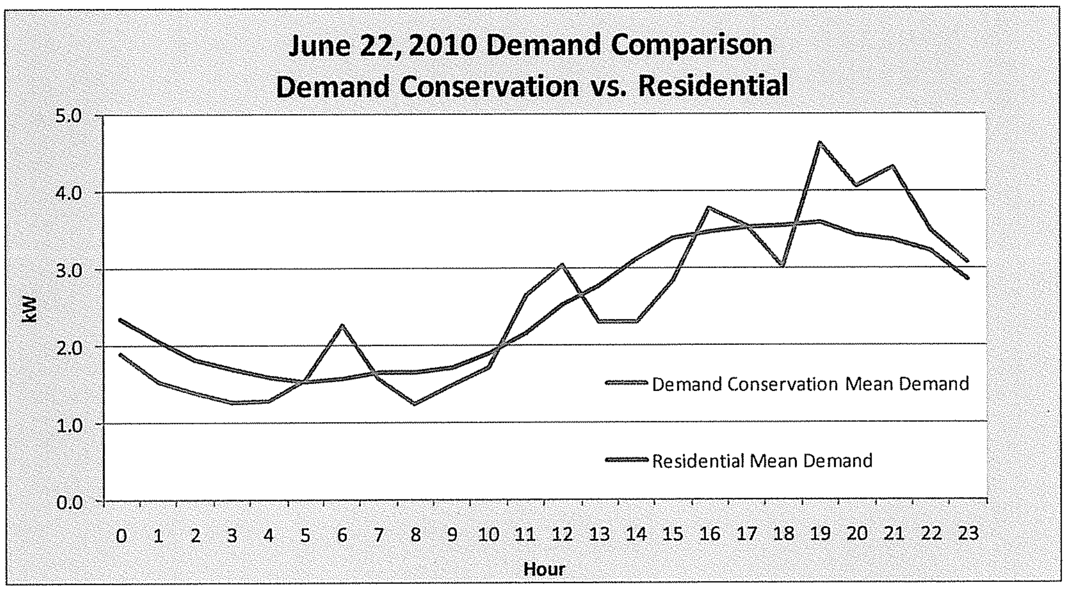
GoodCents developed average load shapes for all days that the critical peak rate was initiated for both the Demand Conservation group customers and its Control comparison group. Each critical peak pricing day is examined in detail below. The maximum daily temperature on June 17th was 90 Degrees (F). The Demand Conservation customers used less energy than residential customers during the CPP period, followed by a bounce-back spike beginning at 7:00 pm when the CPP period ends.



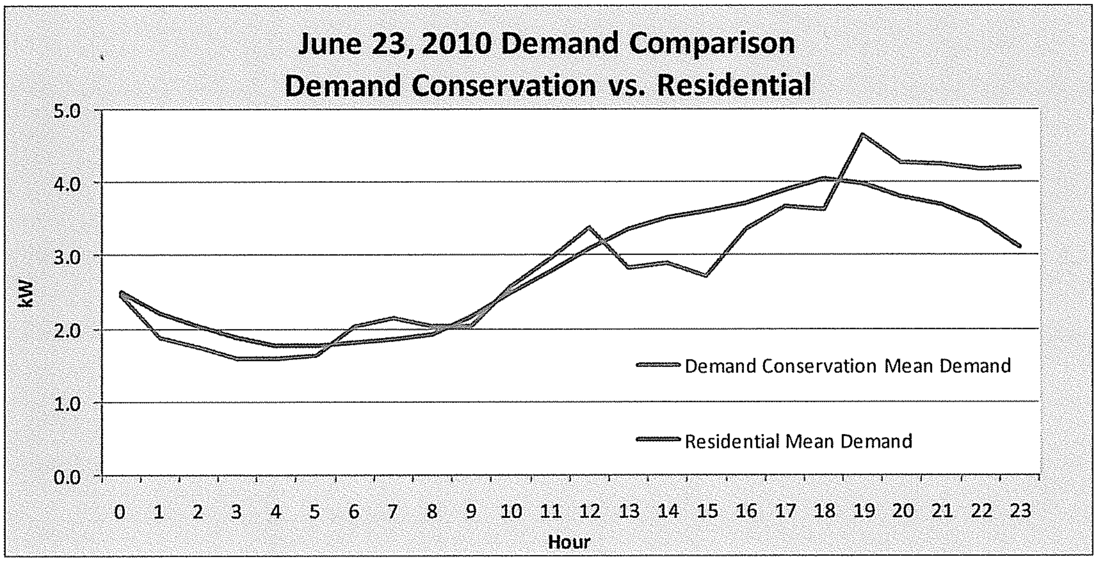
The next CPP days were June 18th and 22nd. The maximum temperature on these two days was 93 Degrees (F).



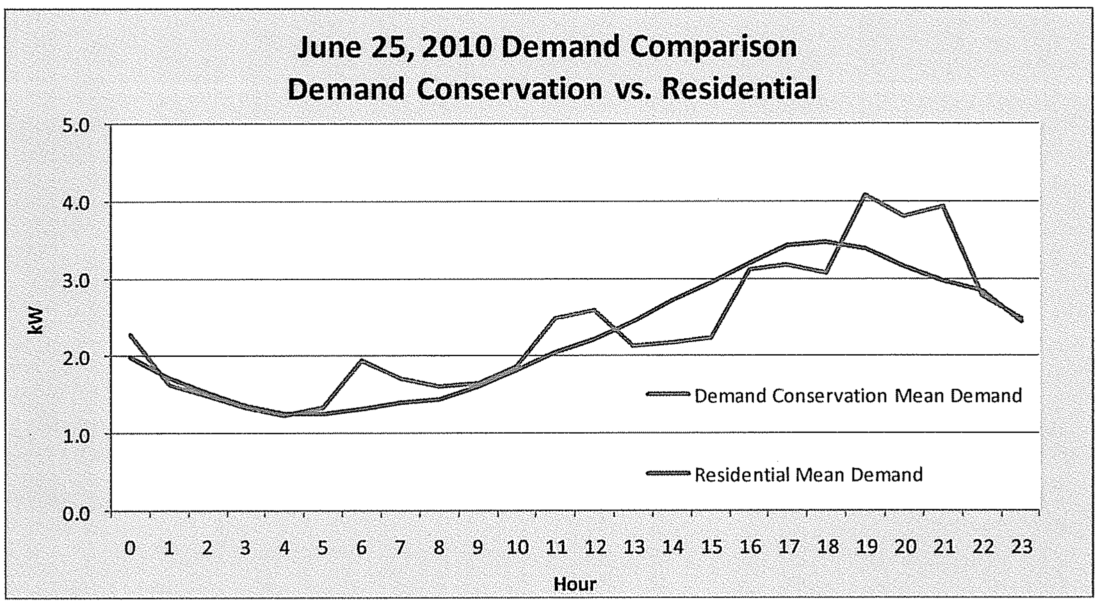
The Demand Conservation customers show reduced demand on these two CPP days from 1:00 pm to 7:00 pm and then the expected demand spike beginning at 7:00 pm.



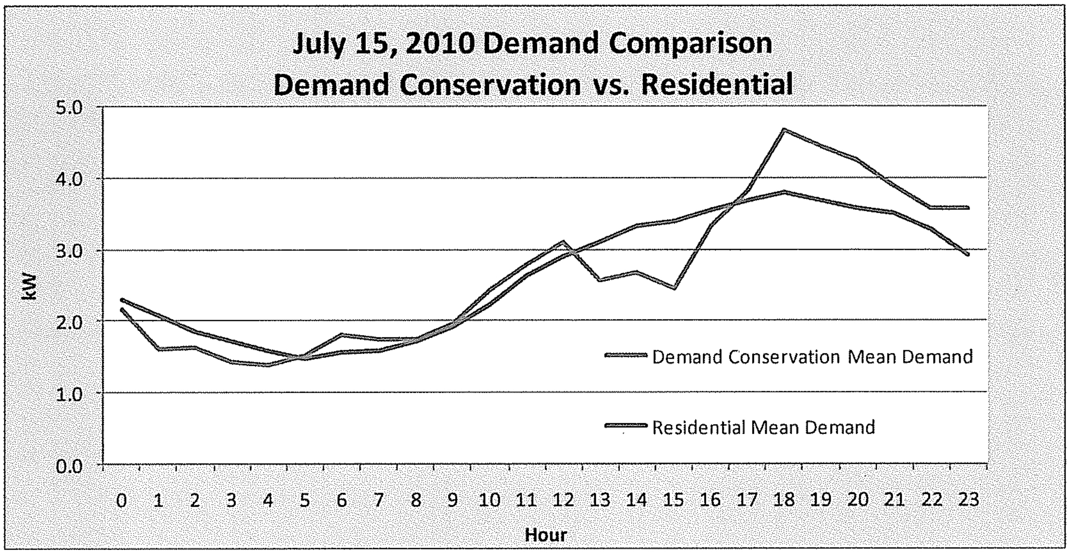
Below are the plots displaying the CPP days of June 23rd and June 25th. The maximum temperatures were 94 and 91 Degrees (F) respectively.



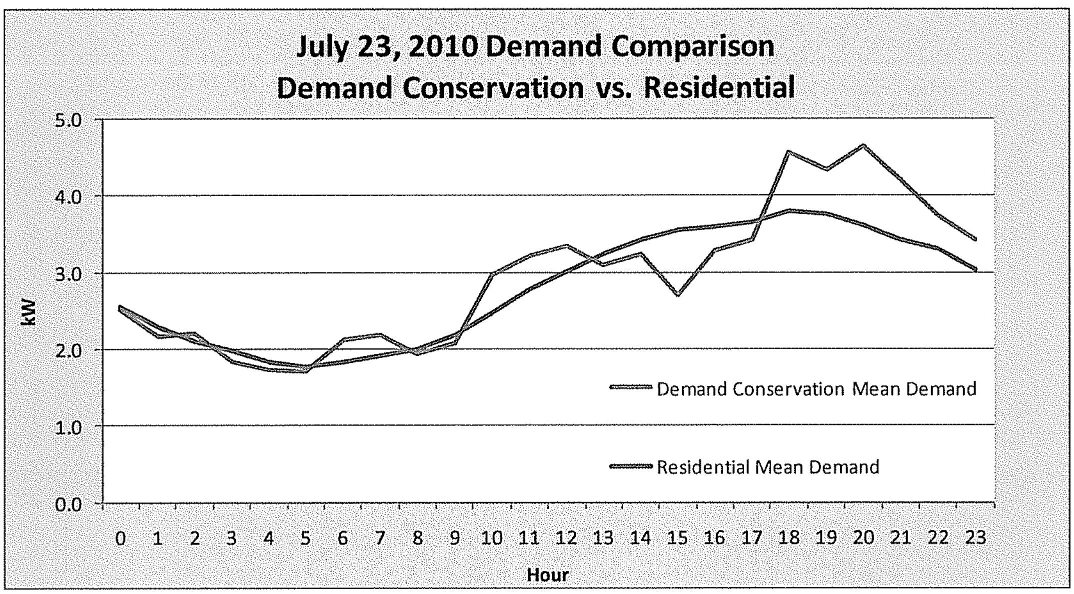
Based on the load shapes displayed in these graphs, it appears that the programmable thermostat and water heater switch are producing significant demand reductions beginning at 1:00 pm when the 'High' pricing begins and a second, less dramatic, load reduction at 3:00 pm when the 'Critical' rate takes effect.



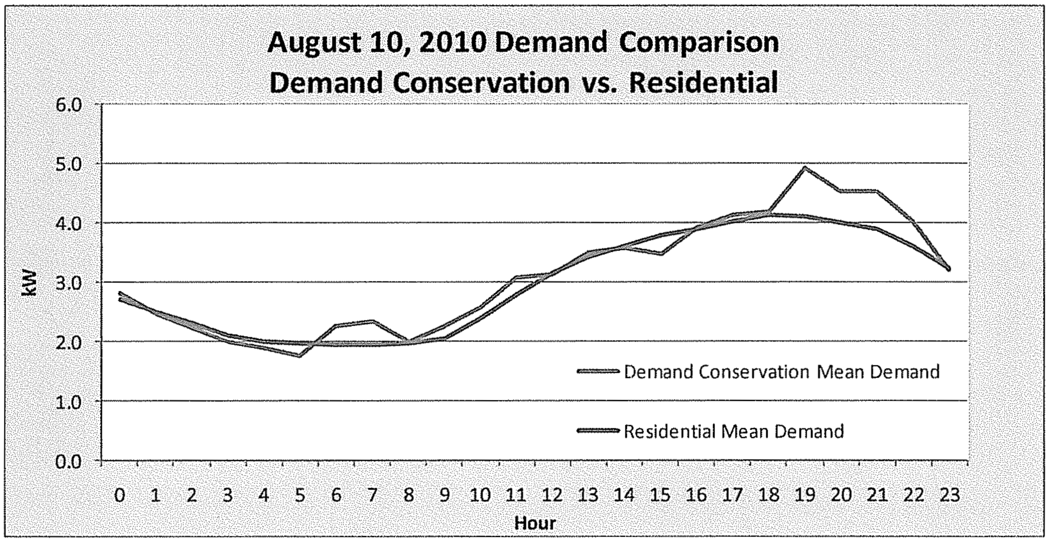
The two CPP events called in July lasted from 3:00 pm to 6:00 pm. The maximum temperatures on these two days were 94 and 95 Degrees (F) respectively.



The effect of the CPP period is more pronounced for these two CPP days than it was for any of the June events. During hour 15 on both days, there is a noticeable drop in the average demand of the group. This could be because the thermostats are programmed to increase several degrees at the onset of CPP, reducing HVAC demand in the home, or because the water heater is being turned off by the switch.



The warmest CPP day in 2010 was August 10th, when temperatures in the Louisville area reached 100 Degrees (F). The 'Critical' pricing period lasted from 3:00 pm to 7:00 pm. The Demand Conservation group does not show the size load reductions that were observed on previous CPP days in 2010.

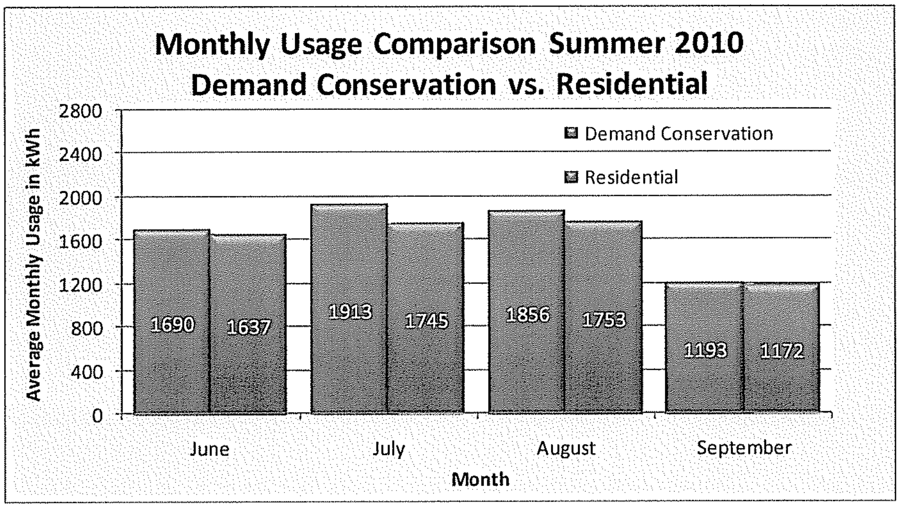


The following table shows the difference by CPP day for the Demand Conservation group versus the Control comparison group for each CPP period.

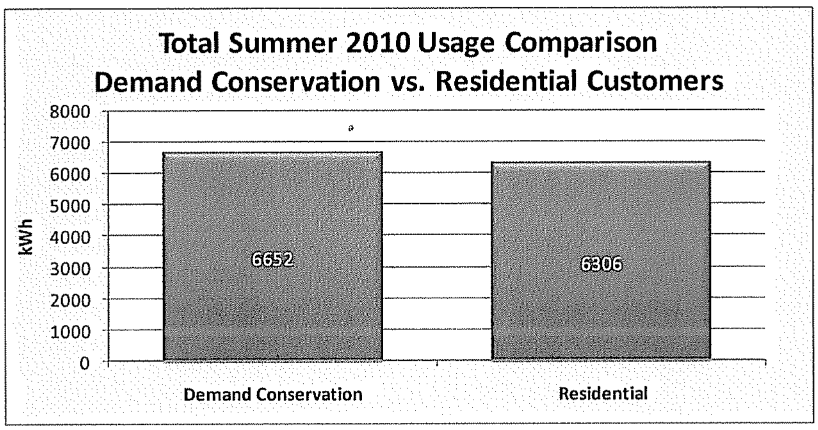
CPP Day Comparison 2010 - Demand Conservation Customers							
Day	Max Temperature	Group	15	16	17	18	19
17-Jun	90	Demand Conservation	2.36	2.87	3.04	2.90	4.01
17-Jun	90	Control	2.89	3.12	3.33	3.38	3.32
17-Jun	90	**Difference**	**-0.54**	**-0.25**	**-0.30**	**-0.48**	**0.69**
18-Jun	93	Demand Conservation	2.52	3.27	3.45	3.40	4.68
18-Jun	93	Control	3.23	3.45	3.65	3.67	3.61
18-Jun	93	**Difference**	**-0.71**	**-0.18**	**-0.20**	**-0.27**	**1.07**
22-Jun	93	Demand Conservation	2.83	3.77	3.55	3.02	4.60
22-Jun	93	Control	3.39	3.45	3.53	3.55	3.59
22-Jun	93	**Difference**	**-0.56**	**0.32**	**0.02**	**-0.53**	**1.01**
23-Jun	94	Demand Conservation	2.73	3.35	3.68	3.62	4.65
23-Jun	94	Control	3.61	3.71	3.89	4.04	3.99
23-Jun	94	**Difference**	**-0.89**	**-0.36**	**-0.22**	**-0.42**	**0.66**
25-Jun	91	Demand Conservation	2.24	3.11	3.19	3.08	4.09
25-Jun	91	Control	2.96	3.20	3.44	3.48	3.38
25-Jun	91	**Difference**	**-0.71**	**-0.09**	**-0.25**	**-0.40**	**0.71**
15-Jul	94	Demand Conservation	2.46	3.33	3.82	4.67	4.43
15-Jul	94	Control	3.40	3.55	3.68	3.78	3.68
15-Jul	94	**Difference**	**-0.94**	**-0.22**	**0.14**	**0.89**	**0.76**
23-Jul	95	Demand Conservation	2.70	3.28	3.42	4.57	4.34
23-Jul	95	Control	3.56	3.59	3.66	3.81	3.75
23-Jul	95	**Difference**	**-0.86**	**-0.31**	**-0.24**	**0.76**	**0.59**
10-Aug	100	Demand Conservation	3.48	3.91	4.13	4.19	4.91
10-Aug	100	Control	3.79	3.89	4.02	4.12	4.11
10-Aug	100	**Difference**	**-0.31**	**0.03**	**0.11**	**0.07**	**0.80**

Summer Energy Use Comparison for the Demand Conservation Group

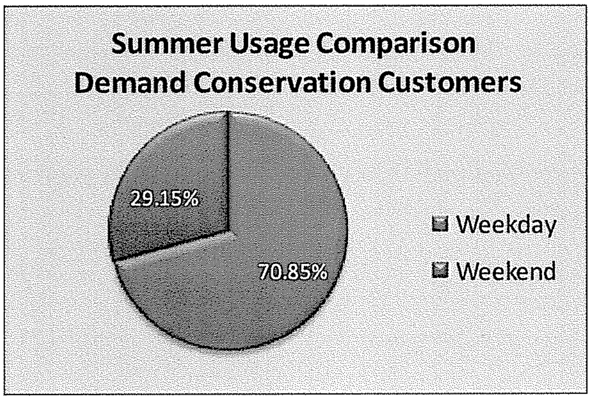
A separate Control comparison group was selected each month for the summer of 2010. Differences between the Demand Conservation and residential customers over the course of the summer were minimized by mimicking the stratification of the experimental group. The following graph shows the average monthly consumption for the Demand Conservation customers and its Control comparison groups from June to September.

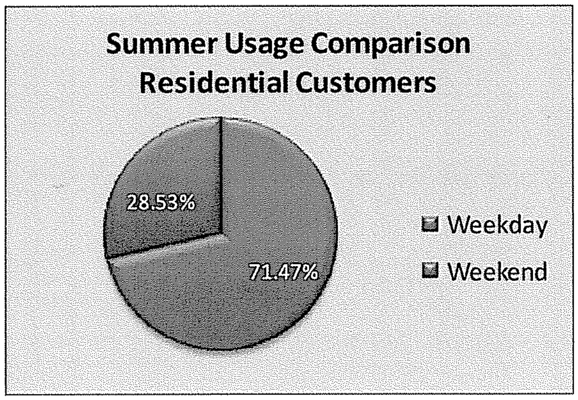


The graph below compares the average total usage for the entire summer.

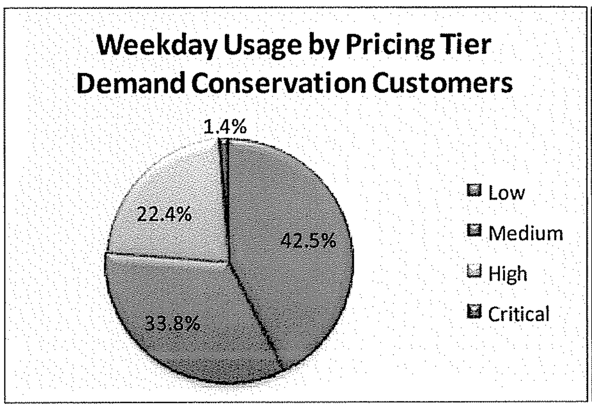


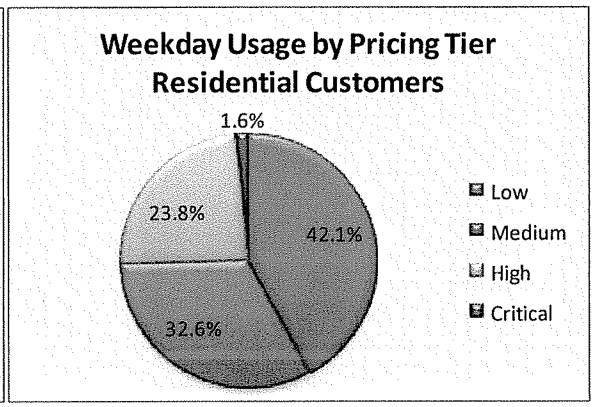
Demand Conservation customers are subject to water heater control and thermostat signals during 'High' and 'Critical' pricing periods even though they pay a flat-rate. This occurs from 1:00 pm to 6:00 pm during June, July, August, and September. 'High' and 'Critical' rates are not in effect on weekends under the summer rate schedule. The two pie charts below compare weekday and weekend consumption levels during these months and show that Demand Conservation customers use a smaller percentage of their summer power on weekdays than standard residential customers. This is expected because the demand conservation activations are only in place on weekdays.





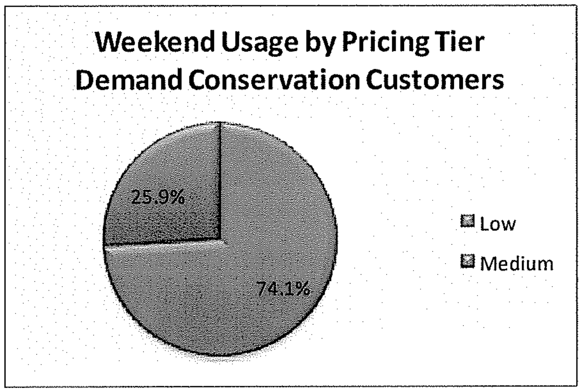
The next two pie charts show how the two groups differ on weekdays during the different pricing periods. It is important to remember that both groups pay the same price per kWh around-the-clock.

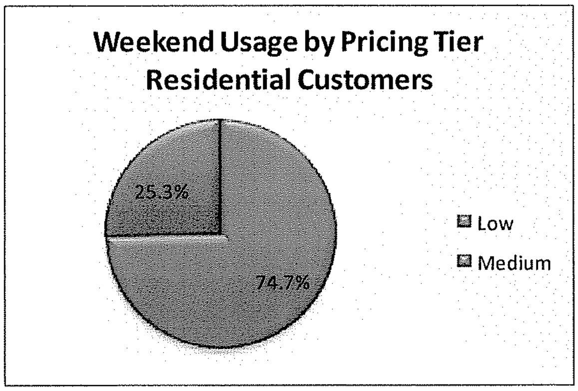




The difference between the two groups is that the Demand Conservation group receives water heater control and thermostat signals during the 'High' and 'Critical' periods. Much like the Information Only group, it appears that the thermostats of the Demand Conservation group have been programmed to respond favorably to the peak periods. These techniques are clearly working because the Demand Conservation customers are using less of their weekday energy during these periods.

The final pair of pie charts compares these groups on weekends. There are no 'High' or 'Critical' periods on weekends, so differences between the two groups should be minimal.



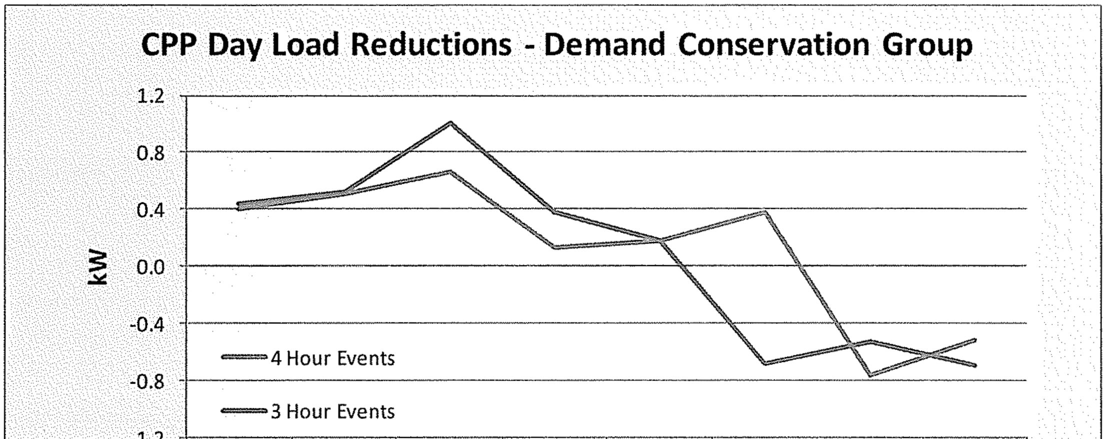


The Demand Conservation group uses slightly more of its weekend energy during the afternoon hours, but the difference is likely due to customer behavior patterns.

The Demand Conservation group showed less load response than the Information Only customers, but more response than the Display Only customers on summer weekdays. The average summer weekday load reduction of the Demand Conservation group from 1:00 pm to 6:00 pm was 0.72 kWh, which is about 40% of the impact produced by the SmartRate group over the same period. This is impressive because the Demand Conservation group was not subjected to elevated rates during these hours. The following table shows the average hourly differences between the Demand Conservation group and its Control comparison groups during peak weekday afternoon hours on non-CPP event days.

Average Summer Weekday Loads - Demand Conservation Group - 1:00 pm to 8:00 pm							
Group	Hour						
	13	14	15	16	17	18	19
Demand Conservation	2.163	2.248	2.564	3.000	3.241	3.640	3.515
Control	2.394	2.606	2.801	2.983	3.154	3.227	3.158
Load Impact	-0.231	-0.358	-0.237	0.017	0.087	0.413	0.358

The programmable thermostat has been most effective in other groups during the hot summer months, and this trend holds true for the Demand Conservation group. The Demand Conservation group also showed increased response on the eight days when CPP events were called. Notice that the bounce-back period begins at 6:00 pm during the 3 hour CPP events, but not until 7:00 pm for 4 hour events.



	13	14	15	16	17	18	19	20
4 Hour Events	0.40	0.51	0.66	0.13	0.18	0.38	-0.77	-0.52
3 Hour Events	0.44	0.52	1.01	0.38	0.18	-0.68	-0.53	-0.70

Hour

The two days when 3 hour events were called were slightly warmer than the six days when 4 hour events were called. This explains why the observed load reductions during hours 13 through 17 are consistently larger for the 3 hour event days. The shapes of the two plots follow the same basic trend. Demand Conservation customers show an increasingly large load reduction during hours 13, 14, and 15. After hour 15, the load reductions start to diminish. Similar to what was observed in SmartRate customers, the bounce-back following a 4 hour event is larger than the bounce-back following a 3 hour event. The size of the bounce-back is directly correlated to the length of and the severity of the control period.

Demand Conservation Group Impact Analysis Conclusions

Demand Conservation customers are subject to water heater control and thermostat signals during 'High' and 'Critical' pricing periods even though they pay a flat-rate. This occurs from 1:00 pm to 6:00 pm during June, July, August, and September. A moderate drop in the average load of the group occurs during peak hours on weekdays. A typical residential water heater uses around 0.2 kWh per hour, which is approximately the size of the reduction observed during months with mild temperatures. On days when CPP events were called, the average afternoon load reduction of this group is considerably larger. This reduction is probably helped by customers with water heater switches, but at some hours the average load reduction is close to 1.0 kW. Load reductions of this magnitude must be tied to a home's HVAC system. For these individuals, this is likely coming from the settings of the programmable thermostat, since they pay a flat-rate.

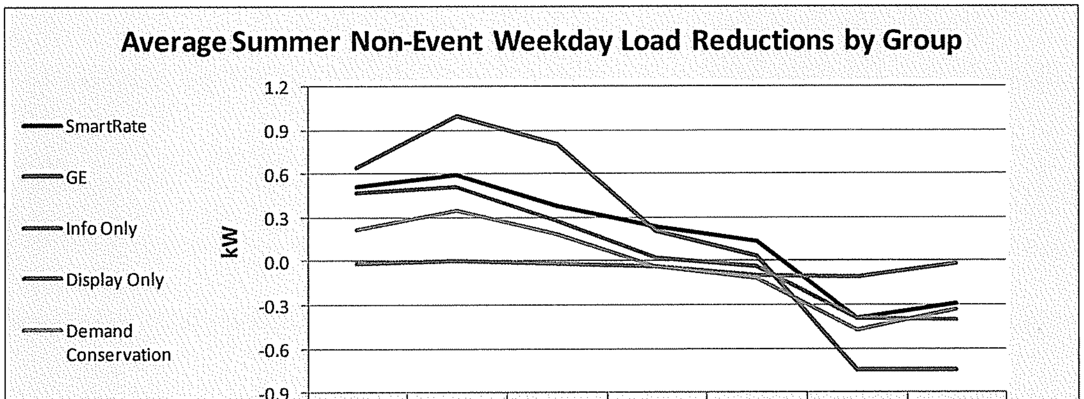
Conclusions

A weather normalized analysis of participating customers determined that the measures in this program don't reduce the overall amount of energy a customer uses. Instead, the benefits of the measures are to shift demand away from the times of day when LG&E's system is close to capacity and onto the times when the system load is smaller. This helps to flatten out the load shape of the system. During the winter, this peak period is weekday evenings. During June, July, August, and September the peak period is weekday afternoons.

In order to test various load shifting measures, customers were given various combinations of equipment and rate incentives. The SmartRate group and its subgroup, the GE group, were the only customers who were billed a varying rate for power, based on the time of use. The other three experimental groups, the Information Only group, the Display Only group, and the Demand Conservation group were given a variety of equipment choices aimed at reducing demand during peak hours. The Control group was given no equipment or rate incentives and was used for comparison purposes. The following table provides the rate and equipment options, along with the number of participating customers, for each group.

LG&E RRP Customer Groups - Summer 2010					
Customer Group	**SmartRate**	**Information Only**	**Demand Conservation**	**Display Only**	**Control Group**
Number of Customers	90	79	13	89	1409
Program Features	Thermostat, Display Device, Water Heater Control, and CPP Rate	Thermostat and Display Device	Thermostat and Water Heater Control	Display Device	
Sub Group	GE				
Number of Customers	10				
Program Features	Smart GE Appliances				

The following graph compares the effectiveness of the five experimental groups on non-event weekdays during June, July, August, and September.



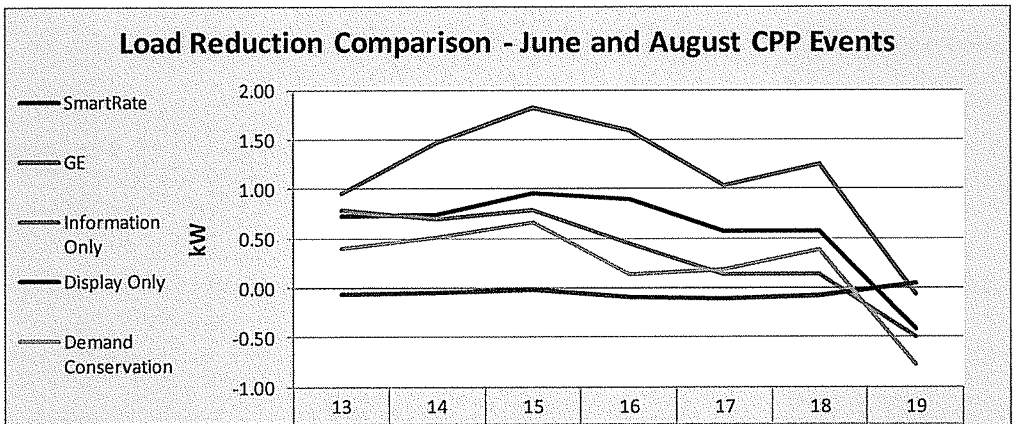
	13	14	15	16	17	18	19
SmartRate	0.510	0.590	0.383	0.237	0.132	-0.387	-0.294
GE	0.648	1.004	0.806	0.206	0.037	-0.749	-0.745
Info Only	0.472	0.512	0.282	0.026	-0.036	-0.392	-0.397
Display Only	-0.018	0.006	-0.015	-0.036	-0.094	-0.110	-0.020
Demand Conservation	0.218	0.351	0.191	-0.039	-0.117	-0.476	-0.330

Hour

The GE group shows the most dramatic results, followed by its parent group, the SmartRate group. It is no surprise that these two groups show the largest response because they are given a financial incentive to do so. Based on the observed load reductions, it appears that the GE Smart appliances have enhanced load shifting capability. The results from the GE subgroup, while impressive, should be used with caution due to the small sample size. It is recommended that further research should be undertaken to understand the load response to CPP for this group.

The Information Only group shows load reductions almost 70% of the size of the SmartRate customers, even though they pay a flat-rate. These customers received both the IHD device and the programmable thermostat, but the impressive demand response exhibited by this group is likely the result of the programmable thermostat. The evidence for this conclusion is that that Display Only customers also received the IHD device, but showed almost no demand response. This implies that the response observed in the Information Only group was due to the thermostat and not the IHD device.

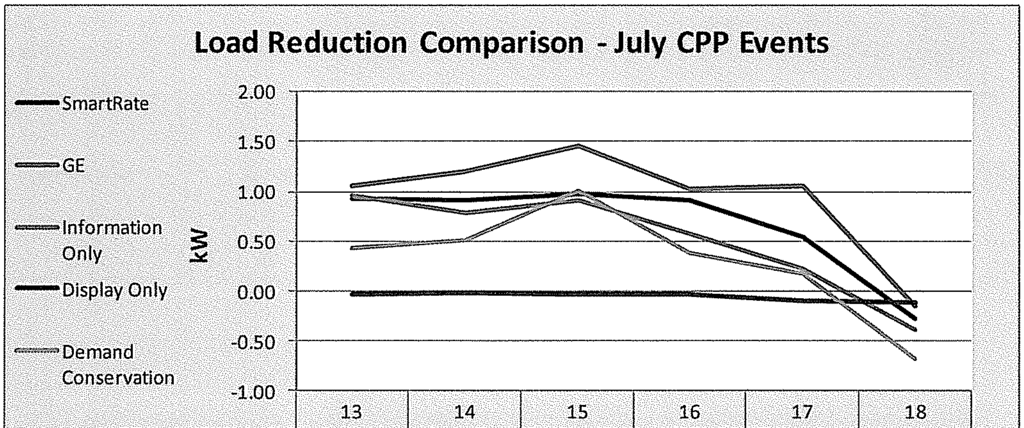
There were eight CPP events called during the season. Six of these events lasted from 3:00 pm to 7:00 pm and were called in June and August. The remaining events lasted from 3:00 pm to 6:00 pm and were called in July. The following graphs explore how each group compared to its Control comparison groups on these days. The primary difference between the two graphs is which hour the groups cross the x-axis (0.00 kW). This signifies the end of load reductions and the beginning of the bounce-back period.



	13	14	15	16	17	18	19
SmartRate	0.72	0.74	0.96	0.89	0.57	0.57	-0.42
GE	0.95	1.46	1.83	1.59	1.04	1.25	-0.07
Information Only	0.79	0.70	0.79	0.44	0.14	0.13	-0.49
Display Only	-0.06	-0.05	-0.01	-0.09	-0.11	-0.08	0.05
Demand Conservation	0.40	0.51	0.66	0.13	0.18	0.38	-0.77

Hour

In the load reduction comparison graphs above, the Information Only and Demand Conservation groups show load reductions almost the same size as the SmartRate group during the early afternoon hours. These customers have no financial incentive to modify their behavior during CPP events, so these load reductions are a result of the equipment measures provided to the members.



	13	14	15	16	17	18
SmartRate	0.93	0.91	0.98	0.91	0.55	-0.27
GE	1.06	1.20	1.46	1.02	1.05	-0.14
Information Only	0.96	0.79	0.91	0.58	0.22	-0.38
Display Only	-0.04	-0.01	-0.04	-0.03	-0.10	-0.11
Demand Conservation	0.44	0.52	1.01	0.38	0.18	-0.68

Hour

GoodCents analyzed the demand of the SmartRate and the GE customers during the hours following CPP implementation to quantify the bounce-back effect that occurs once customers are released from the 'Critical' rate. SmartRate customers show the largest bounce-back during the second hour after a CPP event. SmartRate customers show an average bounce-back of approximately 0.5 kW following a 3-hour CPP event and bounce-back of approximately 0.8 kW following a 4-hour CPP event. This report concludes that the duration of the CPP event influences the size of the bounce-back effect.

GE customers show a steady increase in the size of the bounce-back effect during the evening after CPP implementation. The average bounce-back effect for GE customers following a 3-hour CPP event is approximately 1.5 kW and the average bounce-back effect following a 4-hour CPP event is over 2.0 kW. The sizes of the GE bounce-back effects found during the summer of 2010 were much larger than those found in 2009. This difference is likely a combination of the hotter temperatures on 2010 CPP days and differences in overall usage between the GE group and its Control comparison group inflating the bounce-back estimates.

GoodCents was supplied SmartRate (including GE) customers' summer billed energy usage before the rate was implemented in 2007. From this information, a comparison of summer behavior before and after the SmartRate implementation was developed. Based on this comparison, it does not appear that participation in the SmartRate program affects the amount of energy customers uses. Each year SmartRate customers exhibit a little over 2 kWh, above baseline, per Cooling Degree Day. The major impact of the SmartRate program is when customers use energy, not how much energy they use. The effects of this program would be better described as load-shifting, rather than load-reducing.

The following table compares the average load reductions observed for the SmartRate participants in 2010 to the hourly load reductions LG&E observed during its 2006 Demand Conservation program. The SmartRate program produced larger load reductions for each of the peak hours, with the largest difference occurring at hour 16.

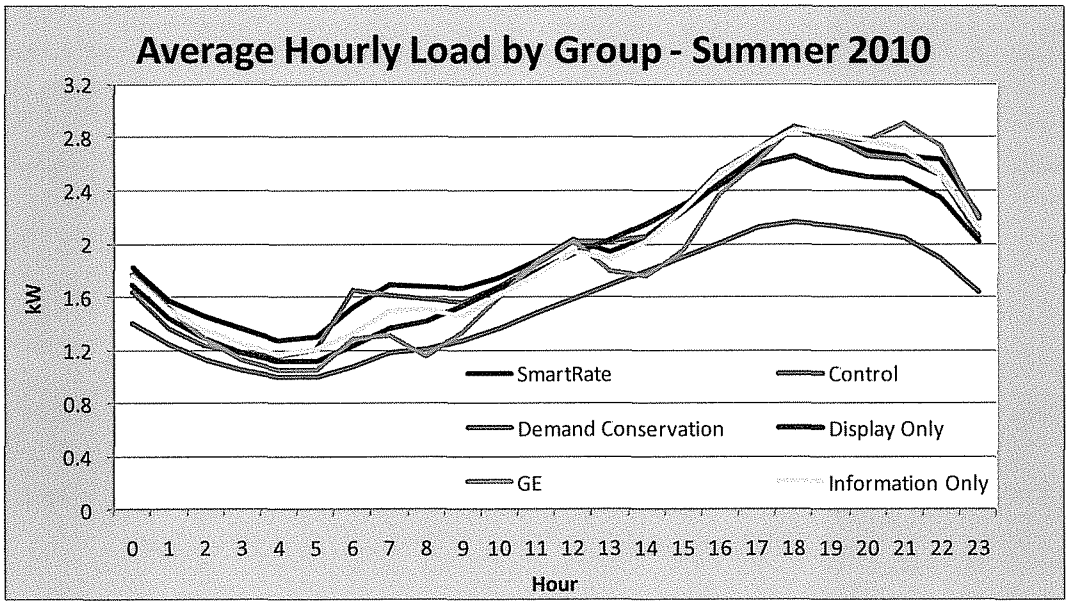
Comparison of Demand Conservation and SmartRate Load Reductions			
Hour	***Demand Conservation kW**	**SmartRate kW**	**Difference kW**
15	0.536	0.958	0.422
16	0.291	0.886	0.595
17	0.314	0.567	0.253
***2006 Analysis load reduction for 88-93 Degrees**			

The load reductions recorded on the warmest CPP day, August 10, 2010, suggest that customers are disregarding the rate control and buying through the 'Critical' period. Further study of the customer response during CPP events with extremely high temperatures is recommended.

GoodCents finds that this pilot has produced consistent load reductions for LG&E when demand response measures were implemented. Analysis of customer reaction to responsive pricing and demand response techniques under a full range of weather conditions provides LG&E with an excellent understanding of the impact which can be expected from implementing each measure. The information will give LG&E the guidance it needs to decide upon expanding any of the measures explored in this pilot program to a larger portion of its customer base.

Appendix A – Sample Selection Methodology

As the following graph demonstrates, the average load of the Control group was lower than the average load of each of the test groups during almost every hour of the summer of 2010. Even if the test group responds to the program features and decreases its consumption during peak hours, identifying and quantifying this decrease would be problematic because the test group's overall consumption is so much higher.



In order to remedy this problem, it was decided that a subset of the Control group should be created whose monthly usage mirrored that of the test group. There were 1,409 customers in the initial Control group. It was concluded that selecting a subset of 500 customers would be large enough to keep the benefits of having a large sample size. In order to select a subset of the Control group with mean, variance, and distribution similar to that of the test group, the Dalenius-Hodges method was used.

In 1957, Dalenius, along with J.L. Hodges introduced a method of approximation called the cumulative root frequency method. This method involves first dividing the sample space into a large number of intervals, then obtaining the square root of the frequency in each class multiplied by the length. When these root frequencies are summed, the result is the accumulation of the root of the frequencies. By dividing the total cumulative root frequency by the desired number of strata, the natural breakpoints in the sample can be identified.

In order to subset the Control group, the Dalenius-Hodges method was applied to the sums (in kWh) of each group of customers, each month. This determined the stratification of the experimental group customers. Three strata were used because it allowed the group to be subset accurately while still maintaining a good sample size in each stratum. Each customer in the group's total monthly usage was rounded to the nearest 100 kWh. This created 'bins' of equal length for each customer to be placed into. The number of customers in each bin was then counted. The key component of the Dalenius-Hodges process is the cumulative $\sqrt{length * frequncy}$ statistic. Each interval that was represented had the same length (100 kWh), but not all intervals were represented, so the length term could be simplified to the number of bins. For example, if the customers are sorted from smallest to largest use, and one customer used 1700 kWh and the next smallest customer used 2100 kWh, the interval that the customer who used 2100 kWh has a length of 400, or 4 bins. A SAS program was used to make these calculations for each represented 'bin'. The following table shows the output of this program for the SmartRate group in August 2010. Strata breakpoints are highlighted in the table below.

Determination of Strata Breakpoints - SmartRate Group - August 2010

kWh	Count	% of Group	Sqrt(Count)	Length	Bins	Sqrt(Bins)	D-Hodges Index (DHI)	Cumulative Count	Cumulative Percent	Cumulative Sqrt(Count)	Cumulative DHI
100	1	1.11%	1	100	1	1	1	1	1.11	1	1.00
200	1	1.11%	1	100	1	1	1	2	2.22	2	2.00
500	1	1.11%	1	300	3	1.73	1.73	3	3.33	3	3.73
600	1	1.11%	1	100	1	1.00	1.00	4	4.44	4	4.73
800	1	1.11%	1	200	2	1.41	1.41	5	5.56	5	6.15
900	2	2.22%	1.41	100	1	1.00	1.41	7	7.78	6.41	7.56
1100	3	3.33%	1.73	200	2	1.41	2.45	10	11.11	8.15	10.01
1200	2	2.22%	1.41	100	1	1.00	1.41	12	13.33	9.56	11.42
1300	3	3.33%	1.73	100	1	1.00	1.73	15	16.67	11.29	13.16
1400	4	4.44%	2.00	100	1	1.00	2.00	19	21.11	13.29	15.16
1500	4	4.44%	2.00	100	1	1.00	2.00	23	25.56	15.29	17.16
1600	8	8.89%	2.83	100	1	1.00	2.83	31	34.44	18.12	19.98
1700	5	5.56%	2.24	100	1	1.00	2.24	36	40.00	20.36	22.22
1800	4	4.44%	2.00	100	1	1.00	2.00	40	44.44	22.36	24.22
1900	6	6.67%	2.45	100	1	1.00	2.45	46	51.11	24.81	26.67
2000	2	2.22%	1.41	100	1	1.00	1.41	48	53.33	26.22	28.08
2100	5	5.56%	2.24	100	1	1.00	2.24	53	58.89	28.46	30.32
2200	3	3.33%	1.73	100	1	1.00	1.73	56	62.22	30.19	32.05
2300	2	2.22%	1.41	100	1	1.00	1.41	58	64.44	31.60	33.47
2400	5	5.56%	2.24	100	1	1.00	2.24	63	70.00	33.84	35.70
2500	4	4.44%	2.00	100	1	1.00	2.00	67	74.44	35.84	37.70
2600	6	6.67%	2.45	100	1	1.00	2.45	73	81.11	38.29	40.15
2700	3	3.33%	1.73	100	1	1.00	1.73	76	84.44	40.02	41.88
2800	1	1.11%	1.00	100	1	1.00	1.00	77	85.56	41.02	42.88
2900	3	3.33%	1.73	100	1	1.00	1.73	80	88.89	42.75	44.62
3100	2	2.22%	1.41	200	2	1.41	2.00	82	91.11	44.17	46.62
3200	1	1.11%	1.00	100	1	1.00	1.00	83	92.22	45.17	47.62
3400	1	1.11%	1.00	200	2	1.41	1.41	84	93.33	46.17	49.03
3500	1	1.11%	1.00	100	1	1.00	1.00	85	94.44	47.17	50.03
3600	1	1.11%	1.00	100	1	1.00	1.00	86	95.56	48.17	51.03
3700	1	1.11%	1.00	100	1	1.00	1.00	87	96.67	49.17	52.03
3900	1	1.11%	1.00	200	2	1.41	1.41	88	97.78	50.17	53.44
4000	1	1.11%	1.00	100	1	1.00	1.00	89	98.89	51.17	54.44
6100	1	1.11%	1.00	2100	21	4.58	4.58	90	100.00	52.17	59.03

The strata breakpoints are identified by dividing the final cumulative CDHI value by the number of strata. In this case, the final CDHI value is 59.03, so strata breakpoints are selected at 19.98, 40.15, and 59.03.

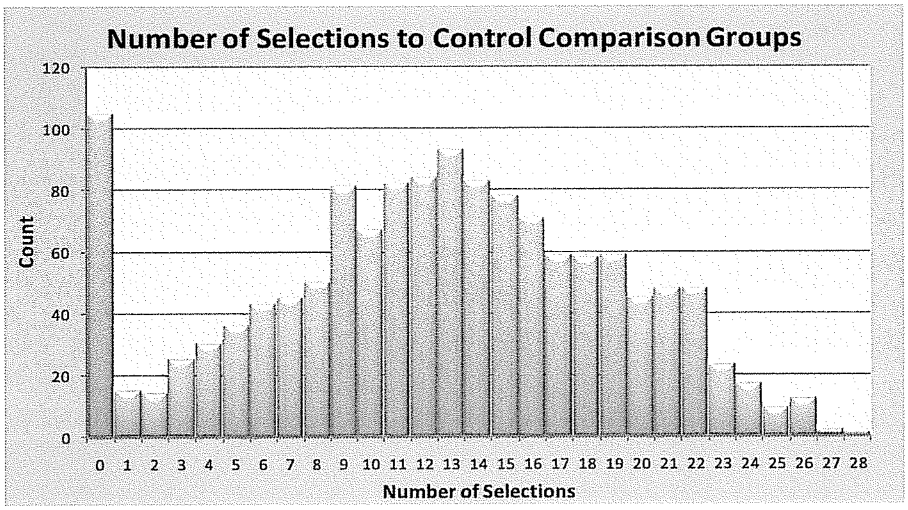
Note that the largest stratum has the fewest members, but the greatest differences in the kWh values. Because the ultimate goal of this procedure is to select 500 members of the original Control group who are stratified the same way as the experimental group, it is necessary to determine the proportion of the customers who fall into each strata and use these proportions. 17 of the 90 (18.88%) SmartRate customers fall into the third strata. Consequently, the following calculation is performed to determine the number of Control group customers that need to be selected who used between 2600 and 6100 kWh in August.

500*0.1888 ~ 94 participants

Once strata breakpoints and the desired number of customers are determined for a group in a given month, a random sample of Control customers are selected to create a Control comparison group. In August, the SmartRate group's Control comparison group contained the 94 customers using between 2600 and 6100 kWh discussed above. No customers using under 100 kWh in a given month were selected to the Control comparison group; therefore, Strata 1 contained 172 customers using between 100 and 1599 kWh. Strata 2 was composed of 234 customers who used between 1600 and 2599 kWh. Monthly strata breakpoints and sizes are included for each group at the beginning of each analysis section in this report.

In previous reports, GoodCents selected one Control comparison group per season for each experimental group. For the summer 2010 analysis period, a separate comparison group was selected for each of the seven months analyzed, May through September. This means that a total of 35 Control comparison groups were selected.

To ensure that this monthly selection process was not biased toward the selection of certain members of the Control group, the following histogram was constructed to show the number of times the 1,409 Control group customers were selected for membership in a Control comparison group.



105 members of the Control group were never selected to be a part of a Control comparison group. A quick investigation reveals that these are individuals' monthly usage is consistently under 100 kWh and are therefore excluded from selection. The bell-shaped distribution of the remaining members of the Control group validates the monthly selection process. The expected number of selections for the remaining 1,304 customers is:

$$^{500}/_{1304} * 35 = 13 \ selections$$

The figure above shows that the most frequent number of selections, aside from zero, is 13. This is further evidence that monthly selection does not bias the creation of Control comparison groups. Because the summer analysis period spans from March to September, customers are bound to respond to the variety of weather conditions differently. Monthly control group selection should minimize these differences and focus the analysis on the way program features affect weekday-weekend and time-of-day demands.

Appendix B – Strata Breakpoints

Strata Breakpoints for Control Comparison Group Selection - SmartRate Group				
Month		**Strata 1**	**Strata 2**	**Strata 3**
June	Monthly kWh Range	100 - 1499	1500 - 2499	2500 - 5699
	Number of Customers	167	227	106
July	Monthly kWh Range	100 - 1599	1600 - 2599	2600 - 5899
	Number of Customers	161	228	111
August	Monthly kWh Range	100 - 1599	1600 - 2599	2600 - 6099
	Number of Customers	172	234	94
September	Monthly kWh Range	100 - 999	1000 - 1799	1800 - 4899
	Number of Customers	194	212	94

Strata Breakpoints for Control Comparison Group Selection - GE Group				
Month		**Strata 1**	**Strata 2**	**Strata 3**
June	Monthly kWh Range	100 - 1699	1700 - 2199	2200 - 3299
	Number of Customers	167	222	111
July	Monthly kWh Range	100 - 1699	1700 - 2399	2400 - 3499
	Number of Customers	222	167	111
August	Monthly kWh Range	100 - 1699	1700 - 2599	2600 - 3399
	Number of Customers	167	222	111
September	Monthly kWh Range	100 - 1199	1200 - 1599	1600 - 2499
	Number of Customers	222	167	111

Strata Breakpoints for Control Comparison Group Selection - Information Only Group				
Month		**Strata 1**	**Strata 2**	**Strata 3**
June	Monthly kWh Range	100 - 1399	1400 - 2399	2400 - 4599
	Number of Customers	171	221	108
July	Monthly kWh Range	100 - 1599	1600 - 2699	2700 - 5199
	Number of Customers	184	202	114
August	Monthly kWh Range	100 - 1499	1500 - 2599	2600 - 5199
	Number of Customers	158	228	114
September	Monthly kWh Range	100 - 999	1000 - 1699	1700 - 3499
	Number of Customers	209	171	120

Strata Breakpoints for Control Comparison Group Selection - Display Only Group				
Month		**Strata 1**	**Strata 2**	**Strata 3**
June	Monthly kWh Range	100 - 1299	1300 - 2299	2300 - 4599
	Number of Customers	195	178	127
July	Monthly kWh Range	100 - 1399	1400 - 2499	2500 - 5899
	Number of Customers	182	210	108
August	Monthly kWh Range	100 -1399	1400 - 2499	2500 - 5599
	Number of Customers	178	207	115
September	Monthly kWh Range	100 - 899	900 - 1799	1800 - 4199
	Number of Customers	197	213	90

Strata Breakpoints for Control Comparison Group Selection - Demand Conservation Group				
Month		**Strata 1**	**Strata 2**	**Strata 3**
June	Monthly kWh Range	100 - 1199	1200 - 1999	2000 - 2999
	Number of Customers	115	231	154
July	Monthly kWh Range	100 - 1399	1400 - 2299	2300 - 3599
	Number of Customers	154	192	154
August	Monthly kWh Range	100 -1399	1400 - 2199	2200 - 3299
	Number of Customers	154	192	154
September	Monthly kWh Range	100 - 899	900 - 1499	1500 - 2399
	Number of Customers	154	192	154

Appendix C – Regression Analysis

Regression Analysis - Load Impact Model – SmartRate Group

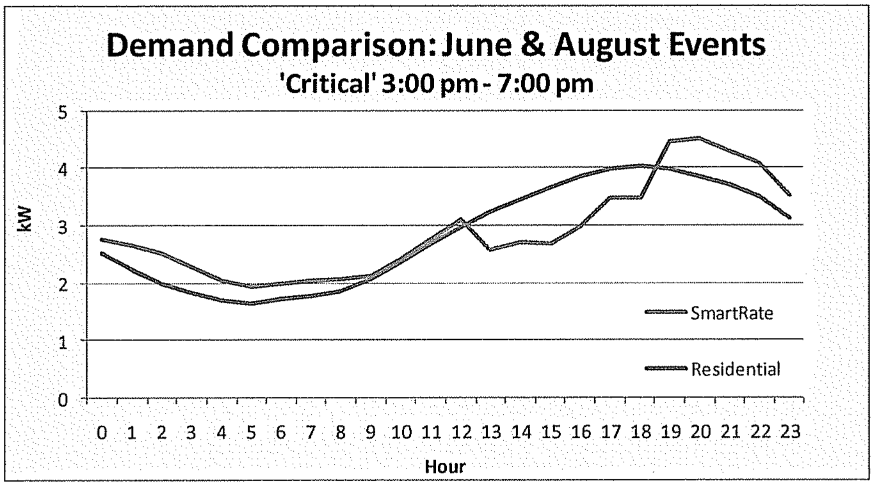
A regression model was developed to compare the SmartRate customers' weekday usage patterns with members of the Control comparison group. This model was run using three separate subsets of summer data to generate load impact estimates under different conditions. The first subset explored was nonevent weekdays. This included all weekdays in June, July, August, and September with the exception of the eight critical peak pricing events. On these days, residential customers paid a flat-rate for electricity and the SmartRate customers were charged according to the appropriate three-tiered 'Summer Weekday' pricing structure. On these days, the 'High' pricing period occurs from 1:00 pm to 6:00 pm.

During the summer of 2010, two different critical peak pricing events were called. Both events began at 3:00 pm. The June and August events lasted until 7:00 pm, while the two July events concluded at 6:00 pm. On both types of days, the SmartRate group is billed according to the 'High' pricing tier from 1:00 pm to 3:00 pm. The following table provides the dates and times of the two types of events, along with the maximum temperature. Regression coefficients were calculated for each stratum, each hour for the two types of events, as well as non-event weekdays. This methodology controls for weather because the SmartRate group's usage is being compared to residential customer usage on the same days.

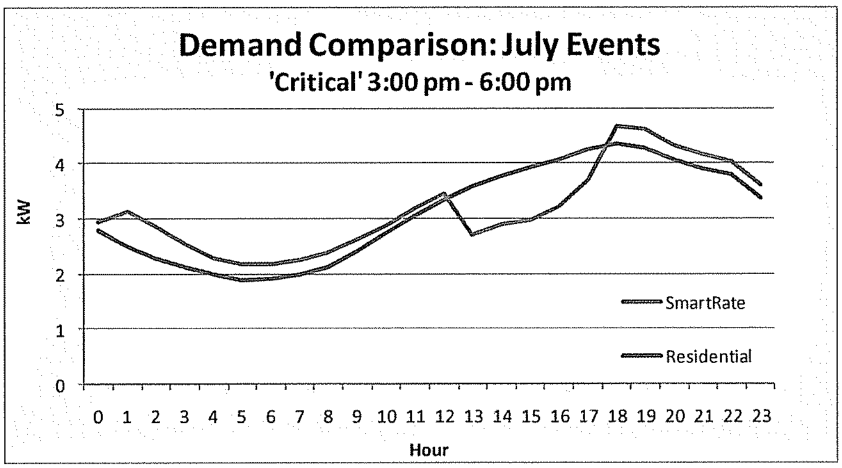
Reference Table - Critical Peak Pricing Events

Month	Day	Max Daily Temperature (F)	Time
June	17	90	3 - 7 PM EDT
June	18	93	3 - 7 PM EDT
June	22	93	3 - 7 PM EDT
June	23	94	3 - 7 PM EDT
June	25	91	3 - 7 PM EDT
July	15	94	3 - 6 PM EDT
July	23	95	3 - 6 PM EDT
August	10	100	3 - 7 PM EDT

The graph below provides a visual comparison of the SmartRate and residential customers on the June and August days when 3:00 pm to 7:00 pm were called.



The final graph examines the average hourly demand of the two groups on the two July days when 3:00 pm to 6:00 pm events were called.



Using regression modeling, GoodCents was able to estimate the differences between the two groups during periods of interest. This includes hours during the 'High' and 'Critical' tiers as well as the hours immediately following them, or bounce-back hours.

HVAC usage is one the major loads that customers responding to the SmartRate program curb during the periods when they are paying more than the standard residential rate. The programmable thermostat provided to the customers can be programmed to increase or lower temperature settings based on the rate. Potential impacts from this type of behavior modification are directly proportional to the size of the HVAC load in the home. GoodCents estimated this load for each customer by taking the average demand on weekday afternoons when the maximum daily temperature was greater than or equal to 85 Degrees (F). Because the primary load in a home on hot afternoons is the air conditioner, and the air conditioner runs steadily during these hours, this term can be thought of as a proxy for the AC unit's connected load.

PREMKWH (Hour t, Site J) = A + B * LOADTEMP+ C * LOADTEMPC

+ D* PREMHR12

Where:

A is the regression intercept

B and **D** are regression coefficients determined during the modeling process

C is the load reduction estimate for the premise at hour t and a given maximum daily temperature

PREMKWH (Hour t, Site J) is the premise kWh in the hour ending t for site J

LOADTEMP is the premise mean load throughout the summer hours 15-18 and maximum temperature above 85 degrees multiplied by the temperature during that hour squared. The premise mean load during these hours is meant to serve as a proxy for AC connected load

LOADTEMPC is an indicator variable (1 for a CPP day, 0 for a non CPP day) multiplied by the premise mean load as defined above and the squared maximum temperature

PREMHR12 is the premise kWh in hour 12, which is the hour preceding the high rate tier implementation

Customers were grouped into one of two bins or strata based on their value of the maximum hourly usage from the summer 2010. Strata 1 was made up of customers with a maximum hourly load of 0-6 kWh and strata 2 included customers above 6 kWh. 43.07% of the sample was placed in strata 1 and 56.93% was placed in strata 2. Separate regressions were performed on the two strata and load reduction estimates were weighted according the prevalence of the two strata in the sample.

The following table provides regression estimates for the six 4-hour CPP events. Appendix D contains the entire regression output for each strata and hour including significance levels for each of the independent variables. The **LOADTEMPC** term was extremely significant in each model (p <.0001).

Parameter Estimates by Strata and Hour - 4 Hour CPP Events							
Strata	Hour	Root Mean Squared Error	Intercept	Loadtemp	LoadtempC	PremHR12	Adjusted R-squared
1	13	0.637	-0.030	0.00004411	-0.00001973	0.689	0.771
	14	0.758	-0.046	0.00007849	-0.00001406	0.422	0.694
	15	0.713	-0.021	0.00010539	-0.00003202	0.232	0.723
	16	0.758	-0.010	0.00011569	-0.00003010	0.154	0.699
	17	0.747	0.029	0.00012195	-0.00001002	0.115	0.711
	18	0.815	0.126	0.00013054	-0.00000876	0.058	0.675
	19	0.816	0.237	0.00012901	0.00001949	0.043	0.669
	20	0.860	0.254	0.00012702	0.00003239	0.043	0.637
2	13	1.044	-0.153	0.00004837	-0.00002589	0.652	0.749
	14	1.235	-0.388	0.00008022	-0.00002442	0.449	0.671
	15	1.274	-0.353	0.00010210	-0.00002741	0.289	0.648
	16	1.284	-0.155	0.00010886	-0.00002018	0.237	0.637
	17	1.258	0.422	0.00011031	-0.00001130	0.129	0.594
	18	1.370	0.840	0.00011084	-0.00001110	0.033	0.499
	19	1.459	1.197	0.00010390	0.00002174	0.017	0.433
	20	1.467	1.336	0.00009757	0.00002455	0.027	0.399

Recall that SmartRate customers pay the 'High' rate from 1:00 pm to 3:00 pm (Hours 13 and 14) and then pay the 'Critical' rate from 3:00 pm to 7:00 pm (Hours 15 through 18). Hours 19 and 20 represent the bounce-back period for this type of event. During non-event weekday afternoons, the coefficient of the **LOADTEMPC** term takes its largest negative values during hours 13 and 14 and then begins to drift back towards 0. On days when CPP events are called, these hours have similar negative coefficients to non-event weekdays, but get even larger once the 'Critical' pricing period begins at 3:00 pm. For both strata, the coefficient of the **LOADTEMPC** term is largest during the first hour of the 'Critical' pricing period and shrinks for each subsequent hour. Because these CPP events lasted from 3:00 pm until 7:00 pm, the bounce-back period occurs during hours 19 and 20.

Parameter Estimates by Strata and Hour - 3 Hour CPP Events							
Strata	Hour	Root Mean Squared Error	Intercept	Loadtemp	LoadtempC	PremHR12	Adjusted R-squared
1	13	0.620	-0.076	0.00005554	-0.00002949	0.611	0.788
	14	0.776	0.004	0.00007238	-0.00002233	0.471	0.690
	15	0.794	0.047	0.00008964	-0.00003067	0.320	0.670
	16	0.826	0.052	0.00010372	-0.00002535	0.242	0.662
	17	0.819	0.169	0.00011576	-0.00000885	0.126	0.662
	18	0.919	0.340	0.00012704	0.00000845	0.005	0.610
	19	0.941	0.408	0.00012047	0.00001532	0.041	0.579
2	13	1.005	0.083	0.00003959	-0.00002811	0.686	0.785
	14	1.184	0.073	0.00006629	-0.00002431	0.479	0.703
	15	1.223	-0.025	0.00008892	-0.00002149	0.316	0.688
	16	1.232	0.239	0.00009984	-0.00001720	0.198	0.660
	17	1.277	0.520	0.00011253	-0.00001015	0.061	0.627
	18	1.410	1.311	0.00010147	0.00002042	-0.001	0.510
	19	1.462	1.588	0.00009120	0.00001808	0.035	0.445

The coefficients of the regression models for the July CPP events follow a similar pattern to the models of the June and August events. There are large negative coefficients for both strata for each hour of the "Critical" period. The bounce-back period begins at 6:00 pm for these events, and the coefficients of the **LOADTEMPC** term become large and positive for both strata, as expected. It is important to note that all four of the **LOADTEMPC** coefficients for the hours following the 'Critical' period are smaller for the 3-hour CPP events than the corresponding coefficient for a 4-hour event. This indicates that the bounce-back effect of a 4-hour event is larger than a 3-hour event.

Calculation of Load Reduction during CPP Periods

The regression models discussed previously are based on air temperature, the customer's average weekday afternoon load (premise mean) on hot days and their demand during the hour prior to the beginning of the 'High' price tier. Using the regression estimates above, the expected load impact for SmartRate customers and residential customers can be calculated and compared. Recall that the premise mean is being used a proxy for the connected load of the home's air conditioning unit. The following comparison is made for a strata 1 customer with a 3.0 kW AC unit on a 92 Degree (F) afternoon for hour 15 (3:00 pm – 4:00 pm) on a day when a 3-hour event is called. This example assumes that the home's load for Hour 12 (12:00 pm to 1:00 pm) is 2.0 kW.

The estimated Hour 15 load for a residential customer is:

INTERCEPT + 92*92*LOADTEMP*3.0 + PREMHR12*2.0

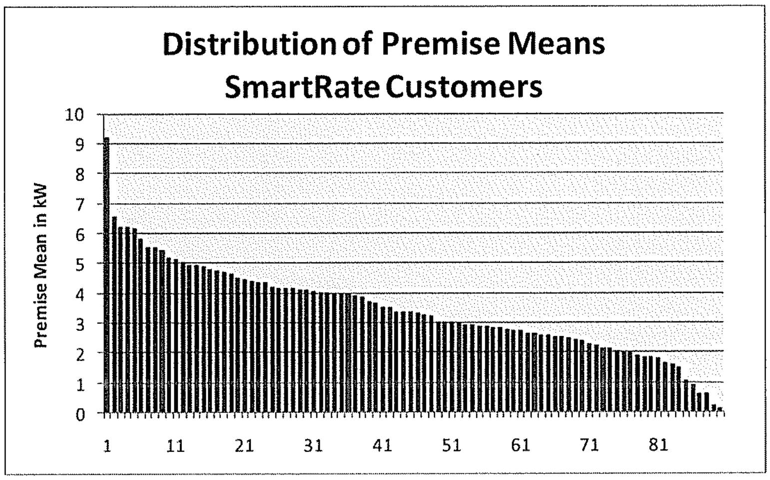
0.047 + 2.276 + 0.640 = 2.963 kW

For residential customers, the **LOADTEMPC** term is always equal to 0 and does not factor into the calculation. For a SmartRate customer, the load reduction calculation uses the **LOADTEMPC** term in addition to the terms used for residential customers.

2.963 + LOADTEMPC*92*92*3.0

2.963 – 0.00003067*92*92*3.0 = 2.184 kW

The estimated load impact under these conditions is -0.779 kW. This type of calculation was performed for many possible combinations of hours, temperatures, and types of day to generate load impact estimates. Calculations for each set of conditions were performed using both the strata 1 and strata 2 models and weighting the results according to that strata's proportion in the sample. The histogram to the left shows the distribution of the premise means of the 90 customers in the SmartRate group sorted from largest to smallest. Most customers' premise mean is between 2 and 5 kW. The average value is 3.44 kW and the median value is 3.33 kW. To best represent the effects of the two types of CPP events, weighted impact estimates are provided for AC sizes (premise means) of 2.0 kW, 3.5 kW, and 5.0 kW.



In the table below, estimates are provided for days when 4-hour events were called. Hours 15 through 18 are when the 'Critical' rate takes effect under this type of event. Estimated load reductions during this period are significant, with high-usage customers expected to shave over 1 kW from their load during hours 15 and 16.

Load Impact Estimates by Temperature, Hour and AC Size - 4-Hour Events

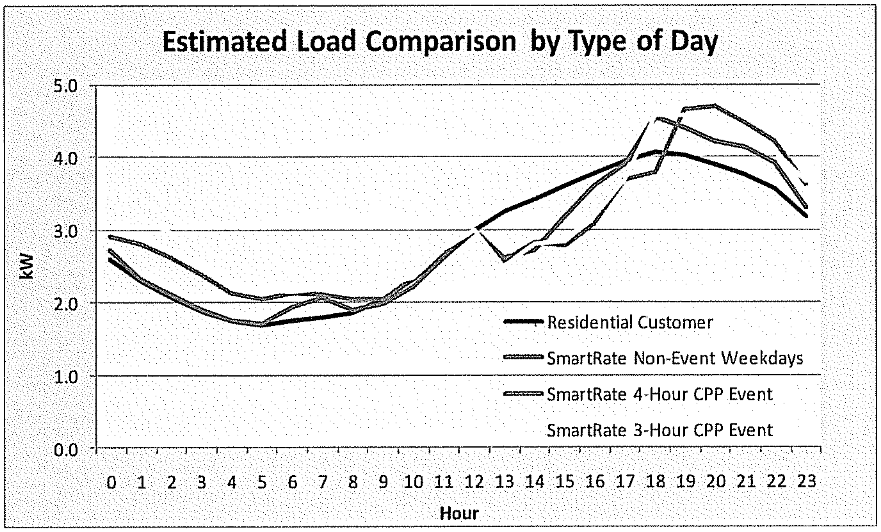
AC Size = 2.0 kW			AC Size = 3.5 kW			AC Size = 5.0 kW		
Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)
90	13	-0.376	90	13	-0.659	90	13	-0.941
90	14	-0.323	90	14	-0.566	90	14	-0.808
90	15	-0.476	90	15	-0.833	90	15	-1.191
90	16	-0.396	90	16	-0.693	90	16	-0.990
90	17	-0.174	90	17	-0.305	90	17	-0.435
90	18	-0.163	90	18	-0.286	90	18	-0.409
90	19	0.337	90	19	0.589	90	19	0.841
90	20	0.452	90	20	0.792	90	20	1.131
92	13	-0.393	92	13	-0.688	92	13	-0.983
92	14	-0.338	92	14	-0.591	92	14	-0.845
92	15	-0.498	92	15	-0.871	92	15	-1.244
92	16	-0.414	92	16	-0.724	92	16	-1.035
92	17	-0.182	92	17	-0.318	92	17	-0.455
92	18	-0.171	92	18	-0.299	92	18	-0.427
92	19	0.352	92	19	0.615	92	19	0.879
92	20	0.473	92	20	0.827	92	20	1.182
94	13	-0.411	94	13	-0.718	94	13	-1.026
94	14	-0.353	94	14	-0.617	94	14	-0.882
94	15	-0.520	94	15	-0.909	94	15	-1.299
94	16	-0.432	94	16	-0.756	94	16	-1.080
94	17	-0.190	94	17	-0.332	94	17	-0.475
94	18	-0.178	94	18	-0.312	94	18	-0.446
94	19	0.367	94	19	0.642	94	19	0.918
94	20	0.494	94	20	0.864	94	20	1.234
96	13	-0.428	96	13	-0.749	96	13	-1.071
96	14	-0.368	96	14	-0.644	96	14	-0.920
96	15	-0.542	96	15	-0.948	96	15	-1.355
96	16	-0.451	96	16	-0.789	96	16	-1.127
96	17	-0.198	96	17	-0.347	96	17	-0.495
96	18	-0.186	96	18	-0.326	96	18	-0.465
96	19	0.383	96	19	0.670	96	19	0.957
96	20	0.515	96	20	0.901	96	20	1.287

Load Impact estimates for 3-hour events are contained in the table below.

Load Impact Estimates by Temperature, Hour and AC Size - 3-Hour Events								
AC Size = 2.0 kW			AC Size = 3.5 kW			AC Size = 5.0 kW		
Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)
90	13	-0.465	90	13	-0.814	90	13	-1.163
90	14	-0.380	90	14	-0.665	90	14	-0.950
90	15	-0.412	90	15	-0.721	90	15	-1.030
90	16	-0.336	90	16	-0.587	90	16	-0.839
90	17	-0.155	90	17	-0.272	90	17	-0.388
90	18	0.247	90	18	0.433	90	18	0.618
90	19	0.274	90	19	0.479	90	19	0.684
92	13	-0.486	92	13	-0.850	92	13	-1.215
92	14	-0.397	92	14	-0.695	92	14	-0.993
92	15	-0.431	92	15	-0.754	92	15	-1.077
92	16	-0.351	92	16	-0.614	92	16	-0.877
92	17	-0.162	92	17	-0.284	92	17	-0.406
92	18	0.258	92	18	0.452	92	18	0.646
92	19	0.286	92	19	0.500	92	19	0.715
94	13	-0.507	94	13	-0.888	94	13	-1.268
94	14	-0.414	94	14	-0.725	94	14	-1.036
94	15	-0.450	94	15	-0.787	94	15	-1.124
94	16	-0.366	94	16	-0.641	94	16	-0.915
94	17	-0.169	94	17	-0.296	94	17	-0.424
94	18	0.270	94	18	0.472	94	18	0.674
94	19	0.298	94	19	0.522	94	19	0.746
96	13	-0.529	96	13	-0.926	96	13	-1.323
96	14	-0.432	96	14	-0.756	96	14	-1.081
96	15	-0.469	96	15	-0.821	96	15	-1.172
96	16	-0.382	96	16	-0.668	96	16	-0.954
96	17	-0.177	96	17	-0.309	96	17	-0.442
96	18	0.281	96	18	0.492	96	18	0.703
96	19	0.311	96	19	0.545	96	19	0.778

Notice that the impact estimates become positive in hour 18, when the SmartRate customers switch from 'Critical' to 'Medium' pricing. These bounce-back estimates are significantly smaller than the estimates for the hours following 4-hour events. This is likely a result of the shorter duration of the actual event. The customer is able to resume normal evening loads an hour earlier, so there is a less dramatic spike once the 'Medium' pricing period begins.

The graph to the right provides a visual representation of the expected behavior of SmartRate customers on Non-Event Weekdays, days when 4-hour CPP events are called and days when 3-hour CPP events are called.



Average Hourly Temperatures CPP Event Days	
Hour	Temperature (F)
0	80.5
1	78.6
2	78.1
3	77.0
4	76.9
5	75.6
6	75.7
7	77.7
8	80.5
9	83.2
10	86.1
11	87.7
12	89.5
13	90.6
14	91.7
15	91.9
16	91.7
17	91.4
18	90.6
19	89.4
20	87.9
21	86.5
22	85.5
23	83.9

Each hourly regression model uses the air temperature squared, the premise mean on hot weekday afternoons (AC Size), and its load from 12:00 pm to 1:00 pm in the estimation of a customer's load. In this example, hourly temperature values were created by taking the average hourly air temperature from the eight 2010 CPP event days. The hourly temperatures used are included in the table to the left. Since the distribution of SmartRate means is centered around 3.5 kW, this is the value used in the following calculations. A hypothetical load of 3.0 kW is used for the Hour 12 load. Estimates for both strata 1 and strata 2 were computed and weighted according to their prevalence in the SmartRate population. The non-event weekday, 4-hour event, and 3-hour event models can all be used to produce an estimate of a residential customer's load under the same conditions. A residential customer estimate was computed for each hour and averaged to produce the "Residential Customer" reference line in the graph above.

This methodology controls for temperature by comparing the expected loads under exactly the same conditions. The most notable result in this type of comparison is that the difference between a SmartRate customer under 'Critical' pricing and a SmartRate customer under 'High' pricing is not as large as the difference between a residential customer and a SmartRate customer under 'High' pricing. CPP events prolong the load reducing behavior in SmartRate customers, but much of the initial drop has already been produced during the 'High' price hours from 1:00 pm to 3:00 pm.

On non-event weekdays, load reductions occur from hour 13 to hour 16, with almost no effect during hour 17. 3-hour events show a second drop at hour 15 when the 'Critical' rate takes effect and a significant load reduction is maintained through hour 17. Because a 4-hour event lasts until 7:00 pm, the estimated load stays lower than that of a residential customer through hour 18 before spiking back up in hour 19. Notice that the height of the bounce-back is proportional to the amount and duration of the rate increases during the afternoon hours. Non-event weekdays show the least bounce-back and 4-hour events exhibit the most.

Estimated Load Comparison by Type of Day in kW

Hour	Residential Customer	SmartRate Non-Event Weekdays	SmartRate 4-Hour CPP Event	SmartRate 3-Hour CPP Event
0	2.60	2.72	2.91	3.04
1	2.30	2.32	2.80	3.18
2	2.06	2.10	2.61	2.94
3	1.88	1.91	2.38	2.56
4	1.76	1.75	2.13	2.30
5	1.68	1.70	2.04	2.17
6	1.76	1.94	2.13	2.16
7	1.80	2.06	2.11	2.19
8	1.86	1.90	2.05	2.14
9	2.05	1.98	2.04	2.26
10	2.32	2.22	2.35	2.35
11	2.67	2.60	2.66	2.75
12	3.00	3.00	3.00	3.00
13	3.24	2.61	2.57	2.49
14	3.42	2.73	2.83	2.81
15	3.59	3.18	2.77	2.84
16	3.77	3.59	3.08	3.19
17	3.95	3.91	3.68	3.68
18	4.07	4.54	3.80	4.57
19	4.02	4.41	4.65	4.57
20	3.89	4.20	4.71	4.37
21	3.75	4.13	4.47	4.21
22	3.57	3.93	4.22	4.06
23	3.17	3.31	3.63	3.67

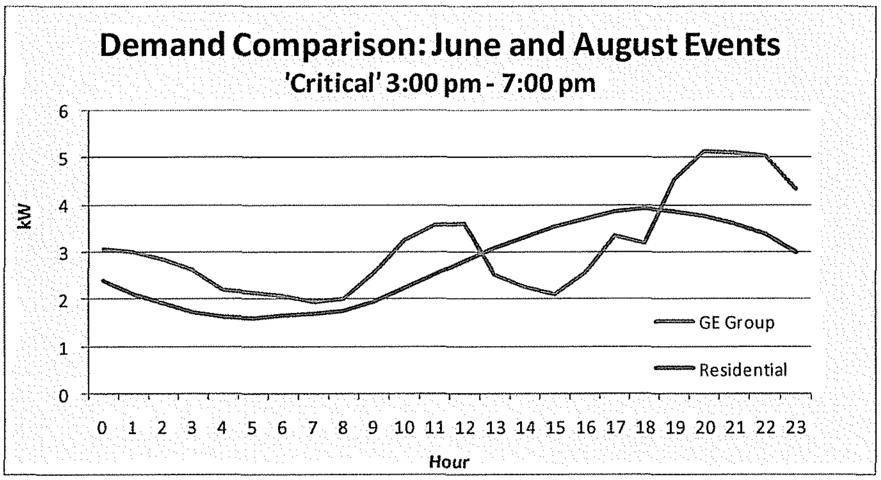
All estimations use Premise Mean = 3.5 kW, PremHR12 = 3.0 kW and Temperature = Average Hourly Temperature 2010 CPP Event Days

The relationship between these curves will not change based on the particular temperature and premise statistics in question. The size of the loads and the resulting impact estimates will be affected, but the shape will not. The load estimates in the graph above are presented, in table format to the right. The table can used to calculate load impacts at a given hour by subtracting the residential estimated load from SmartRate estimated load in question.

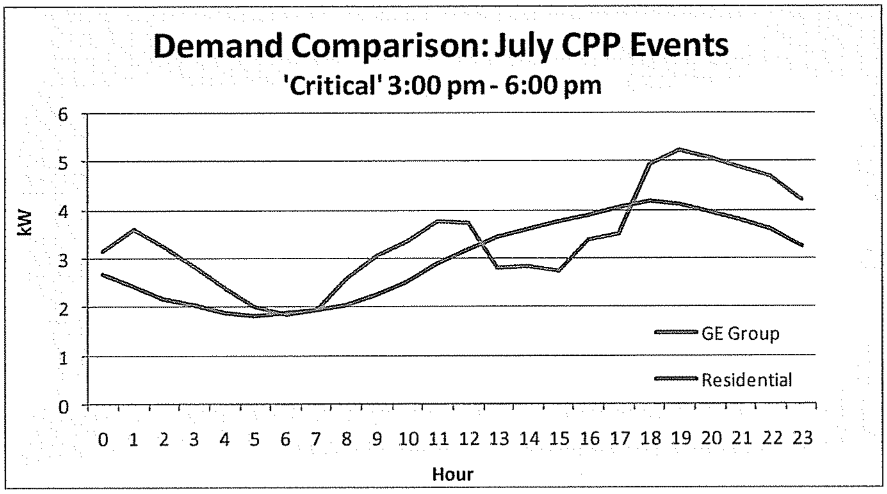
Regression Analysis – Load Impact Model – GE Group

Regression modeling was also used to compare the GE groups' weekday usage patterns with standard residential customers. Like the modeling procedure used for the SmartRate group, two separate subsets of summer data are used to generate load impact estimates under different conditions. During the summer of 2010, two different critical peak pricing events were called. Both events began at 3:00 pm. The June and August events lasted until 7:00 pm, while the two July events concluded at 6:00 pm. On both types of days, the GE group is billed according to the 'High' pricing tier from 1:00 pm to 3:00 pm. Regression coefficients were calculated for each stratum, each hour for the two types of events, as well as non-event weekdays. This methodology controls for weather because the GE group's usage is being compared to residential customer usage on the same days.

The graph below provides a visual comparison of the GE and residential customers on the days when 3:00 pm to 7:00 pm events were called.



The next graph examines the average hourly demand of the two groups on the two July days when 3:00 pm to 6:00 pm events were called. Using regression modeling, GoodCents was able to estimate the differences between the two groups during periods of interest. This includes hours during the 'High' and 'Critical' tiers as well as the hours immediately following them, or bounce-back hours.



HVAC usage is one of the major loads that customers responding to the SmartRate program curb during the periods when they are paying more than the standard residential rate. The programmable thermostat customers are provided can be programmed to raise or lower temperature settings based on the rate. Potential impacts from this type of behavior modification are directly proportional to the size of the HVAC load in the home. GoodCents estimated this load for each customer by taking the average demand on weekday afternoons when the maximum daily temperature was greater than or equal to 85 Degrees (F). Because the primary load in a home on hot afternoons is the air conditioner, and the air conditioner runs steadily during these hours, this term can be thought of as a proxy for the AC unit's connected load.

PREMKWH (Hour t, Site J) = A + B * LOADTEMP+ C * LOADTEMPC

+ D* PREMHR12

Where:

A is the regression intercept

B and **D** are regression coefficients determined during the modeling process

C is the load reduction estimate for the premise at hour t and a given maximum daily temperature

PREMKWH (Hour t, Site J) is the premise kWh in the hour ending t for site J

LOADTEMP is the premise mean load throughout the summer hours 15-18 and maximum temperature above 85 degrees multiplied by the temperature during that hour squared. The premise mean load during these hours is meant to serve as a proxy for AC connected load

LOADTEMPC is an indicator variable (1 for a CPP day, 0 for a non CPP day) multiplied by the premise mean load as defined above and the squared maximum temperature

PREMHR12 is the premise kWh in hour 12, which is the hour preceding the high rate tier implementation

Both GE and residential customers were grouped into one of two bins or strata based on their value of the maximum hourly usage from the summer 2010. Strata 1 was made up of customers with a maximum hourly load of 0-6 kWh and strata 2 included customers above 6 kWh. 44.32% of the sample was placed in strata 1 and 55.68% was placed in strata 2. Separate regressions were performed on the two strata and load reduction estimates were weighted according the prevalence of the two strata in the sample.

The following table provides regression estimates for the six 4-hour CPP events. Appendix D contains the entire regression output for each strata and hour including significance levels for each of the independent variables for the GE customers. The **LOADTEMPC** term was extremely significant in each model (p <.0001).

GE Group Parameter Estimates by Strata and Hour - 4 Hour CPP Events							
Strata	Hour	Root Mean Squared Error	Intercept	Loadtemp	LoadtempC	PremHR12	Adjusted R-squared
1	13	0.578	-0.070	0.00004930	-0.00004352	0.662	0.815
	14	0.719	-0.031	0.00008049	-0.00006087	0.399	0.731
	15	0.707	0.013	0.00010621	-0.00006875	0.208	0.745
	16	0.716	0.071	0.00011362	-0.00007205	0.143	0.740
	17	0.720	0.123	0.00012020	-0.00002273	0.094	0.736
	18	0.762	0.179	0.00012993	-0.00000172	0.028	0.714
	19	0.784	0.230	0.00013880	0.00004640	-0.028	0.701
	20	0.857	0.264	0.00014206	0.00006673	-0.051	0.653
2	13	1.027	-0.255	0.00004973	-0.00003613	0.668	0.681
	14	1.230	-0.277	0.00007838	-0.00004324	0.453	0.554
	15	1.228	-0.358	0.00010097	-0.00005302	0.322	0.552
	16	1.263	-0.152	0.00011026	-0.00003639	0.224	0.510
	17	1.263	0.343	0.00011476	-0.00002048	0.105	0.458
	18	1.429	0.997	0.00010638	-0.00003022	0.039	0.334
	19	1.388	1.231	0.00010224	0.00001123	0.016	0.303
	20	1.456	1.352	0.00009613	0.00003441	0.021	0.259

Recall that GE customers pay the 'High' rate from 1:00 pm to 3:00 pm (hours 13 and 14) and then pay the 'Critical' rate from 3:00 pm to 7:00 pm (hours 15 through 18). Hours 19 and 20 represent the bounce-back period for this type of event. During non-event weekday afternoons, the coefficient of the **LOADTEMPC** term takes its largest negative values during hours 13 and 14 and then begins to drift back towards 0. On days when 4-hour CPP events are called, these hours have similar negative coefficients to non-event weekdays, but get even larger once the 'Critical' pricing period begins at 3:00 pm. For strata 1, the coefficient of the **LOADTEMPC** term is actually largest during the second hour of the 'Critical' pricing period. Because these CPP events last from 3:00 pm until 7:00 pm, the bounce-back period occurs during hours 19 and 20.

The coefficients of the regression models for 3-hour CPP Events follow a similar pattern to the models of 4-hour events and are displayed in the table below. There are large negative coefficients for both strata for each hour of the 'Critical' period. The bounce-back period should begin at 6:00 pm for these events, but strata 1's Hour 18 coefficient remains negative. It is important to remember that the small size of the GE group makes the regression estimates less reliable than those from the entire SmartRate group. This is especially true for 3-hour events because there were only two such events in 2010. The coefficient for strata 2 shows the expected response for Hour 18, with the coefficient of the **LOADTEMPC** term becoming positive.

GE Group Parameter Estimates by Strata and Hour - 3 Hour CPP Events							
Strata	Hour	Root Mean Squared Error	Intercept	Loadtemp	LoadtempC	PremHR12	Adjusted R-squared
1	13	0.521	-0.113	0.00005151	-0.00005450	0.639	0.736
	14	0.659	0.039	0.00007176	-0.00005161	0.432	0.574
	15	0.650	0.223	0.00008690	-0.00004202	0.268	0.534
	16	0.683	0.376	0.00009631	-0.00003262	0.192	0.493
	17	0.716	0.592	0.00010367	-0.00005644	0.084	0.446
	18	0.817	0.887	0.00010696	-0.00001084	-0.016	0.335
	19	0.783	0.958	0.00010985	0.00000757	-0.067	0.328
2	13	0.903	0.182	0.00004427	-0.00002745	0.622	0.674
	14	1.035	0.180	0.00006410	-0.00002615	0.488	0.590
	15	1.097	0.116	0.00008835	-0.00003900	0.305	0.541
	16	1.188	0.094	0.00010628	-0.00001899	0.177	0.490
	17	1.191	0.375	0.00010752	-0.00001405	0.130	0.468
	18	1.339	0.814	0.00010441	0.00002152	0.082	0.378
	19	1.275	0.929	0.00010248	0.00003044	0.081	0.383

Calculation of Load Reduction during CPP Periods

These regression models are based on air temperature and the customer's average weekday afternoon load (premise mean) on hot days. Using the regression estimates above, the expected load impact for GE customers and residential customers can be calculated and compared. Recall that premise mean is being used a proxy for the connected load of the home's air conditioning unit. The following comparison is made for a strata 1 customer with a 3.0 kW AC unit on a 92 Degree (F) afternoon for hour 15 (3:00 pm – 4:00 pm) on a day when a 3-hour event is called. This example assumes that the home's load for hour 12 (12:00 pm to 1:00 pm) is 2.0 kW. The estimated hour 15 load for a residential customer is:

INTERCEPT + 92*92*LOADTEMP*3.0 + PREMHR12*2.0

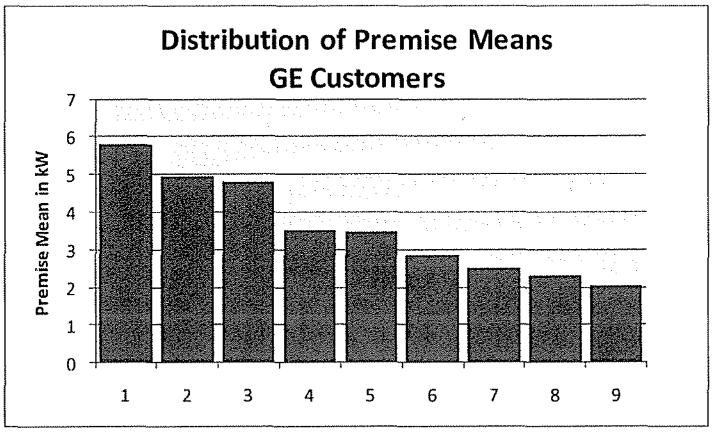
0.223 + 2.207 + 0.536 = 2.966 kW

For residential customers, the **LOADTEMPC** term is always equal to 0 and does not factor into the calculation. For a SmartRate customer, the load reduction calculation uses the **LOADTEMPC** term in addition to the terms used for residential customers.

2.966 + LOADTEMPC*92*92*3.0

2.966 – 0.00004202*92*92*3.0 = 1.899 kW

The estimated load impact under these conditions is -1.067 kW. This type of calculation was performed for many possible combinations of hours, temperatures, and types of day to generate load impact estimates. Calculations for each set of conditions were performed using both the strata 1 and strata 2 models and weighting the results according to that strata's proportion in the sample. The following histogram shows the premise means of the 9 customers in the GE group sorted from largest to smallest. The tenth customer showed extremely low usage and was omitted from analysis. Eight of nine customers have premise means between 2 and 5 kW. The average premise mean value is 3.59 kW and the median premise mean value is 3.49 kW. To best represent the effects of the 'High' pricing period and the two types of CPP events, weighted impact estimates are provided for AC sizes (premise means) of 2.0 kW, 3.5 kW, and 5.0 kW.



In the table below, estimates are provided for days when 4-hour events were called. The response to the CPP event is very dramatic for the GE group. Large customers (AC Size = 5.0 kW) have estimated load reductions greater than 2 kW during the first two hours of the event for all temperatures above 90 Degrees (F).

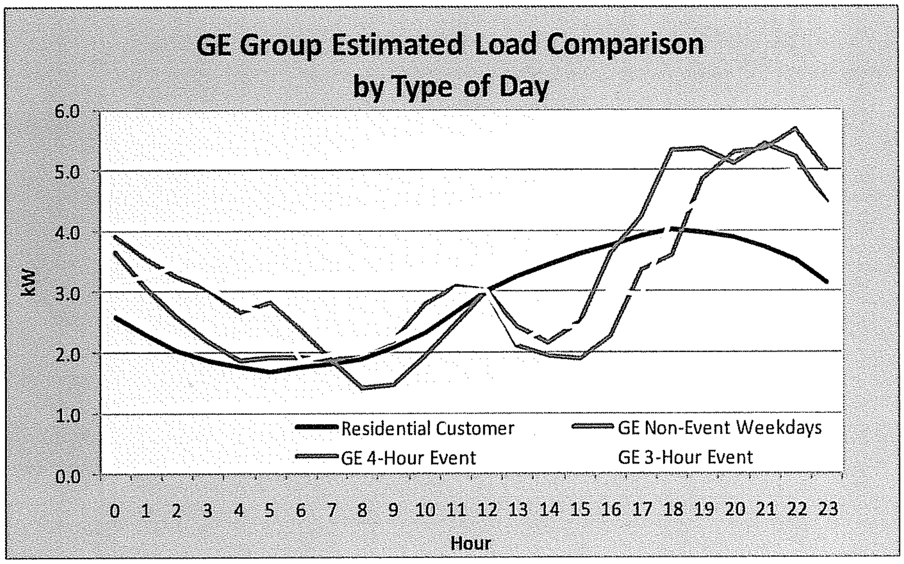
GE Group Load Impact Estimates by Temperature, Hour and AC Size - 4-Hour Events								
AC Size = 2.0 kW			AC Size = 3.5 kW			AC Size = 5.0 kW		
Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)
90	13	-0.638	90	13	-1.117	90	13	-1.596
90	14	-0.827	90	14	-1.447	90	14	-2.068
90	15	-0.972	90	15	-1.701	90	15	-2.430
90	16	-0.846	90	16	-1.480	90	16	-2.114
90	17	-0.348	90	17	-0.609	90	17	-0.870
90	18	-0.285	90	18	-0.499	90	18	-0.712
90	19	0.434	90	19	0.760	90	19	1.086
90	20	0.790	90	20	1.382	90	20	1.974
92	13	-0.667	92	13	-1.167	92	13	-1.668
92	14	-0.864	92	14	-1.512	92	14	-2.161
92	15	-1.016	92	15	-1.777	92	15	-2.539
92	16	-0.884	92	16	-1.546	92	16	-2.209
92	17	-0.364	92	17	-0.636	92	17	-0.909
92	18	-0.298	92	18	-0.521	92	18	-0.744
92	19	0.454	92	19	0.794	92	19	1.135
92	20	0.825	92	20	1.444	92	20	2.062
94	13	-0.696	94	13	-1.219	94	13	-1.741
94	14	-0.902	94	14	-1.579	94	14	-2.255
94	15	-1.060	94	15	-1.855	94	15	-2.650
94	16	-0.922	94	16	-1.614	94	16	-2.306
94	17	-0.380	94	17	-0.664	94	17	-0.949
94	18	-0.311	94	18	-0.544	94	18	-0.777
94	19	0.474	94	19	0.829	94	19	1.185
94	20	0.861	94	20	1.507	94	20	2.153
96	13	-0.726	96	13	-1.271	96	13	-1.816
96	14	-0.941	96	14	-1.647	96	14	-2.352
96	15	-1.106	96	15	-1.935	96	15	-2.764
96	16	-0.962	96	16	-1.684	96	16	-2.405
96	17	-0.396	96	17	-0.693	96	17	-0.990
96	18	-0.324	96	18	-0.567	96	18	-0.811
96	19	0.494	96	19	0.865	96	19	1.236
96	20	0.898	96	20	1.572	96	20	2.246

Load Impact estimates for 3-hour events are contained in the table below.

GE Group Load Impact Estimates by Temperature, Hour and AC Size - 3-Hour Events								
AC Size = 2.0 kW			AC Size = 3.5 kW			AC Size = 5.0 kW		
Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)	Temperature (F)	Hour	Load Impact (kW)
90	13	-0.639	90	13	-1.118	90	13	-1.597
90	14	-0.606	90	14	-1.061	90	14	-1.516
90	15	-0.653	90	15	-1.144	90	15	-1.634
90	16	-0.406	90	16	-0.710	90	16	-1.014
90	17	-0.532	90	17	-0.931	90	17	-1.330
90	18	0.116	90	18	0.203	90	18	0.291
90	19	0.329	90	19	0.576	90	19	0.822
92	13	-0.668	92	13	-1.168	92	13	-1.669
92	14	-0.634	92	14	-1.109	92	14	-1.584
92	15	-0.683	92	15	-1.195	92	15	-1.707
92	16	-0.424	92	16	-0.742	92	16	-1.059
92	17	-0.556	92	17	-0.973	92	17	-1.390
92	18	0.121	92	18	0.213	92	18	0.304
92	19	0.344	92	19	0.601	92	19	0.859
94	13	-0.697	94	13	-1.220	94	13	-1.742
94	14	-0.661	94	14	-1.158	94	14	-1.654
94	15	-0.713	94	15	-1.247	94	15	-1.782
94	16	-0.442	94	16	-0.774	94	16	-1.106
94	17	-0.580	94	17	-1.016	94	17	-1.451
94	18	0.127	94	18	0.222	94	18	0.317
94	19	0.359	94	19	0.628	94	19	0.897
96	13	-0.727	96	13	-1.272	96	13	-1.817
96	14	-0.690	96	14	-1.207	96	14	-1.725
96	15	-0.743	96	15	-1.301	96	15	-1.859
96	16	-0.461	96	16	-0.808	96	16	-1.154
96	17	-0.605	96	17	-1.059	96	17	-1.513
96	18	0.132	96	18	0.231	96	18	0.331
96	19	0.374	96	19	0.655	96	19	0.936

Notice that the impact estimates become positive in hour 18, when the GE customers switch from 'Critical' to 'Medium' pricing. These bounce-back estimates are significantly smaller than the estimates for the hours following 4-hour events. This is likely a result of the shorter duration of the actual event. The customer is able to resume normal evening HVAC and appliance usage an hour earlier, so there is a less dramatic spike once the 'Medium' pricing period begins.

The graph to the right provides a visual representation of the expected behavior of GE customers on non-event weekdays, 4-hour events and 3-hour events.



Average Hourly Temperatures CPP Event Days	
Hour	Temperature (F)
0	80.5
1	78.6
2	78.1
3	77.0
4	76.9
5	75.6
6	75.7
7	77.7
8	80.5
9	83.2
10	86.1
11	87.7
12	89.5
13	90.6
14	91.7
15	91.9
16	91.7
17	91.4
18	90.6
19	89.4
20	87.9
21	86.5
22	85.5
23	83.9

Each hourly regression model uses the air temperature squared, the premise mean on hot weekday afternoons (AC Size) and its load from 12:00 pm to 1:00 pm in its estimation of a customer's load. In this example, hourly temperature values were created by taking the average hourly air temperature from the eight 2010 CPP event days. The hourly temperatures used are included in the table shown to the left. Since the distribution of GE means is centered around 3.5 kW, this is the value used in the following calculations. A hypothetical load of 3.0 kW is used for the hour 12 load. Estimates for both strata 1 and strata 2 were computed and weighted according to their prevalence in the SmartRate population. The different models can all be used to produce an estimate of a residential customers load under the same conditions. A residential customer estimate was computed for each hour and averaged to produce the "Residential Customer" reference line in the graph above.

This methodology controls for temperature by comparing the expected loads under exactly the same conditions. The GE group's load is being estimated consistently higher than the load for residential customers for all hours except the 'High' and 'Critical' pricing periods. Like the SmartRate group as a whole, the difference between 'High' and 'Critical' pricing is not as dramatic as the difference between the standard residential rate and 'High' pricing. Calling a CPP event clearly prolongs the demand conservation activity of customers compared to non-event weekdays. As expected, the bounce-back peak for a 4-hour event is slightly higher than the bounce-back peak from a 3-hour event. The height of this peak should be directly correlated to the amount of behavior modification during the event. In this vein, it is curious that the bounce-back spike on non-event weekdays is larger than that of either type of CPP event. Individual behavior will have significant leverage when sample size and number of events are small. Likely this result is a consequence of some unexpected behavior by one or more members of the GE group.

The relationship between these curves will not change based on the particular temperature and premise statistics in question. The size of the loads and the resulting impact estimates will be affected, but the shape will not. The load estimates in the graph above are presented, in table format to the right. The table can used to calculate load impacts at a given hour by subtracting the Residential estimated load from GE estimated load in question.

GE Group Estimated Load Comparison by Type of Day in kW

Hour	Residential Customer	GE Non-Event Weekdays	GE 4-Hour Event	GE 3-Hour Event
0	2.58	3.66	3.91	3.16
1	2.28	3.06	3.53	3.25
2	2.04	2.60	3.26	3.44
3	1.87	2.18	3.04	3.10
4	1.76	1.86	2.67	2.76
5	1.68	1.93	2.84	2.64
6	1.76	1.92	2.36	1.86
7	1.83	1.86	1.87	1.97
8	1.88	1.41	2.01	2.00
9	2.07	1.47	2.17	2.23
10	2.33	1.93	2.80	2.53
11	2.67	2.47	3.08	3.03
12	3.00	3.00	3.00	3.00
13	3.24	2.43	2.11	2.17
14	3.44	2.15	1.95	2.39
15	3.62	2.50	1.90	2.43
16	3.77	3.63	2.27	3.03
17	3.91	4.24	3.34	2.93
18	4.01	5.33	3.59	4.20
19	3.98	5.35	4.84	4.51
20	3.88	5.12	5.30	4.91
21	3.74	5.44	5.35	4.92
22	3.52	5.22	5.66	4.99
23	3.15	4.47	5.01	4.43

All estimations use Premise Mean = 3.5 kW, PremHR12 = 3.0 kW and Temperature = Average Hourly Temperature 2010 CPP Event Days

Appendix D: SmartRate Group Regression Output

4 Hour CPP Events

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=13

Number of Observations Read	1215
Number of Observations Used	1211
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1657.64359	552.54786	1359.74	<.0001
Error	1207	490.48084	0.40636		
Corrected Total	1210	2148.12443			

Root MSE	0.63747	**R-Square**	0.7717
Dependent Mean	1.90585	**Adj R-Sq**	0.7711
Coeff Var	33.44796		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.02955	0.03975	-0.74	0.4573
loadtemp	1	0.00004411	0.00000308	14.34	<.0001
loadtempc	1	-0.00001973	0.00000263	-7.50	<.0001
premhr12	1	0.68888	0.02098	32.83	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=14

Number of Observations Read	1218
Number of Observations Used	1213
Number of Observations with Missing Values	5

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1576.88466	525.62822	915.80	<.0001
Error	1209	693.91242	0.57396		
Corrected Total	1212	2270.79708			

Root MSE	0.75760	**R-Square**	0.6944
Dependent Mean	2.03459	**Adj R-Sq**	0.6937
Coeff Var	37.23587		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.04580	0.04724	-0.97	0.3325
loadtemp	1	0.00007849	0.00000355	22.08	<.0001
loadtempc	1	-0.00001406	0.00000304	-4.63	<.0001
premhr12	1	0.42247	0.02491	16.96	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=15

Number of Observations Read	1215
Number of Observations Used	1211
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1602.05053	534.01684	1051.25	<.0001
Error	1207	613.13654	0.50798		
Corrected Total	1210	2215.18707			

Root MSE	0.71273	**R-Square**	0.7232
Dependent Mean	2.11927	**Adj R-Sq**	0.7225
Coeff Var	33.63099		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.02119	0.04445	-0.48	0.6337
loadtemp	1	0.00010539	0.00000336	31.33	<.0001
loadtempc	1	-0.00003202	0.00000287	-11.16	<.0001
premhr12	1	0.23154	0.02351	9.85	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=16

Number of Observations Read	1214
Number of Observations Used	1210
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1618.27121	539.42374	938.50	<.0001
Error	1206	693.17835	0.57477		
Corrected Total	1209	2311.44956			

Root MSE	0.75814	**R-Square**	0.7001
Dependent Mean	2.17396	**Adj R-Sq**	0.6994
Coeff Var	34.87357		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.01021	0.04748	-0.22	0.8298
loadtemp	1	0.00011569	0.00000358	32.35	<.0001
loadtempc	1	-0.00003010	0.00000305	-9.85	<.0001
premhr12	1	0.15367	0.02489	6.17	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=17

Number of Observations Read	1212
Number of Observations Used	1208
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1658.10825	552.70275	989.62	<.0001
Error	1204	672.43289	0.55850		
Corrected Total	1207	2330.54114			

Root MSE	0.74733	**R-Square**	0.7115
Dependent Mean	2.28506	**Adj R-Sq**	0.7108
Coeff Var	32.70492		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.02926	0.04685	0.62	0.5324
loadtemp	1	0.00012195	0.00000357	34.19	<.0001
loadtempc	1	-0.00001002	0.00000306	-3.27	0.0011
premhr12	1	0.11465	0.02452	4.68	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=18

Number of Observations Read	1211
Number of Observations Used	1209
Number of Observations with Missing Values	2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1666.51597	555.50532	836.56	<.0001
Error	1205	800.16109	0.66403		
Corrected Total	1208	2466.67706			

Root MSE	0.81488	**R-Square**	0.6756
Dependent Mean	2.38144	**Adj R-Sq**	0.6748
Coeff Var	34.21813		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.12616	0.05085	2.48	0.0132
loadtemp	1	0.00013054	0.00000397	32.87	<.0001
loadtempc	1	-0.00000876	0.00000339	-2.59	0.0098
premhr12	1	0.05798	0.02690	2.16	0.0313

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=19

Number of Observations Read	1211
Number of Observations Used	1209
Number of Observations with Missing Values	2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1625.52242	541.84081	814.33	<.0001
Error	1205	801.78650	0.66538		
Corrected Total	1208	2427.30893			

Root MSE	0.81571	**R-Square**	0.6697
Dependent Mean	2.45914	**Adj R-Sq**	0.6689
Coeff Var	33.17058		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.23673	0.05095	4.65	<.0001
loadtemp	1	0.00012901	0.00000408	31.63	<.0001
loadtempc	1	0.00001949	0.00000348	5.60	<.0001
premhr12	1	0.04267	0.02687	1.59	0.1125

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=13

Number of Observations Read	2308
Number of Observations Used	2304
Number of Observations with Missing Values	4

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	7509.72965	2503.24322	2295.31	<.0001
Error	2300	2508.36345	1.09059		
Corrected Total	2303	10018			

Root MSE	1.04431	**R-Square**	0.7496
Dependent Mean	3.78503	**Adj R-Sq**	0.7493
Coeff Var	27.59064		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.15264	0.06796	-2.25	0.0248
loadtemp	1	0.00004837	0.00000248	19.53	<.0001
loadtempc	1	-0.00002589	0.00000171	-15.10	<.0001
premhr12	1	0.65219	0.01421	45.91	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=14

Number of Observations Read	2312
Number of Observations Used	2308
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	7185.08080	2395.02693	1569.61	<.0001
Error	2304	3515.62232	1.52588		
Corrected Total	2307	10701			

Root MSE	1.23526	**R-Square**	0.6715
Dependent Mean	4.02014	**Adj R-Sq**	0.6710
Coeff Var	30.72689		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	-0.38751	0.08047	-4.82	<.0001
loadtemp	**1**	0.00008022	0.00000284	28.26	<.0001
loadtempc	**1**	-0.00002442	0.00000197	-12.40	<.0001
premhr12	**1**	0.44913	0.01674	26.83	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=15

Number of Observations Read	2312
Number of Observations Used	2308
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	6889.13439	2296.37813	1415.28	<.0001
Error	2304	3738.37855	1.62256		
Corrected Total	2307	10628			

Root MSE	1.27380	**R-Square**	0.6482
Dependent Mean	4.23584	**Adj R-Sq**	0.6478
Coeff Var	30.07189		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	-0.35276	0.08295	-4.25	<.0001
loadtemp	**1**	0.00010210	0.00000294	34.79	<.0001
loadtempc	**1**	-0.00002741	0.00000204	-13.44	<.0001
premhr12	**1**	0.28945	0.01726	16.77	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=16

Number of Observations Read	2311
Number of Observations Used	2307
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	6680.86072	2226.95357	1351.37	<.0001
Error	2303	3795.16588	1.64792		
Corrected Total	2306	10476			

Root MSE	1.28371	**R-Square**	0.6377
Dependent Mean	4.52357	**Adj R-Sq**	0.6373
Coeff Var	28.37835		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.15515	0.08392	-1.85	0.0646
loadtemp	1	0.00010886	0.00000295	36.86	<.0001
loadtempc	1	-0.00002018	0.00000206	-9.79	<.0001
premhr12	1	0.23702	0.01728	13.72	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=17

Number of Observations Read	2312
Number of Observations Used	2308
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	5346.22525	1782.07508	1125.57	<.0001
Error	2304	3647.83925	1.58326		
Corrected Total	2307	8994.06450			

Root MSE	1.25828	**R-Square**	0.5944
Dependent Mean	4.76516	**Adj R-Sq**	0.5939
Coeff Var	26.40578		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	0.42229	0.08235	5.13	<.0001
loadtemp	**1**	0.00011031	0.00000293	37.62	<.0001
loadtempc	**1**	-0.00001130	0.00000204	-5.54	<.0001
premhr12	**1**	0.12948	0.01695	7.64	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=18

Number of Observations Read	2310
Number of Observations Used	2306
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	4316.23953	1438.74651	766.88	<.0001
Error	2302	4318.76885	1.87609		
Corrected Total	2305	8635.00838			

Root MSE	1.36971	**R-Square**	0.4999
Dependent Mean	4.76964	**Adj R-Sq**	0.4992
Coeff Var	28.71720		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.84048	0.08880	9.47	<.0001
loadtemp	1	0.00011084	0.00000325	34.10	<.0001
loadtempc	1	-0.00001110	0.00000226	-4.90	<.0001
premhr12	1	0.03289	0.01859	1.77	0.0770

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=19

Number of Observations Read	2313
Number of Observations Used	2309
Number of Observations with Missing Values	4

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	3756.95134	1252.31711	588.13	<.0001
Error	2305	4908.04362	2.12930		
Corrected Total	2308	8664.99496			

Root MSE	1.45921	**R-Square**	0.4336
Dependent Mean	4.89430	**Adj R-Sq**	0.4328
Coeff Var	29.81454		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	1.19713	0.09483	12.62	<.0001
loadtemp	1	0.00010390	0.00000356	29.21	<.0001
loadtempc	1	0.00002174	0.00000248	8.78	<.0001
premhr12	1	0.01717	0.01975	0.87	0.3848

3 Hour CPP Events

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=13

Number of Observations Read	400
Number of Observations Used	399
Number of Observations with Missing Values	1

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	570.84265	190.28088	494.65	<.0001
Error	395	151.94809	0.38468		
Corrected Total	398	722.79073			

Root MSE	0.62022	**R-Square**	0.7898
Dependent Mean	2.08503	**Adj R-Sq**	0.7882
Coeff Var	29.74660		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.07557	0.07113	-1.06	0.2887
loadtemp	1	0.00005554	0.00000491	11.30	<.0001
loadtempc	1	-0.00002949	0.00000427	-6.90	<.0001
premhr12	1	0.61078	0.03183	19.19	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=14

Number of Observations Read	400
Number of Observations Used	397
Number of Observations with Missing Values	3

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	532.97783	177.65928	295.02	<.0001
Error	393	236.66570	0.60220		
Corrected Total	396	769.64353			

Root MSE	0.77602	**R-Square**	0.6925
Dependent Mean	2.22661	**Adj R-Sq**	0.6902
Coeff Var	34.85201		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.00376	0.08957	0.04	0.9665
loadtemp	1	0.00007238	0.00000609	11.88	<.0001
loadtempc	1	-0.00002233	0.00000529	-4.22	<.0001
premhr12	1	0.47138	0.03985	11.83	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=15

Number of Observations Read	400
Number of Observations Used	398
Number of Observations with Missing Values	2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	510.36988	170.12329	269.76	<.0001
Error	394	248.47654	0.63065		
Corrected Total	397	758.84642			

Root MSE	0.79414	**R-Square**	0.6726
Dependent Mean	2.28144	**Adj R-Sq**	0.6701
Coeff Var	34.80852		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.04738	0.09152	0.52	0.6049
loadtemp	1	0.00008964	0.00000610	14.70	<.0001
loadtempc	1	-0.00003067	0.00000530	-5.79	<.0001
premhr12	1	0.31967	0.04071	7.85	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=16

Number of Observations Read	399
Number of Observations Used	396
Number of Observations with Missing Values	3

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	529.00966	176.33655	258.41	<.0001
Error	392	267.50021	0.68240		
Corrected Total	395	796.50987			

Root MSE	0.82607	**R-Square**	0.6642
Dependent Mean	2.38810	**Adj R-Sq**	0.6616
Coeff Var	34.59122		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.05243	0.09563	0.55	0.5838
loadtemp	1	0.00010372	0.00000641	16.18	<.0001
loadtempc	1	-0.00002535	0.00000557	-4.55	<.0001
premhr12	1	0.24162	0.04235	5.71	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=17

Number of Observations Read	396
Number of Observations Used	394
Number of Observations with Missing Values	2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	519.20069	173.06690	257.80	<.0001
Error	390	261.81676	0.67133		
Corrected Total	393	781.01745			

Root MSE	0.81934	**R-Square**	0.6648
Dependent Mean	2.53797	**Adj R-Sq**	0.6622
Coeff Var	32.28349		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.16853	0.09510	1.77	0.0772
loadtemp	1	0.00011576	0.00000638	18.15	<.0001
loadtempc	1	-0.00000885	0.00000563	-1.57	0.1172
premhr12	1	0.12639	0.04195	3.01	0.0028

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=18

Number of Observations Read	399
Number of Observations Used	396
Number of Observations with Missing Values	3

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	524.29146	174.76382	206.78	<.0001
Error	392	331.30024	0.84515		
Corrected Total	395	855.59170			

Root MSE	0.91932	**R-Square**	0.6128
Dependent Mean	2.72969	**Adj R-Sq**	0.6098
Coeff Var	33.67868		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	0.33994	0.10660	3.19	0.0015
loadtemp	**1**	0.00012704	0.00000714	17.80	<.0001
loadtempc	**1**	0.00000845	0.00000620	1.36	0.1739
premhr12	**1**	0.00497	0.04706	0.11	0.9159

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=1 hour=19

Number of Observations Read	398
Number of Observations Used	396
Number of Observations with Missing Values	2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	484.27760	161.42587	182.25	<.0001
Error	392	347.20670	0.88573		
Corrected Total	395	831.48430			

Root MSE	0.94113	**R-Square**	0.5824
Dependent Mean	2.69757	**Adj R-Sq**	0.5792
Coeff Var	34.88820		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.40843	0.10901	3.75	0.0002
loadtemp	1	0.00012047	0.00000756	15.93	<.0001
loadtempc	1	0.00001532	0.00000656	2.34	0.0200
premhr12	1	0.04103	0.04827	0.85	0.3958

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=13

Number of Observations Read	764
Number of Observations Used	764

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	2812.64458	937.54819	928.25	<.0001
Error	760	767.61104	1.01001		
Corrected Total	763	3580.25562			

Root MSE	1.00499	**R-Square**	0.7856
Dependent Mean	4.18343	**Adj R-Sq**	0.7848
Coeff Var	24.02324		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	0.08337	0.10731	0.78	0.4375
loadtemp	**1**	0.00003959	0.00000400	9.88	<.0001
loadtempc	**1**	-0.00002811	0.00000275	-10.22	<.0001
premhr12	**1**	0.68563	0.02528	27.13	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=14

Number of Observations Read	766
Number of Observations Used	766

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	2536.30516	845.43505	603.18	<.0001
Error	762	1068.04042	1.40163		
Corrected Total	765	3604.34558			

Root MSE	1.18390	**R-Square**	0.7037
Dependent Mean	4.37879	**Adj R-Sq**	0.7025
Coeff Var	27.03722		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	0.07296	0.12606	0.58	0.5629
loadtemp	**1**	0.00006629	0.00000464	14.28	<.0001
loadtempc	**1**	-0.00002431	0.00000319	-7.61	<.0001
premhr12	**1**	0.47889	0.02969	16.13	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=15

Number of Observations Read	764
Number of Observations Used	764

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	2520.54077	840.18026	562.15	<.0001
Error	760	1135.87521	1.49457		
Corrected Total	763	3656.41598			

Root MSE	1.22253	**R-Square**	0.6893
Dependent Mean	4.56311	**Adj R-Sq**	0.6881
Coeff Var	26.79151		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	-0.02492	0.13087	-0.19	0.8490
loadtemp	**1**	0.00008892	0.00000474	18.77	<.0001
loadtempc	**1**	-0.00002149	0.00000323	-6.65	<.0001
premhr12	**1**	0.31629	0.03082	10.26	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=16

Number of Observations Read	764
Number of Observations Used	764

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	2251.96322	750.65441	494.46	<.0001
Error	760	1153.77390	1.51812		
Corrected Total	763	3405.73712			

Root MSE	1.23212	**R-Square**	0.6612
Dependent Mean	4.74510	**Adj R-Sq**	0.6599
Coeff Var	25.96618		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.23927	0.13231	1.81	0.0709
loadtemp	1	0.00009984	0.00000484	20.65	<.0001
loadtempc	1	-0.00001720	0.00000330	-5.21	<.0001
premhr12	1	0.19785	0.03104	6.37	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=17

Number of Observations Read	766
Number of Observations Used	766

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	2099.16455	699.72152	428.83	<.0001
Error	762	1243.36567	1.63171		
Corrected Total	765	3342.53021			

Root MSE	1.27739	**R-Square**	0.6280
Dependent Mean	4.99873	**Adj R-Sq**	0.6266
Coeff Var	25.55421		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	0.51971	0.13666	3.80	0.0002
loadtemp	**1**	0.00011253	0.00000500	22.50	<.0001
loadtempc	**1**	-0.00001015	0.00000341	-2.97	0.0030
premhr12	**1**	0.06069	0.03218	1.89	0.0597

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=18

Number of Observations Read	766
Number of Observations Used	766

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1586.37767	528.79256	265.88	<.0001
Error	762	1515.47295	1.98881		
Corrected Total	765	3101.85062			

Root MSE	1.41025	**R-Square**	0.5114
Dependent Mean	5.28475	**Adj R-Sq**	0.5095
Coeff Var	26.68529		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	1.31110	0.15087	8.69	<.0001
loadtemp	**1**	0.00010147	0.00000552	18.38	<.0001
loadtempc	**1**	0.00002042	0.00000377	5.42	<.0001
premhr12	**1**	-0.00120	0.03553	-0.03	0.9731

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=19

Number of Observations Read	766
Number of Observations Used	766

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	1315.40986	438.46995	205.12	<.0001
Error	762	1628.84485	2.13759		
Corrected Total	765	2944.25472			

Root MSE	1.46205	**R-Square**	0.4468
Dependent Mean	5.18937	**Adj R-Sq**	0.4446
Coeff Var	28.17395		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	1.58804	0.15634	10.16	<.0001
loadtemp	**1**	0.00009120	0.00000591	15.44	<.0001
loadtempc	**1**	0.00001808	0.00000403	4.48	<.0001
premhr12	**1**	0.03501	0.03683	0.95	0.3420

The REG Procedure
Model: MODEL1
Dependent Variable: PremLoad1
strata=2 hour=19

Number of Observations Read	667
Number of Observations Used	667

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	677.25968	225.75323	138.94	<.0001
Error	663	1077.23965	1.62480		
Corrected Total	666	1754.49933			

Root MSE	1.27467	**R-Square**	0.3860
Dependent Mean	4.65438	**Adj R-Sq**	0.3832
Coeff Var	27.38658		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.92907	0.19316	4.81	<.0001
loadtemp	1	0.00010248	0.00000704	14.57	<.0001
loadtempc	1	0.00003044	0.00000996	3.05	0.0023
premhr12	1	0.08102	0.03772	2.15	0.0321

Exhibit 3

SmartRate Telephone Number: 502-627-4252
Web: www.lge-ku.com/smartrate
Email: smart.rate@lge-ku.com

ACCOUNT INFORMATION	
Account Number:	000000000000
Account Name:	John Q. Customer
Service Address:	123 Any Street

SmartRate CUSTOMER REPORT

This document is not a bill; it is provided for infomation purposes only.

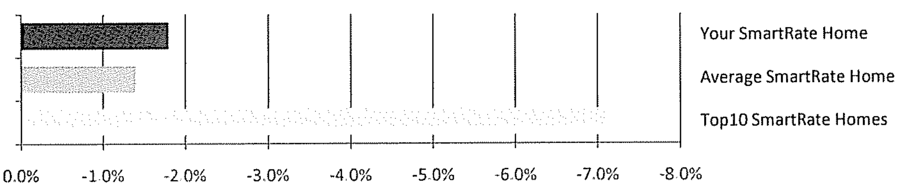
Summer 2009

We are quickly approaching the hot summer months, and you will rely heavily on your air conditioning system to keep you cool when the temperatures rise. As a customer on the LG&E SmartRate pilot, your rate varies according to when you use your electricty. To help you gain more control over your energy bills this summer, we summarized your usage from last summer and offer it in this report. For comparison purposes, we also reviewed the usage for LG&E SmartRate customers who managed to save the most to help you understand how you can make the most of the SmartRate.

Your Bills on the SmartRate

Total billed amount for the 2009 summer period using SmartRate:	$296.71		
Total billed amount for the 2009 summer period had you been on standard rates:	$302.15	1.8%	bill decrease
Overall impact on billed amount	-$5.44		

As you can see, using the SmartRate your bills decreased for the time period by approximately 1.8% while the bills for the Top10 SmartRate homes decreased by over 7%.



Reduce your bill by shifting usage from the High and Critical rate periods to the Low and Medium rate periods.

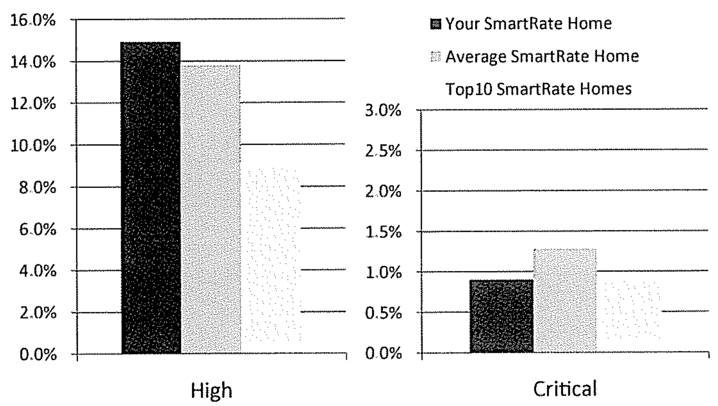
Your Usage on the SmartRate

	Time	June (kWh)	July (kWh)	August (kWh)	Total (kWh)	% Mix
Critical	6 Events *	16	12	7	35	0.9%
High	1pm to 6pm	180	209	211	600	14.9%
Medium	10am to 1pm and 6pm to 9pm	383	381	389	1,153	28.6%
Low	9pm to 10am	724	735	780	2,239	55.6%
Total		1,303	1,337	1,387	4,027	100.0%

* Critical events typically occur on weekday afternoons and last roughly four hours.

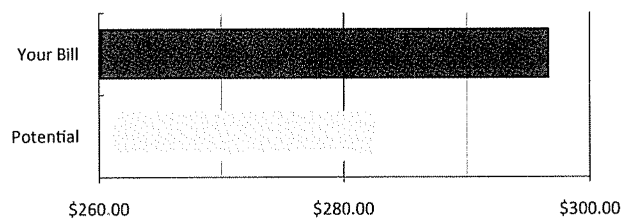
Ways to Save Money on the SmartRate

This graph shows your percentage usage in the High and Critical rate periods compared to average and the Top10 SmartRate homes.



Suggestions for you to continue to make the most of the SmartRate program:

- Use your non-essential appliances, such as the dishwasher, clothes washer and dryer during off peak times.
- Monitor the changes in rate periods using your In-Home Display.
- Adjust your thermostat and hot water settings to minimize usage during the High and Critical rate periods.



By shifting your usage to the Low and Medium rate periods (as achieved in the Top10 SmartRate households), we estimate you can reduce your total summer billing by: $14.17

his calculation is based on your total summer 2010 usage remaining consistent with your 2009 summer usage, but reducing your usage during the High and Critical rate periods to 10%.

Please visit us online at www.lge-ku.com/smartrate