RLW ANALYTICS

AmerenUE
Residential TOU Pilot Study
Load Research Analysis
First Look Results

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Prepared for
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AmerenUE

Residential Time-Of-Use (RTOU) Pilot Study
Load Research Analysis Report

1 EXECUTIVE SUMMARY

AmerenUE in conjunction with the Missouri Collaborative launched a Residential Time-Of-Use (RTOU) Pilot study in the Spring of 2004. This report documents the first summer results of the Pilot study.

1.1 Overview

The RTOU Pilot study encompassed two innovative rate offerings that provide financial incentives for customers to modify their consumption patterns during higher priced "critical peak periods" (i.e., CPP). The rate offerings were organized into three treatment groups for the Pilot study and included:

Treatment Group #1 - These customers received a three-tier time-of-use rate[1] with high differentials;

Treatment Group #2 - These customers received the same time-of-use rate as the first treatment group but were also subject to a critical peak pricing (CPP) element; and

Treatment Group #3 - These customers received the same treatment, i.e., TOU rate and CPP, as treatment group number two but had enabling technology, i.e., a "smart" thermostat, installed by AmerenUE. The enabling technology automatically increased the customers thermostat setting during critical peak pricing events.

Fifteen-minute interval load monitoring equipment was installed on the total premise load for a statistically representative sample of customers in each treatment group. In addition to the three treatment groups, the Company constructed three control groups[2] for use in the analysis. Once again, fifteen-minute interval load monitoring equipment was installed on a statistically representative sample of customers from each control group. Data collection began in the late Spring.

1.2 Analysis Summary

Table Ex 1~~Table Ex 1~~ presents a listing of several of the key analysis variables included in the study. These include the average CPP demand, the July 13th system peak demand, the on-peak, mid-peak, off-peak and CPP use during the defined time of use periods and the average summer use. The table presents the information for each treatment group (i.e., rate options) for customers in the control group and the voluntary study group. The table includes the average as well as the achieved relative precision estimated for the sample.

[1] The TOU rates differ by season (i.e., summer versus winter).
[2] The control groups were offered and they accepted the treatment but were deferred actually receiving the treatment.

Study Group	Rate Options	Maximum Sample Size	Estimated Average (kW or kWh) and Estimated Relative Precision (%)						
			Average CPP Demand (kW)	July 13th System Peak Demand (kW)	Time-Of-Use On-Peak Period #1 (kWh)	Time-Of-Use Mid-Peak Period #2 (kWh)	Time-Of-Use Off-Peak Period #3 (kWh)	CPP Event Use Period #4 (kWh)	Average Summer Use (kWh)
Control Group	Standard Residential Rate	91	5.06	5.70	1,188	2,028	4,103		7,320
			±4.8%	±5.4%	±4.8%	±5.1%	±5.7%		±5.2%
	Standard Residential Rate	89	4.98	5.68	1,106	2,073	4,372	119	7,670
			±5.4%	±7.3%	±5.3%	±5.6%	±6.5%	±5.3%	±5.8%
	Standard Residential Rate	117	5.36	6.05	1,189	2,224	4,588	128	8,129
			±4.5%	±5.4%	±4.9%	±4.9%	±5.3%	±4.2%	±4.9%
Voluntary Study Groups	3-Tier TOU	91	4.51	5.18	1,149	1,959	4,255		7,362
			±5.9%	±10.0%	±6.4%	±5.6%	±5.6%		±5.5%
	3-Tier TOU w/ CPP	87	4.37	4.85	1,063	2,111	4,680	113	7,967
			±7.1%	±8.9%	±6.6%	±5.8%	±6.5%	±7.4%	±6.1%
	3-Tier TOU w/ CPP and Smart Thermostat	78	3.49	4.07	1,022	1,932	4,063	93	7,110
			±7.3%	±8.7%	±6.4%	±5.5%	±6.0%	±7.0%	±5.6%

Table Ex 1 – Key Summary Statistics

Table Ex 2~~Table Ex 2~~ presents the T-Test comparisons for the control and voluntary study group (i.e., RTOU Group). The table presents the seasonal average use by time of use period, the absolute difference, the T-value[3] or test result, the probability of getting a higher T-value, and the result of the test. The null hypothesis is that the two test statistics are equal. For both the three-tier TOU rate and the three-tier TOU rate with CPP there were no statistical differences found with regard to the energy used by time-of-use period between the control groups and voluntary test groups. However, the addition of the enabling technology (i.e., the thermostat) shows the RTOU group with a statistically significantly lower use in all of the defined time-of-use periods.

Three Tier TOU with No CPP (NO-CPP)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Seasonal Use	7,320	7,362	(42)	(0.12)	0.905	Cannot Reject
Off-Peak Use	4,103	4,255	(151)	(0.71)	0.479	Cannot Reject
Mid-Peak Use	2,028	1,959	69	0.71	0.476	Cannot Reject
On-Peak Use	1,188	1,149	39	0.67	0.505	Cannot Reject
Three Tier TOU with CPP (CPP)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	7,671	7,967	(296)	(0.72)	0.473	Cannot Reject
Off-Peak Use	4,372	4,680	(308)	(1.19)	0.235	Cannot Reject
Mid-Peak Use	2,073	2,111	(37)	(0.34)	0.733	Cannot Reject
On-Peak Use	1,106	1,063	43	0.73	0.466	Cannot Reject
CPP Use	119	113	6	0.86	0.390	Cannot Reject
	7,670	7,967				
Three Tier TOU with CPP and Thermostat (CPP-THERM)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	8,129	7,110	1,019	2.88	0.000	Reject
Off-Peak Use	4,588	4,063	525	2.44	0.002	Reject
Mid-Peak Use	2,224	1,932	292	3.00	0.003	Reject
On-Peak Use	1,189	1,022	167	3.09	0.002	Reject
CPP Use	128	93	36	6.50	0.000	Reject

Table Ex 2 – Seasonal Time-Of-Use Usage Comparisons

[3] High T-values lead us to reject the null hypothesis that the two statistics are equal.

Table Ex 3~~Table Ex 3~~ presents similar findings for the six critical peak pricing periods. The table presents the average demand for the control and RTOU groups, the absolute difference, the T-value or test result, p-value (i.e., the probability of getting a larger T-value) and whether or not we can reject the null hypothesis that the corresponding demands were equal. In all but one instance we can conclude that the demands of the RTOU study group were statistically different than those of the control group.

Three Tier TOU with CPP (CPP)								
CPP Event			Control	RTOU	Difference			
	Hour Ending		Group	Group	Control-RTOU			
Date	Start	End	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	3:00 PM	6:59 PM	5.55	4.91	0.65	2.09	0.038	Reject
20-Jul-2004	3:00 PM	6:59 PM	4.92	4.20	0.72	2.42	0.017	Reject
21-Jul-2004	3:00 PM	6:59 PM	5.29	4.62	0.67	2.30	0.023	Reject
3-Aug-2004	3:00 PM	6:59 PM	4.89	4.58	0.31	1.01	0.314	Cannot Reject
18-Aug-2004	3:00 PM	6:59 PM	4.77	3.98	0.79	2.89	0.004	Reject
27-Aug-2004	3:00 PM	6:59 PM	4.44	3.91	0.53	1.72	0.087	Reject
Average			4.98	4.37	0.61	2.54	0.012	Reject
Three Tier TOU with CPP and Thermostat (CPP-THERM)								
CPP Event			Control	RTOU	Difference			
	Hour Ending		Group	Group	Control-RTOU			
Date	Start	End	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	3:00 PM	6:59 PM	6.05	4.01	2.04	7.52	0.000	Reject
20-Jul-2004	3:00 PM	6:59 PM	5.30	3.44	1.86	7.44	0.000	Reject
21-Jul-2004	3:00 PM	6:59 PM	5.79	3.87	1.93	7.04	0.000	Reject
3-Aug-2004	3:00 PM	6:59 PM	5.19	3.29	1.90	7.27	0.000	Reject
18-Aug-2004	3:00 PM	6:59 PM	5.10	3.26	1.83	6.63	0.000	Reject
27-Aug-2004	3:00 PM	6:59 PM	4.75	3.09	1.65	6.88	0.000	Reject
Average			5.36	3.49	1.87	8.09	0.000	Reject

Table Ex 3 – CPP Event Day Comparisons

Table Ex 4~~Table Ex 4~~ presents the T-test comparisons for the four system peak hours. For the three-tier TOU rate with and without CPP the results were mixed. However, for the three-tier TOU rate with CPP and the enabling technology the results were consistent with all RTOU demands being statistically lower than their control group counterparts.

Three Tier TOU with No CPP (NO-CPP)							
System Peak		Control Group	RTOU Group	Difference Control-RTOU			
Date	Time	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.06	4.49	0.57	1.74	0.084	Reject
13-Jul-2004	5pm	5.70	5.18	0.52	1.43	0.155	Cannot Reject
3-Aug-2004	6pm	5.18	4.32	0.85	3.01	0.003	Reject
14-Sep-2004	5pm	3.68	3.44	0.24	0.90	0.369	Cannot Reject
Three Tier TOU with CPP (CPP)							
System Peak		Control Group	RTOU Group	Difference Control-RTOU			
Date	Time	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.19	5.02	0.17	0.46	0.650	Cannot Reject
13-Jul-2004	5pm	5.68	4.85	0.83	2.34	0.021	Reject
3-Aug-2004	6pm	5.13	4.66	0.47	1.38	0.169	Cannot Reject
14-Sep-2004	5pm	3.84	3.62	0.21	0.70	0.485	Cannot Reject
Three Tier TOU with CPP and Thermostat (CPP-THERM)							
System Peak		Control Group	RTOU Group	Difference Control-RTOU			
Date	Time	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.45	4.70	0.74	2.24	0.003	Reject
13-Jul-2004	5pm	6.05	4.07	1.99	6.82	0.000	Reject
3-Aug-2004	6pm	5.51	3.24	2.28	8.11	0.000	Reject
14-Sep-2004	5pm	4.05	3.48	0.57	2.14	0.033	Reject

Table Ex 4 – System Peak Comparisons

Payback was defined as the three-hour period immediately following the CPP event. Table Ex 5~~Table Ex 5~~ presents a summary of the payback periods immediately following each of the six CPP events. In all cases the RTOU load was either not statistically different or in the two instances where a difference existed was actually lower than the control group load.

Three-Tier TOU Rate with CPP (CPP)								
CPP Event			Control Group	RTOU Group	Difference Control-RTOU			
	Payback Period							
Date	Start	End	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	7pm	10pm	5.31	5.50	(0.19)	(0.61)	0.542	Cannot Reject
20-Jul-2004	7pm	10pm	4.96	5.20	(0.24)	(0.76)	0.448	Cannot Reject
21-Jul-2004	7pm	10pm	5.23	5.43	(0.19)	(0.57)	0.571	Cannot Reject
3-Aug-2004	7pm	10pm	4.97	5.19	(0.23)	(0.69)	0.489	Cannot Reject
18-Aug-2004	7pm	10pm	4.57	4.50	0.07	0.25	0.804	Cannot Reject
27-Aug-2004	7pm	10pm	3.73	4.11	(0.38)	(1.28)	0.202	Cannot Reject
Average			4.80	4.99	(0.19)	(0.63)	0.528	Cannot Reject
Three-Tier TOU Rate with CPP and Thermostat (CPP-THERM)								
CPP Event			Control Group	RTOU Group	Difference Control-RTOU			
	Payback Period							
Date	Start	End	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	7pm	10pm	5.72	5.30	0.42	1.67	0.096	Reject
20-Jul-2004	7pm	10pm	5.15	5.04	0.11	0.45	0.653	Cannot Reject
21-Jul-2004	7pm	10pm	5.40	4.96	0.44	1.79	0.075	Reject
3-Aug-2004	7pm	10pm	5.17	5.00	0.18	0.70	0.487	Cannot Reject
18-Aug-2004	7pm	10pm	4.86	4.92	(0.06)	(0.24)	0.807	Cannot Reject
27-Aug-2004	7pm	10pm	3.90	4.20	(0.30)	(1.33)	0.186	Cannot Reject
Average			5.03	4.90	0.13	0.45	0.639	Cannot Reject

Table Ex 5 – Payback Comparisons

Figure Ex 1~~Figure Ex 1~~ presents the average 15-minute load shape for each of the three treatment groups compared to a single composite control group[4] on the day before, day of and day after the summer system peak day, i.e., Tuesday, July 13, 2004. The load associated with each of the treatment groups shows significant load reductions on this day. The treatment group receiving the enabling technology displays a substantially different load shape than the remaining three groups. The load reduction reaches nearly 2.0 kW at hour ending 5pm (i.e., the summer system peak hour). Load profiles for all CPP event days that compare the RTOU test groups with their respective control groups are included in Appendix A.

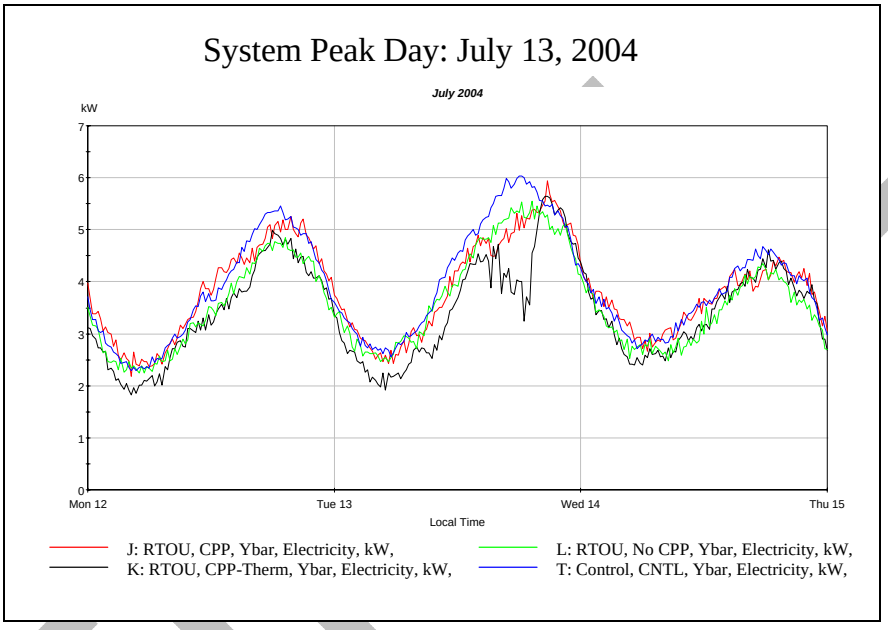

Figure Ex 1 – Summer Peak Day

1.3 General Conclusions

The study results indicate the following:

- The residential time-of-use rate alone does not appear to motivate customers to shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods,
- The time-of-use rate coupled with the critical peak pricing component does motivate customers to reduce demand during most of the CPP events, but does not appear effective in motivating customers to shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods.
- The group receiving the "smart" thermostat displayed much stronger load response than the either of the other two groups. This group had lower demand on each of the four summer peak days, lower load during the CPP event days, and shifted a statistically significant amount of load from the on-peak to off-peak or mid- peak periods.

[4] The composite control group is used for demonstration purposes. In the actual analysis the control group constructed for each treatment group was used in the analysis.

2 INTRODUCTION

This document provides a comprehensive review and analysis of the Residential Time-Of-Use (RTOU) Pilot Project conducted by AmerenUE in collaboration with the Missouri Collaborative. The Missouri Collaborative consists of the Office of Public Counsel (OPC), the Missouri Public Service Commission (MPSC), the Department of Natural Resources (DNR) and two industrial intervener groups. AMEREN, the OPC and the MPSC have been the most active parties with regard to the TOU Pilot Study. The data collection period covered in this report is for the 2004 Summer defined as June 1, 2004 through September 30, 2004.

2.1 Background

AMEREN is an energy services company providing electricity to 2.3 million customers and natural gas to 900,000 customers in Illinois and Missouri. A map of the AMEREN service territory is presented in Figure 1~~Figure 1~~. The current project is applicable to the AmerenUE's Missouri retail electric service territory.

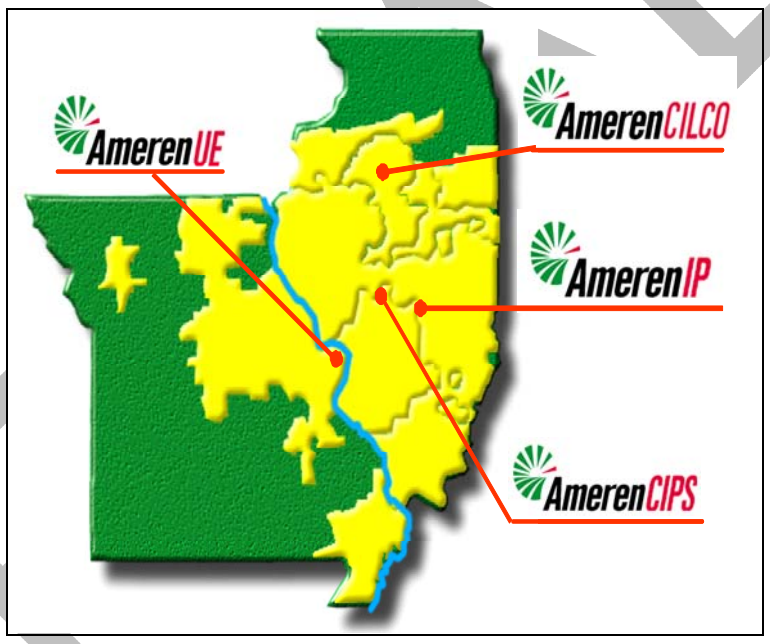

Figure 1 – AMEREN Power Service Territory

The TOU Pilot Study is the result of the July 30, 2002 Missouri Commission Report and Order Approving Stipulation and Agreement that resolved the Case No. EC-2002-1. Public Counsel filed testimony in May 2002 proposing a TOU pilot study in that case. In December of 2003, the Collaborative agreed to a pilot concept. Such agreement laid the foundation for the current project work.

2.2 Purpose, Goals and Objectives

Project Purpose: Obtain information needed to determine if and how residential time-of-use rates will be beneficial in Missouri.

2.2.1 Report Goals and Analysis

The primary goals of the current analysis are to measure and evaluate specific analysis objectives identified by the project team. The analysis objectives include:

- Evaluating the pros/cons and cost effectiveness[1,5] of three TOU program designs including:
  - TOU with three rate levels;
  - TOU with three rate levels and a critical peak pricing component; and
  - TOU with three rate levels, a critical peak pricing component and enabling technology in the form of a "smart" thermostat.
- Estimate the demand reduction occurring at the AmerenUE system peak;
- Determine the magnitude of the load shifted between on-peak and off-peak periods;
- Estimate the impact, if any, of the energy conservation as a result of this pilot;
- Estimate the load reduced during the critical peak pricing periods;
- Determine the amount of load "payback" that occurs immediately following the critical peak pricing periods;

3 PROJECT DESIGN

This section provides background information on the key elements of the experimental design including:

- Treatment Groups
- Control Groups
- Target Populations
- Geographical Constraint
- Project Duration
- Sample Design
- Sample Sizes

3.1 Experimental Design

The Residential TOU Pilot Study will follow a Test/Control Experimental Design.

[5] The cost effectiveness should be evaluated from both the Company's and participating customer's perspectives.

During early 2003, the AmerenUE project team initiated a load research sample using the Company's automatic meter reading (AMR) CellNet system. The new load research sample was designed based on AmerenUE's existing load research sample. The intent of the new residential load research sample was for the collaborative to have a sample with one year of history to use as it needed. After agreeing to the pilot framework, the collaborative decided to recruit as many pilot participants as possible from the new sample. The Marketing Research firm hired to assist with the development of the recruitment request for proposal (RFP) indicated that a relatively small proportion of these customers are likely to decide to participate. In light of this likely reality, the project team agreed to use a Test/Control experimental design.

3.1.1 Treatment Groups

Three Treatment Groups were formed.

After much discussion, the Collaborative parties agreed to construct and test the following three treatment groups:

Treatment Group #1 - The customers in treatment group number one will receive a three-tier time-of-use rate[6] with high differentials. This group will be termed the "No-CPP" treatment cell;

Treatment Group #2 - The customers in treatment group number two will receive approximately the same time-of-use rate as treatment group number 1 but will also be subject to a critical peak pricing (CPP) element. This group will be termed the "CPP" treatment cell; and

Treatment Group #3 - The customers in treatment group number three will receive the same treatment, i.e., TOU rate and CPP, as treatment group number two but will have the Company install enabling technology, i.e., a "smart" thermostat, to aid customers in responding to the price signals from the rate design. This group will be termed the "CPP-THERM" treatment cell.

3.1.2 Control Group Development

Control Groups will be formed for each of the three Treatment Groups.

Under the Test/Control experimental design, each *Test* group, (i.e., treatment group), is paired with a control group of similar size that is selected following a recruitment protocol identical to the treatment group but then does not receive the treatment, i.e., the TOU rate. This is easily accomplished by randomly assigning the customers successfully recruited into the TOU Pilot Study to either the Test group or the Control group. In practice, the randomization can happen at the time of recruitment by assigning a uniform random number[7] between 0 and 1 to each customer. For example, if the recruited customer's random number is less than or equal to 0.5 then the customer is assigned to the Test group and if the random number is greater than 0.5 then the customer is assigned to the Control group. Assigning the number at the time of recruitment prevents any delay between recruitment and field implementation. In

[6] The TOU rates will differ by season (i.e., summer versus winter).
[7] The assignment can occur in Excel using the "**=rand()**" function.

this analysis the "Test" or "Treatment" group will be termed the "RTOU" and the control group will be termed "Control".

3.1.3 Target Populations

High Summer Use Residential Customers will be targeted.

There was significant discussion concerning whether or not to open up the Residential TOU Pilot Study to the full population of residential customers or to a subset of customers. On the one hand, the group felt that the project should be targeted to the widest group possible. On the other hand, the group realized that the desired load reduction would come from customers that were high summer use customers. Given the goals and objectives of this project, the Collaborative agreed to focus the project on high summer use customers. A comprehensive discussion of this issue is contained in the Final Project Plan.

Ameren stratifies the residential class by winter and summer use. Winter use is defined as the billing months December through March and summer is defined as the billing months June through September. The specific definitions used to classify the residential customers are displayed in Table 1~~Table 1~~. Customers with more than 1500 kWh in the summer are classified as high summer use customers.

Strata	Description	Winter Use	Summer Use
1	Low Winter/Low Summer	0-1150 kWh	0-1500 kWh
2	High Winter/Low Summer	>1150 kWh	0-1500 kWh
3	Low Winter/High Summer	0-1150 kWh	>1500 kWh
4	High Winter/High Summer	>1150 kWh	>1500 kWh

Table 1 – Residential Domains

Table 2~~Table 2~~ presents the population characteristics of the residential class broken down by low/high winter/summer use. Approximately 365,000 customers (i.e., 36% of the population) are classified as high summer use customers.

Strata	Description	Sample Size	Population Size	Percent of Population
1	Low Winter/Low Summer	122	504,462	50.1%
2	High Winter/Low Summer	68	136,344	13.6%
3	Low Winter/High Summer	36	166,015	16.5%
4	High Winter/High Summer	149	199,290	19.8%
	Totals	375	1,006,111	100.0%

Table 2 – AmerenUE Residential Population

3.1.4 Geographical Constraint

The Residential TOU Pilot Study will be geographically constrained to the City of St Louis and St. Louis County.

To help control the cost and to expedite the implementation of the Residential TOU Pilot Study, the project team has elected to constrain the project to an area that encompasses the City of St. Louis and St. Louis County. Geographically constraining the project provides the following benefits:

- Minimizes the cost incurred implementing the enabling technology, i.e., the "smart" thermostats. The selected "smart" thermostat technology uses a one-way paging strategy to allow for remote programming of the thermostats. Therefore, AmerenUE needs to licenses with paging companies to provide the communications backbone. Spreading the project throughout the state increases the number of providers needed.
- By limiting the study to St. Louis City and County, it reduces the training needed of AmerenUE Metering System personnel and Call Center personnel to implement the program.
- Simplifies and reduces cost of the planned Pilot Experience Focus Groups.
- Reduces the cost of installing and subsequent follow-ups (if needed) on the "smart" thermostats.
- Thermostat installers will have less distance between installations by limiting the geographic area, thus expediting the installations.

Figure 2~~Figure 2~~ presents the geographical target area of the City of St. Louis and St. Louis County.

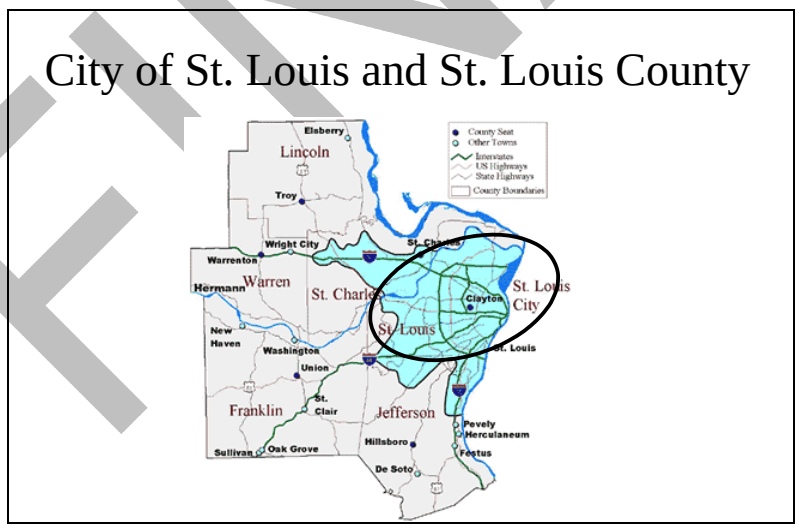

Figure 2 – Geographic Target Area

Figure 3~~Figure 3~~ presents the paging coverage for the City of St. Louis and St. Louis County area. The paging system has excellent coverage in this area.

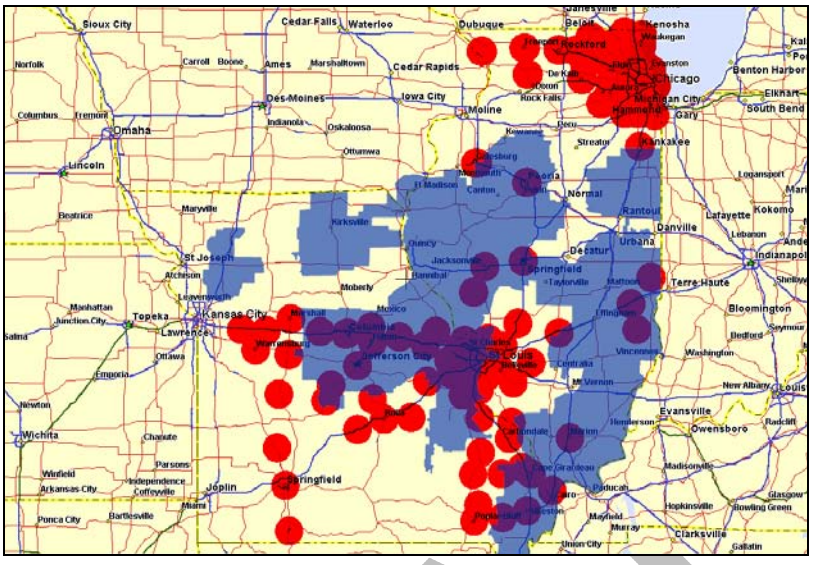

Figure 3 – Paging coverage

3.1.5 Project Duration

The Residential TOU Pilot Study is funded through the 2004 calendar year.

The current agreement is for the pilot study to continue for a sixteen (16) month period. There appears to be consensus agreement that the bulk of the information content of the pilot will likely be derived during the summer of 2004. AmerenUE has budgeted funding for the project through calendar year 2004. Barring unforeseen circumstances, e.g., an abnormally cool summer, technical difficulties with the paging system, installation challenges, etc., the bulk of the objectives may be satisfied with a single summer season of data. However, to hedge against these unknowns, the project team has elected to advise recruited customers indicating that the project will last between six (6) months and sixteen (16) months. Also, some Collaborative members believe that the incremental value of continuing the pilot for a second summer season cannot be determined until a preliminary assessment of the first summer season is completed.

3.1.6 Sample Design

A stratified random sample was used to select the program participants.

Focusing on the high use residential customers lends itself to a stratified sample design utilizing the third and fourth strata of the residential cost-of-service stratification. Table 3~~Table 3~~ presents the distribution of the more than 365,000 customers in our generalized target population. The population totals are used to construct case weights for the analysis. Each test, i.e., treatment, and control group will be extrapolated to these same population totals.

Strata	Description	Winter Use	Summer Use	Population Size	Percent of Population
3	Low Winter/High Summer	0-1150 kWh	>1500 kWh	166,015	16.5%
4	High Winter/High Summer	>1150 kWh	>1500 kWh	199,290	19.8%
			Totals	365,305	36.3%

Table 3 – Residential TOU Pilot Sample Design

3.1.7 Sample Sizes

The planned sample sizes are expected to provide meaningful results.

The current agreement is for the Residential TOU Pilot Study to include a sufficiently large sample of residential customers to provide meaningful results. The project team suggested that a minimum of 60 residential customers be included in each of three previously mentioned treatment groups. To protect against lost data, the project subsequently increased the number of sample points to 75 in each group. The same size samples were planned for the Test and Control groups. Table 4~~Table 4~~ presents the planned allocation for each combination of group (i.e., Control versus RTOU) and treatment (i.e., NO-CPP, CPP, and CPP-THERM).

Strata	Description	Winter Use	Summer Use	Population Size	Percent of Population	Sample Size
3	Low Winter/High Summer	0-1150 kWh	>1500 kWh	166,015	16.5%	34
4	High Winter/High Summer	>1150 kWh	>1500 kWh	199,290	19.8%	41
			Totals	365,305	36.3%	75

Table 4 – Sample Size and Allocation: Planned

Table 5~~Table 5~~ presents the actual sample installed by AMEREN at the time of the July system peak (i.e., July 13, 2004). The actual sample exceeded the planned sample in every cell.

Group	Treatment	Strata	Planned Sample	Actual Sample on 7/13/04
CONTROL	NO-CPP	3	34	48
		4	41	41
Totals			75	89
CONTROL	CPP	3	34	51
		4	41	38
Totals			75	89
CONTROL	CPP-THERM	3	34	59
		4	41	58
Totals			75	117
RTOU	NO-CPP	3	34	41
		4	41	47
Totals			75	88
RTOU	CPP	3	34	37
		4	41	48
Totals			75	85
RTOU	CPP-THERM	3	34	36
		4	41	41
Totals			75	77

Table 5 – Sample Size and Allocation: Actual

3.2 Enabling Technology

The project team selected the Cannon/Honeywell ExpressGate™ thermostat.

3.2.1 Technology Choices

AmerenUE and the Collaborative narrowed three competing technology vendors[8] down to two: Lightstat and Cannon Technologies. The group indicated that the Lightstat website was superior to the Cannon website. However, the Company was concerned that using the Lightstat Internet programmable thermostat would require an additional site visit at the conclusion of the pilot for thermostat removal/replacement. This is due to the Internet programmable nature of the thermostat, i.e., the Lightstat thermostat can only be programmed over the Internet through the paging system. In contrast, the Cannon/Honeywell thermostat would allow the pilot program participant to keep the thermostat without additional intervention from the project team since the ExpressStat can be programmed manually. The project team selected the Cannon/Honeywell ExpressStat for use in the Residential TOU Pilot study. A picture of the thermostat is presented in Figure 4~~Figure 4~~.

[8] The third technology vendor was Comverge.

Figure 4 – Cannon/Honeywell ExpressStat

3.2.2 Thermostat Features

Thermostat – Settings

The Cannon/Honeywell thermostat is capable of precise temperature control with four time and temperature settings per day. The thermostat has the capacity to handle weekday, Saturday and Sunday schedules. Figure 5~~Figure 5~~ presents the Web screen used to program the thermostat. As evidenced by the figure, the thermostat can be set at different temperatures for waking, leaving, returning and sleeping. Of course, these could be adjusted to correspond with the AmerenUE TOU periods.

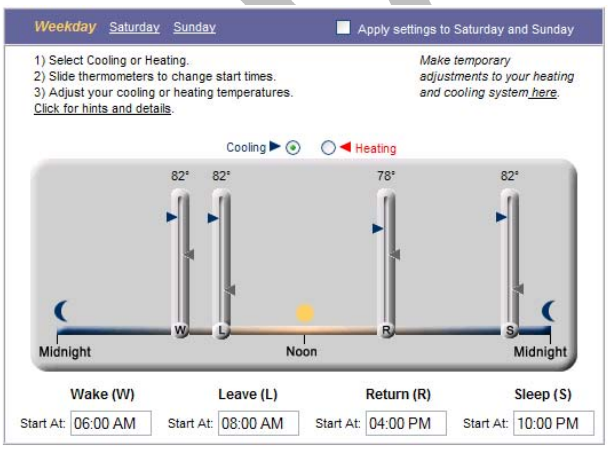

Figure 5 – Thermostat Settings

Thermostat – Control Features

From a control perspective, the thermostat can accommodate simple cycling strategies, cycling strategies with pre-defined limits, ramped temperature control and randomization. The project team has elected to use ramped temperature control allowing the customers to choose their comfort setting by time-of-use period and modify their thermostat during CPP events. Under this customer choice method, the thermostat can be set to roll up a predetermined number of degrees for selected periods. There was considerable discussion of whether or not to limit the customer choices, e.g., 2-degree roll-up, 4-degree roll-up. Additional discussions with Cannon Technologies Incorporated (CTI) resulted in developing

six distinct schedules for the customers to invoke during the critical peak pricing period. The offering is presented in Figure 6~~Figure 6~~ and is based on a four hour CPP period.

Degree Per Hour	Maximum Change	Pre Cool (2 degrees)
1	4	No
2	4	No
2	6	No
2	8	No
2	6	Yes
2	8	Yes

Figure 6 – Customer Choice: Degree Roll-Up

Thermostat – Data Logging Capabilities

The Cannon/Honeywell thermostat is capable of securing specific data elements to assist the evaluation. The following elements can be collected on an hourly basis. The thermostat can store up to 90 days of data.

- Temperature,
- Compressor run times, and
- Shed times.

While this information would certainly be beneficial to the evaluation, we do not view it as critical to successfully satisfying the major evaluation objectives, i.e., estimating the demand reduction at system peak, CPP, etc. However, with that said, the available information (i.e., compressor run times, shed times, and temperature) would allow the evaluators to determine if the CPP signal was reaching the participant households. Without this feedback loop, the evaluators will be unable to fully understand the demand reductions they are estimating. Therefore, we would encourage the Company to secure this information at the conclusion of the project for each household with the "Smart" thermostat. If at all possible, it would be valuable to secure the data at the end of July to ensure the information a) is being collected and b) will be useful in informing the analysis.

3.3 Residential TOU/CPP Rate Design

A three-part time-of-use (TOU) rate with high differentials is planned along with an even more severe critical peak-pricing (CPP) component.

The Residential TOU rate was developed by the AmerenUE Rate Engineering Department. It is important to note that the TOU rates were not based of the true costs of serving loads during the indicated pricing period, but instead designed to gauge customer reaction to "high" prices. In other words, while the average cents/kWh realization resulting from these rates recover the Company's costs of providing service, such costs do not vary as widely by rating period as the TOU prices suggest.

The series of time-of-use rates are detailed below.

The summer billing season uses a four-hour on-peak period defined as hour beginning 3:00PM to hour ending 7:00PM.

Summer: Three-Tier TOU Only		**Rate**
Off Peak	(Weekday 10PM–10AM, Weekends, Holidays)	4.80 cents/kWh
Mid Peak	(Weekdays 10AM– 3PM and 7PM-10PM)	7.50 cents/kWh
Peak	(Weekday 3PM – 7PM)	18.31 cents/kWh

Summer: Three-Tier TOU with CPP		**Rate**
Off Peak	(Weekday 10PM–10AM, Weekends, Holidays)	4.80 cents/kWh
Mid Peak	(Weekdays 10AM– 3PM and 7PM-10PM)	7.50 cents/kWh
Peak	(Weekday 3PM – 7PM)	16.75 cents/kWh
CPP	(Weekday 3PM – 7PM, 10 times per summer)	30.00 cents/kWh

The winter billing season uses a nine-hour on-peak period defined as the four hour period beginning 5:00 AM to hour ending 9:00 AM plus the five hour period beginning 4:00PM to hour ending 9PM.

Winter: Three-Tier TOU Only		**Rate**
Off Peak	(Weekday 9PM–5AM, Weekends, Holidays)	3.10 cents/kWh
Mid Peak	(Weekdays 9AM– 4PM)	5.30 cents/kWh
Peak	(Weekdays 5AM – 9AM and 4PM – 9PM)	6.95 cents/kWh

3.4 Customer Recruitment

Program participants will receive a $25 incentive for participation. An additional incentive of $75 will be provided to customers for each six-month period of study.

recruitment assistance. AmerenUE is looking for an outbound telemarketing vendor to partner to help fulfill two specific business objectives:

- Outbound sales conversion of 700 existing residential customers to the new TOU service plan; and
- Recruit and fulfill quotas in order of priorities set for three alternative approaches for households to participate in the TOU study. A total of 700 households will be recruited.
  - Test Group 1 – TOU Rate only: 220 households;
  - Test Group 2 – TOU Rate with CPP component: 220 households;
  - Test Group 3 – TOU Rate with CPP component and enabling technologies: 260 households

Quotas for each Test Group should be filled in proportion of the population distribution between low winter/high summer use (46%) and high winter/high summer use (54%) customers. An equal allocation, while not optimal, would be sufficient.

3.4.1 Outbound Sales Conversion

AmerenUE provided the recruitment vendor a file of customers to target for conversion to the TOU service. The main selling propositions are:

- Potential savings may be realized by reducing electricity usage in response to higher prices during peak hours. Additionally, the shifting of electric usage patterns to day parts when electric costs will be at lower rates will result in savings. (Similar to long distance phone usage plans.)
- Most customers should recognize savings with more efficient use of electricity; however, in the event they are not able to take advantage of favorable off-peak rates, their bill may increase.
- There are no forms/or steps to convert, just confirm they would like to participate in the Pilot and the billing change will be automatic.
- In the event they want to opt out of participating in the future, they can change back to their former rate application.
- For those that qualify for the research, based primarily on the ability of Ameren to read their meters remotely, a sign on incentive of $25 will be offered and an additional $75 dollars will be provided to those that maintain their participation in the Pilot for at least six months.

3.5 CPP Customer Notification

Customers will be provided day-ahead notification of the Critical Peak Price.

The day before a CPP period is to be called, AmerenUE records a notification message for affected customers. An automated, outbound telephone call was placed to all pilot participants on a rate with the CPP provision communicating the prerecorded message.

In addition, the "smart" thermostats are sent a control message to raise temperature to a predetermined level. Customers were able to opt out of a CPP control period by contacting AmerenUE's Call Center or at the Cannon Technologies web site.

3.6 Customer Billing

Customers will be billed from the interval load data collected for the evaluation.

The TOU Pilot began on June 1, 2004. However, the plan is to keep all customers recruited for the study on their same billing cycle. This means that the first TOU bill the customer saw came as the July bill for the billing period beginning sometime in June but not necessarily June 1, 2004.

The Pilot participants are billed from their evaluation data. The evaluation data was collected on a 15-minute basis using the Company's CellNet automatic meter reading (AMR) system. After CellNet collected the data, the data were sent to the ARES Lodestar billing system. The Lodestar system was used to validate, estimate, and edit the data as necessary. Then, the system summarizes the interval data to the Residential Time-Of-Use periods. The TOU information was sent to the Customer Service System (CSS) for billing and the interval load data was sent to the Load Research group for retention and analysis.

3.7 CPP Event Calls

During the pilot test AmerenUE staff put into place an algorithm that was used to call a CPP event anytime the temperature was forecasted to be at least 90° F. Table 6~~Table 6~~ presents the dates and times the temperature was forecasted to be above the 90° F threshold. In addition the table includes the number of actual hours (39) the temperature exceeded 90° F. AmerenUE staff called CPP events on each of these six days. The events encompassed the entire allowed time period, i.e., hour beginning 3pm through hour ending 7pm.

	Forecast			Actual		
	Hour Ending		Total	Hour Ending		Total
Date	Start	End	Hours	Start	End	Hours
13-Jul-2004	11:00 AM	8:59 PM	10	10:00 AM	8:59 PM	11
20-Jul-2004	2:00 PM	4:59 PM	3	1:00 PM	6:59 PM	6
21-Jul-2004	11:00 AM	7:59 PM	9	10:00 AM	7:59 PM	10
3-Aug-2004	12:00 PM	7:59 PM	8	4:00 PM	7:59 PM	4
18-Aug-2004	2:00 PM	3:59 PM	2	12:00 PM	5:59 PM	6
27-Aug-2004	2:00 PM	4:59 PM	3	3:00 PM	4:59 PM	2
Total Event Hours			35			39

Table 6 – CPP Event Day Temperatures

3.8 2003 Control Group Analysis

Table 7~~Table 7~~ presents a comparison between the RTOU group and the Control group for each of the treatments. The table compares the *2003 annual use* and the *2003 June through August use*. This analysis was conducted to ensure that the control group and the RTOU treatment groups were not statistically different in the pre-participation period. As evidenced by the table, each test group was not statistically different from their control group counterparts.

Three Tier TOU with No CPP (NO-CPP)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
2003 Annual Use	18,371	19,058	(687)	(0.74)	0.461	Cannot Reject
2003 Use (Jun-Aug)	5,906	5,795	111	0.47	0.639	Cannot Reject
Three Tier TOU with CPP (CPP)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
2003 Annual Use	19,649	20,296	(647)	(0.52)	0.602	Cannot Reject
2003 Use (Jun-Aug)	6,121	6,415	(294)	(0.95)	0.345	Cannot Reject
Three Tier TOU with CPP and Thermostat (CPP-THERM)						
TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
2003 Annual Use	18,847	18,007	840	1.08	0.280	Cannot Reject
2003 Use (Jun-Aug)	6,149	5,886	263	1.00	0.321	Cannot Reject

Table 7 – Control Group versus Test Group

4 PROJECT ANALYSIS

This section documents the analysis conducted to date for this project. The following analysis elements are explored:

- Determine the significance between the means for the following analysis variables:
  - Demand at the monthly AmerenUE system peaks;
  - Average demand during the critical peak pricing (CPP) periods;
  - Average summer energy use by time-of-use categories; and
  - Average payback for the three-hour period immediately following the CPP periods.

The analysis is conducted for each treatment group, i.e., NO-CPP, CPP, and CPP-THERM.

4.1 Analysis for Treatment Group NO-CPP

This section details the analysis conducted for the first treatment group of RTOU pilot participants. Recall, these participants were subjected to the time-of-use rate but were not subjected to the critical peak-pricing (CPP) event. The control group is comprised of customers that indicated they would have enrolled in the time-of use rate but remained on the standard residential rate for this study.

4.1.1 Available Sample

The NO-CPP treatment group received the residential time of use rate without the critical peak-pricing component. The "control" group was represented by a sample of 89 customers and the "test" group (i.e., RTOU group) was represented by a similar sized sample of 88 customers. The distribution by strata, the population counts and the case weights are displayed in Table 8~~Table 8~~. In the analysis each test group was weighted and extrapolated to represent the full population of stratum 3 and 4 customers. Following the expansion the average demand per customer was calculated by dividing through by the total population size.

Group	Treatment	Strata	Planned Sample	Actual Sample on 7/13/04	Population Size	Weight
CONTROL	NO-CPP	3	34	48	166,015	3,458.65
		4	41	41	199,290	4,860.73
Totals			75	89	365,305	
RTOU	NO-CPP	3	34	41	166,015	4,049.15
		4	41	47	199,290	4,240.21
Totals			75	88	365,305	

Table 8 – Available Sample: NO-CPP Treatment

4.1.2 Hourly Load Estimates

Figure 7~~Figure 7~~ presents the results of the analysis. The figure displays the "control" group in blue and the "treatment" group (i.e., RTOU) in red. To the left of the figure are EnergyPrints that display the hourly load in three dimensions. The day of the year is on the y-axis, the time of day on the x-axis and the demand is displayed on the z-axis as a color gradient with low levels of load in the black-blue spectrum and high levels of load in the yellow-white spectrum. The graph shows the "control" group having slightly higher peak demands than the RTOU group.

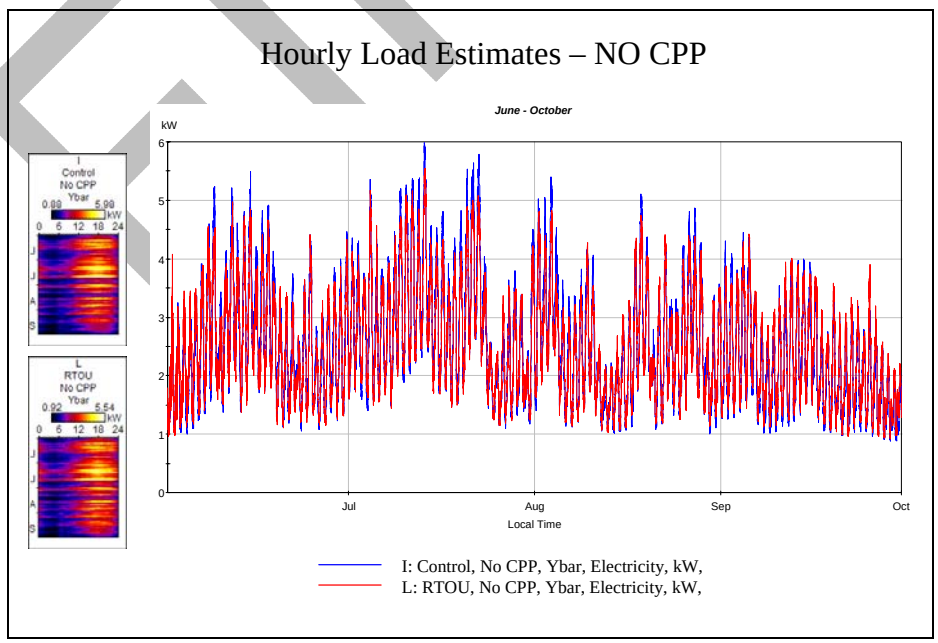

Figure 7 – Hourly Load Estimates: NO-CPP Treatment

4.1.3 Demand at System Peak

Figure 8~~Figure 8~~ displays the hourly demand for the "control" and "treatment" groups on each of the four summer system peak days. The blue line represents the "control" group and the red line represents the treatment group. In three of the months the RTOU group is substantially lower than the control group. The system peak days include:

- Monday, June 14, 2004,
- Tuesday, July 13, 2004
- Tuesday, August 3, 2004, and
- Tuesday, September 14, 2004.

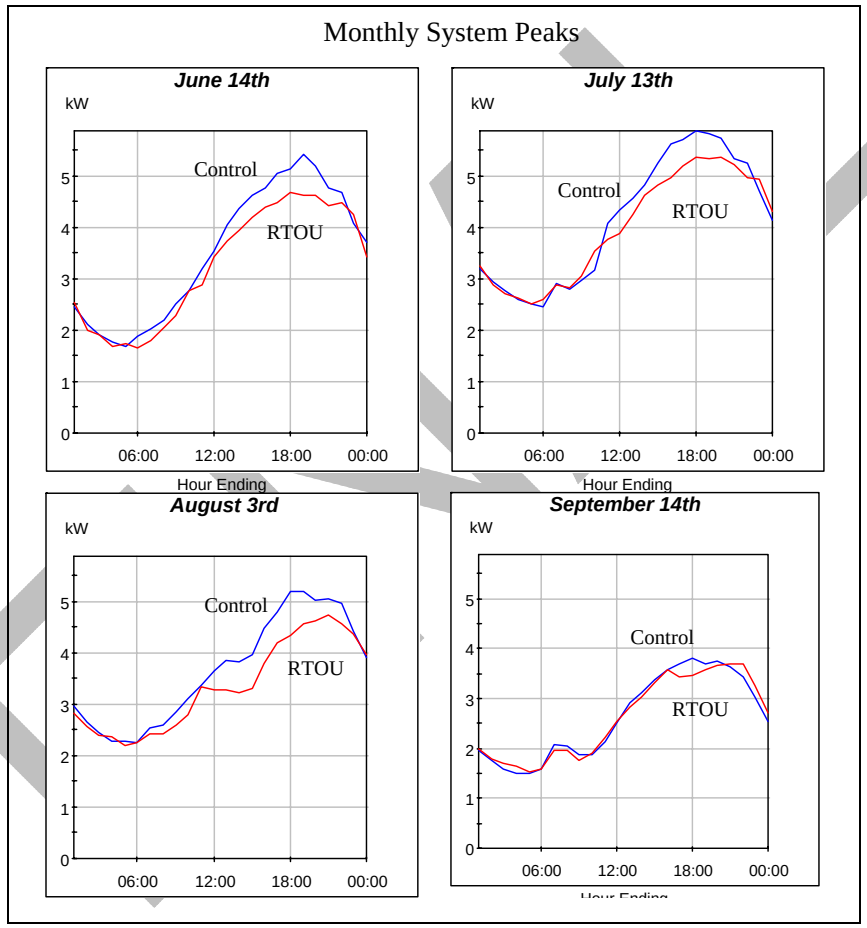

Figure 8 – Monthly System Peaks: NO-CPP Treatment

To test whether or not there is a significant difference, we conducted a T-test under the null hypothesis that the two means were equal. Table 9~~Table 9~~ presents the outcome of the analysis. For June 14 and August 3, we are able to reject the hypothesis that the two means are equal indicating that the demand for the RTOU group is statistically smaller at the 90% level of confidence.

System Peak		Control Group	RTOU Group	Difference Control-RTOU			
Date	Time	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.06	4.49	0.57	1.74	0.084	Reject
13-Jul-2004	5pm	5.70	5.18	0.52	1.43	0.155	Cannot Reject
3-Aug-2004	6pm	5.18	4.32	0.85	3.01	0.003	Reject
14-Sep-2004	5pm	3.68	3.44	0.24	0.90	0.369	Cannot Reject

Table 9 – T-Test for System Peak Demand: NO-CPP Treatment

4.1.4 Time-Of-Use Energy Analysis

Time-of-use (TOU) periods consistent with the TOU rate tariff were constructed and analyzed by the project team. These periods and their definitions are as follows:

- Average daily summer energy use: This value was defined as the average daily energy use across the periods June 1, 2004 through September 30, 2004. A total of 122 days or 2,928 hours are included in the analysis.
- Average on-peak summer energy use: This value was defined as the four hour period beginning at 3pm through hour ending 7pm on summer weekdays. Summer weekdays are defined as Monday through Friday excluding holidays. The summer on-peak period encompassed a total of 86 weekdays or 344 on-peak hours.
- Average mid-peak summer energy use: This value was defined as an eight-hour weekday period. The period encompasses the five hours beginning at 10am through hour ending 3pm and the three-hour period beginning at 7pm through hour ending 10pm. During the summer of 2004 there were 86 weekdays for a total of 8 mid-peak hours per day or 688 total mid-peak hours.
- Average off-peak summer energy use: This value was defined as all weekend hours, all holiday hours (defined as July 4, 2004 which was observed on July 5, 2004 and September 6, 2004), and all remaining weekday hours (i.e., the twelve hour period beginning at 10pm through hour ending 10am). In the summer of 2004, there were 86 weekdays with 12 off-peak hours per day and 36 weekend and holidays with 24 off-peak hours per day yielding a total of 1,896 off-peak hours.

Once again, a T-test analysis was conducted for each variable of interest. The results of the analysis are displayed in Table 10~~Table 10~~ and Table 11~~Table 11~~. Table 10~~Table 10~~ presents the average daily use[9] for the summer season. Table 11~~Table 11~~ converts the average daily use into their seasonal total equivalents. In every instance we are unable to reject the null hypothesis that the means of the two groups are equal. This indicates that the NO-CPP group does not appear to shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods.

[9] Calculated based on the relevant number of days and hours, e.g., the mid-peak period encompasses 87 weekdays non holidays for 8 hours per day.

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Seasonal Use	60.00	60.34	(0.35)	(0.12)	0.905	Cannot Reject
Off-Peak Use	33.63	34.87	(1.24)	(0.71)	0.479	Cannot Reject
Mid-Peak Use	23.59	22.78	0.81	0.71	0.476	Cannot Reject
On-Peak Use	13.81	13.36	0.46	0.67	0.505	Cannot Reject

Table 10 – T-Test for Average Summer Use by TOU Periods: NO-CPP Treatment

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Seasonal Use	7,320	7,362	(42)	(0.12)	0.905	Cannot Reject
Off-Peak Use	4,103	4,255	(151)	(0.71)	0.479	Cannot Reject
Mid-Peak Use	2,028	1,959	69	0.71	0.476	Cannot Reject
On-Peak Use	1,188	1,149	39	0.67	0.505	Cannot Reject

Table 11 – T-Test for Total Summer Use by TOU Periods: NO-CPP Treatment

Figure 9~~Figure 9~~ presents two pie charts that display the proportion of summer energy use by time-of-use classification. Clearly these charts show very similar proportions with the treatment group off-peak increasing by 1.7 percentage points and the mid-peak and on-peak decreasing by approximately 1 percentage point each.

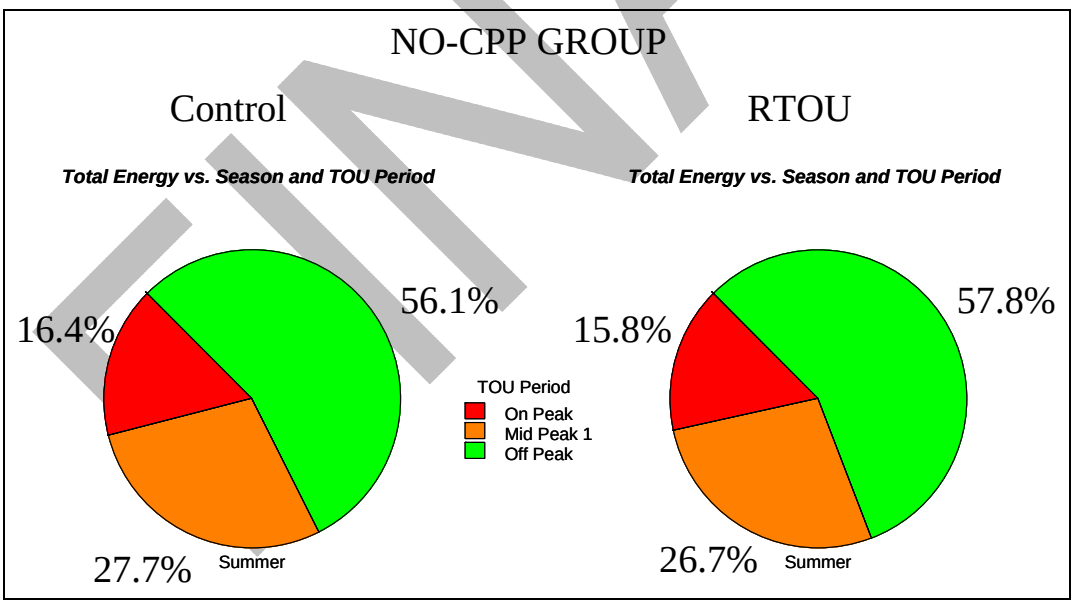

Figure 9 – Time-of-Use Periods: NO-CPP Treatment

4.1.5 Payback Analysis

Payback is defined as the average demand for the three-hour period immediately following a critical peak-pricing (CPP) event. Since the NO-CPP pilot participants were not subjected to a CPP event, the project team did not conduct any payback analysis for this group.

4.2 Analysis of Treatment Group CPP

This section details the analysis conducted for the second treatment group of RTOU pilot participants. These customers were subjected to both the time-of-use rate and the critical peak-pricing component.

4.2.1 Available Sample

The CPP treatment group received the residential time of use rate with the critical peak-pricing component. The "control" group was represented by a sample of 89 customers and the "test" group (i.e., RTOU group) was represented by a similar sized sample of 85 customers. The distribution by strata, the population counts and the case weights are displayed in Table 12~~Table 12~~. In the analysis each test group was weighted and extrapolated to represent the full population of stratum 3 and 4 customers. Following the expansion the average demand per customer was calculated by dividing through by the total population size.

Group	Treatment	Strata	Planned Sample	Actual Sample on 7/13/04	Population Size	Weight
CONTROL	CPP	3	34	51	166,015	3,255.20
		4	41	38	199,290	5,244.47
Totals			75	89	365,305	
RTOU	CPP	3	34	37	166,015	4,486.89
		4	41	48	199,290	4,151.88
Totals			75	85	365,305	

Table 12 – Available Sample: CPP Treatment

4.2.2 Hourly Load Estimates

Figure 10~~Figure 10~~ presents the results of the analysis. The figure displays the "control" group in blue and the "treatment" group (i.e., RTOU) in red. To the left of the figure are EnergyPrints that display the hourly load in three dimensions. The day of the year is on the y-axis, the time of day on the x-axis and the demand is displayed on the z-axis as a color gradient with low levels of load in the black-blue spectrum and high levels of load in the yellow-white spectrum. The graph shows the "control" group having slightly higher peak demands than the RTOU group.

Figure 11~~Figure 11~~ presents the control group versus the RTOU group for each of the monthly system peaks. These include:

- Monday, June 14, 2004,
- Tuesday, July 13, 2004
- Tuesday, August 3, 2004, and
- Tuesday, September 14, 2004.

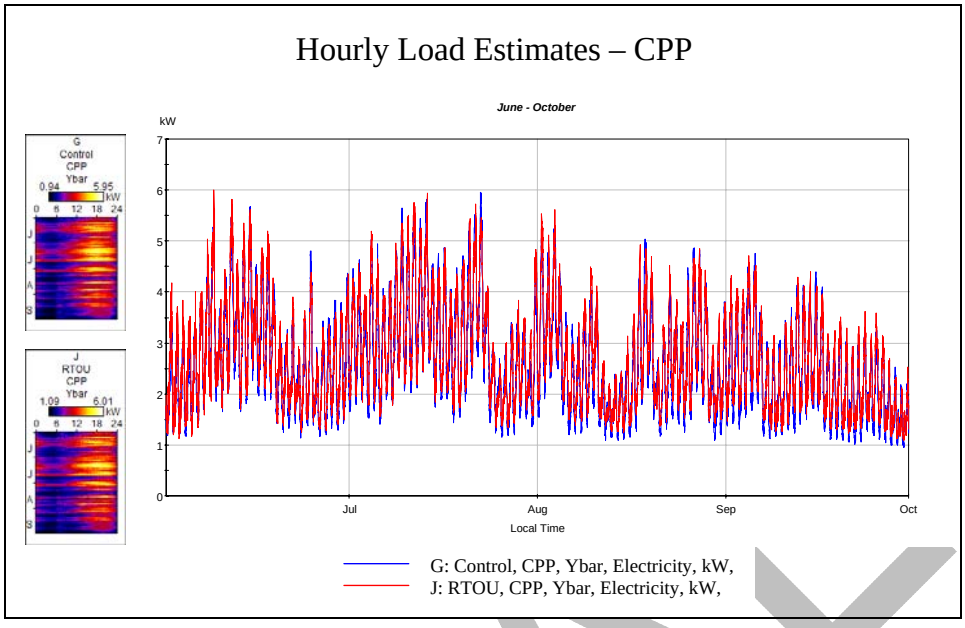

Figure 10 – Hourly Load Estimates: CPP Treatment

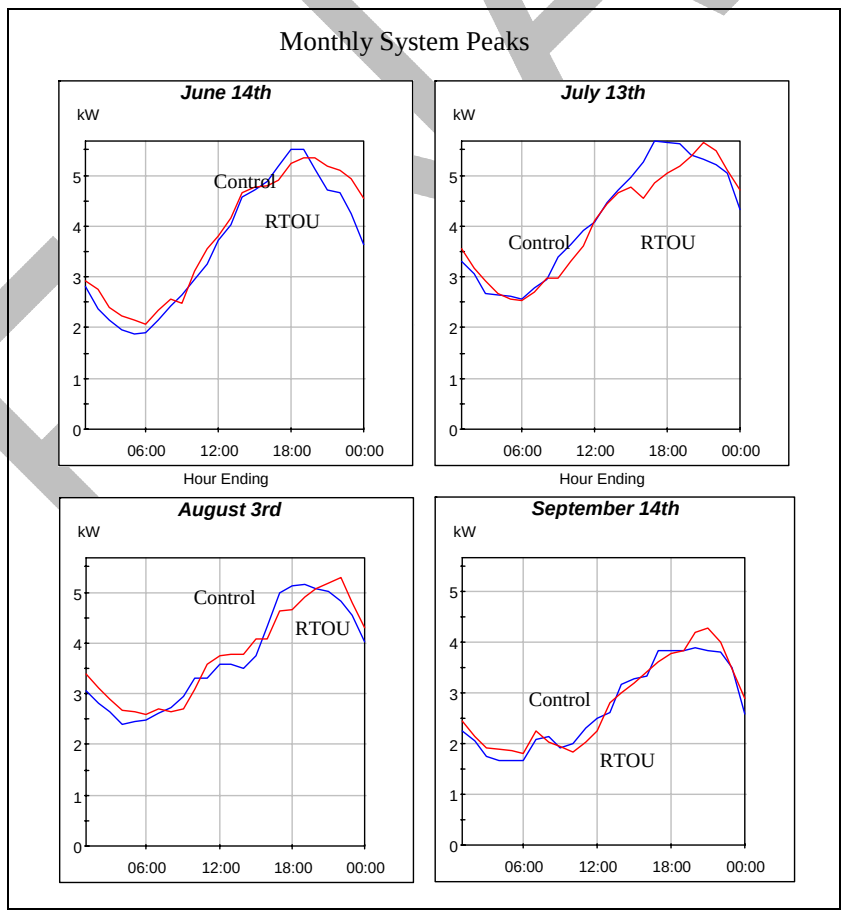

Figure 11 – Monthly System Peaks: CPP Treatment

To test whether or not there is a significant difference we conducted a T-test under the null hypothesis that the two means were equal. Table 13~~Table 13~~ presents the outcome of the analysis. For July 13, we are able to reject the hypothesis that the two means are equal indicating that the demand for the RTOU group is statistically smaller.

System Peak		Control Group (kW)	RTOU Group (kW)	Difference Control-RTOU (kW)			
Date	Time				T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.19	5.02	0.17	0.46	0.650	Cannot Reject
13-Jul-2004	5pm	5.68	4.85	0.83	2.34	0.021	Reject
3-Aug-2004	6pm	5.13	4.66	0.47	1.38	0.169	Cannot Reject
14-Sep-2004	5pm	3.84	3.62	0.21	0.70	0.485	Cannot Reject

Table 13 – T-Test for System Peak Demand: CPP Treatment

4.2.3 CPP Event Day Analysis

During the pilot test, a total of six CPP events were called for a total of 24 hours. The CPP events were invoked on days when the forecasted temperature was expected to exceed 90° F. The CPP event lasted the entire four-hour on-peak period (i.e., hour beginning 3pm to hour ending 7pm. Table 14~~Table 14~~ presents the dates and times associated with the six CPP events.

Date	Hour Ending		Total Hours
	Start	End	
13-Jul-2004	3:00 PM	6:59 PM	4
20-Jul-2004	3:00 PM	6:59 PM	4
21-Jul-2004	3:00 PM	6:59 PM	4
3-Aug-2004	3:00 PM	6:59 PM	4
18-Aug-2004	3:00 PM	6:59 PM	4
27-Aug-2004	3:00 PM	6:59 PM	4
Total Event Hours			24

Table 14 – CPP Event Day Schedule

Figure 12~~Figure 12~~ presents a comparison of the actual hourly load for the RTOU group versus the baseline load calculated from the Control group. The solid black lines drawn parallel to the y-axis highlight the event period. In this figure, the graph highlights the difference between the RTOU group and the control in yellow. Clearly, the RTOU group shows a substantially lower level of load during most of the event period. Figures for each of the event days are contained in Appendix A.

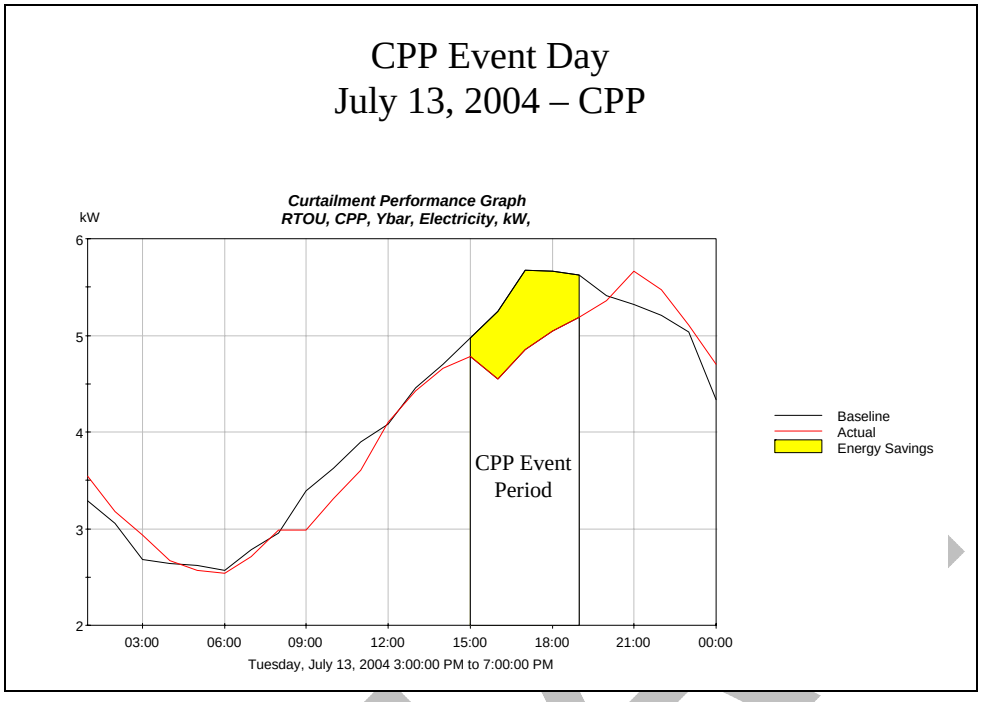

Figure 12 – CPP Event Day: July 13, 2004: CPP Treatment

To determine if there is a statistically significant difference between the RTOU and Control group we set up and conducted a T-Test. For this analysis, we calculate and compare the average demand across the entire CPP event period. The CPP event day analysis results are presented in Table 15~~Table 15~~. The RTOU participants demonstrated a statistically lower demand when compared to their Control group counterparts in five of the six events. In addition, the average demand across all event hours was deemed to be significantly different.

CPP Event			Control Group (kW)	RTOU Group (kW)	Difference Control-RTOU (kW)			
	Hour Ending							
Date	Start	End				T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	3:00 PM	6:59 PM	5.55	4.91	0.65	2.09	0.038	Reject
20-Jul-2004	3:00 PM	6:59 PM	4.92	4.20	0.72	2.42	0.017	Reject
21-Jul-2004	3:00 PM	6:59 PM	5.29	4.62	0.67	2.30	0.023	Reject
3-Aug-2004	3:00 PM	6:59 PM	4.89	4.58	0.31	1.01	0.314	Cannot Reject
18-Aug-2004	3:00 PM	6:59 PM	4.77	3.98	0.79	2.89	0.004	Reject
27-Aug-2004	3:00 PM	6:59 PM	4.44	3.91	0.53	1.72	0.087	Reject
Average			4.98	4.37	0.61	2.54	0.012	Reject

Table 15 – T-Test for CPP Event Day Demands: CPP Treatment

4.2.4 Time-Of-Use Energy Analysis

Time-of-use (TOU) periods consistent with the TOU rate tariff were constructed and analyzed by the project team. These periods and their definitions are as follows:

- Average daily summer energy use: This value was defined as the average daily energy use across the periods June 1, 2004 through September 30, 2004.
- Average on-peak summer energy use: This value was defined as the four hour period beginning at 3pm through hour ending 7pm on summer weekdays. Summer weekdays are defined as Monday through Friday excluding holidays.

- Average on-peak summer energy use during CPP events: This value was defined as the four hour period beginning at 3pm through hour ending 7pm during the six called CPP events.
- Average mid-peak summer energy use: This value was defined as an eight-hour weekday period. The period encompasses the five hours beginning at 10am through hour ending 3pm and the three-hour period beginning at 7pm through hour ending 10pm.
- Average off-peak summer energy use: This value was defined as all weekend hours, all holiday hours (defined as July 4, 2004 and September 6, 2004), and all remaining weekday hours (i.e., the twelve hour period beginning at 10pm to hour ending 10am).

A T-test analysis was conducted for each variable of interest. The results of the analysis are displayed in Table 16~~Table 16~~. In every instance we are unable to reject the null hypothesis that the means of the two groups are equal. This indicates that the CPP group does not appear to shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods.

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	62.87	65.30	(2.43)	(0.72)	0.473	Cannot Reject
Off-Peak Use	35.84	38.36	(2.52)	(1.19)	0.235	Cannot Reject
Mid-Peak Use	24.11	24.54	(0.43)	(0.34)	0.733	Cannot Reject
On-Peak Use	13.82	13.29	0.54	0.73	0.466	Cannot Reject
CPP Use	19.80	18.85	0.95	0.86	0.390	Cannot Reject

Table 16 – T-Test for Average Summer Use by TOU Periods: CPP Treatment

The information in Table 17~~Table 17~~ translates the daily time-of-use data into seasonal energy use information. The average energy used in the CPP periods is estimated to be 119 kWh for the control group and 113 kWh for the treatment group.

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	7,671	7,967	(296)	(0.72)	0.473	Cannot Reject
Off-Peak Use	4,372	4,680	(308)	(1.19)	0.235	Cannot Reject
Mid-Peak Use	2,073	2,111	(37)	(0.34)	0.733	Cannot Reject
On-Peak Use	1,106	1,063	43	0.73	0.466	Cannot Reject
CPP Use	119	113	6	0.86	0.390	Cannot Reject

Table 17 – T-Test for Total Summer Use by TOU Periods: CPP Treatment

While not statistically different, Figure 13~~Figure 13~~ displays the percentage of summer seasonal use by time-of-use period. The treatment group (i.e., RTOU) increases their off-peak consumption slightly while decreasing their on-peak and mid-peak use.

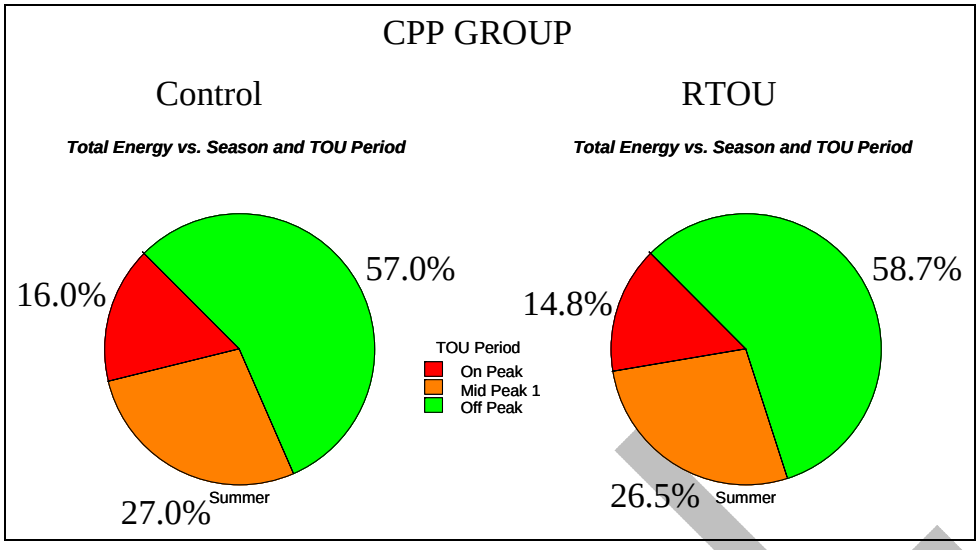

Figure 13 – Time-Of-Use Periods: CPP Treatment

4.2.5 Payback Analysis

Payback is defined as the average demand for the three-hour period immediately following a critical peak-pricing (CPP) event. Table 18~~Table 18~~ presents the analysis for the payback. The table indicates that the payback for the RTOU group following the CPP event was moderate and not statistically different than the load following the CPP period for the control group. On the first four events the payback averaged approximately 0.23 kW.

Three-Tier TOU Rate with CPP (CPP)								
CPP Event			Control Group (kW)	RTOU Group (kW)	Difference Control-RTOU (kW)			
	Payback Period							
Date	Start	End				T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	7pm	10pm	5.31	5.50	(0.19)	(0.61)	0.542	Cannot Reject
20-Jul-2004	7pm	10pm	4.96	5.20	(0.24)	(0.76)	0.448	Cannot Reject
21-Jul-2004	7pm	10pm	5.23	5.43	(0.19)	(0.57)	0.571	Cannot Reject
3-Aug-2004	7pm	10pm	4.97	5.19	(0.23)	(0.69)	0.489	Cannot Reject
18-Aug-2004	7pm	10pm	4.57	4.50	0.07	0.25	0.804	Cannot Reject
27-Aug-2004	7pm	10pm	3.73	4.11	(0.38)	(1.28)	0.202	Cannot Reject
Average			4.80	4.99	(0.19)	(0.63)	0.528	Cannot Reject

Table 18 – T-Test for Payback Analysis: CPP Treatment

4.3 Analysis of Treatment Group CPP-THERM

This section details the analysis conducted for the third treatment group. This group of RTOU pilot participants were subjected to the critical peak-pricing component of the rate but were provided additional enabling technology (see Section 3.2 Enabling Technology for a description of the thermostat) to aid in their load modification. This group is termed the CPP-THERM group.

It is interesting to note that during the test almost all of the customers remained on the default control option (i.e., 1^{o} change per hour with a 4^{o} maximum change). Only four customers

elected a control option different than the default setting with two of these customers selecting the highest option (i.e., 2^{o} change per hour with a 8^{o} maximum change).

4.3.1 Available Sample

The CPP-THERM treatment group received the residential time of use rate with the critical peak-pricing component and an ExpresStat thermostat. The "control" group was represented by a sample of 89 customers and the "test" group (i.e., RTOU group) was represented by a similar sized sample of 85 customers. The distribution by strata, the population counts and the case weights are displayed in Table 19~~Table 19~~. In the analysis each test group was weighted and extrapolated to represent the full population of stratum 3 and 4 customers. Following the expansion the average demand per customer was calculated by dividing through by the total population size.

Group	Treatment	Strata	Planned Sample	Actual Sample on 7/13/04	Population Size	Weight
CONTROL	CPP-THERM	3	34	59	166,015	2,813.81
		4	41	58	199,290	3,436.03
Totals			75	117	365,305	
RTOU	CPP-THERM	3	34	36	166,015	4,611.53
		4	41	41	199,290	4,860.73
Totals			75	77	365,305	

Table 19 – Available Sample: CPP-THERM Treatment

4.3.2 Hourly Load Estimates

Figure 14~~Figure 14~~ presents the results of the analysis. The figure displays the "control" group in blue and the "treatment" group (i.e., RTOU) in red. To the left of the figure are EnergyPrints that display the hourly load in three dimensions. The day of the year is on the y-axis, the time of day on the x-axis and the demand is displayed on the z-axis as a color gradient with low levels of load in the black-blue spectrum and high levels of load in the yellow-white spectrum. The graph shows the "control" group having substantially higher peak demands than the RTOU group.

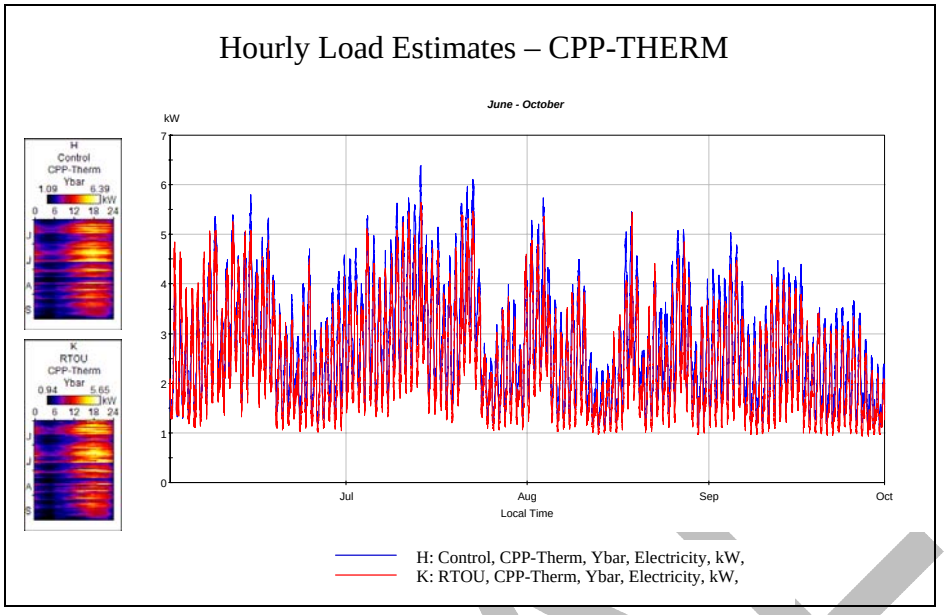

Figure 14 – Hourly Load Estimates: CPP-THERM Treatment

4.3.3 Demand at System Peak

Figure 15~~Figure 15~~ displays the hourly demand for the "control" and "treatment" groups on each of the four summer system peak days. The blue line represents the "control" group and the red line represents the treatment group. While differences are evident on all four, system peak days, these differences are extreme on July 13, 2004 and August 3, 2004, two of the CPP event days.

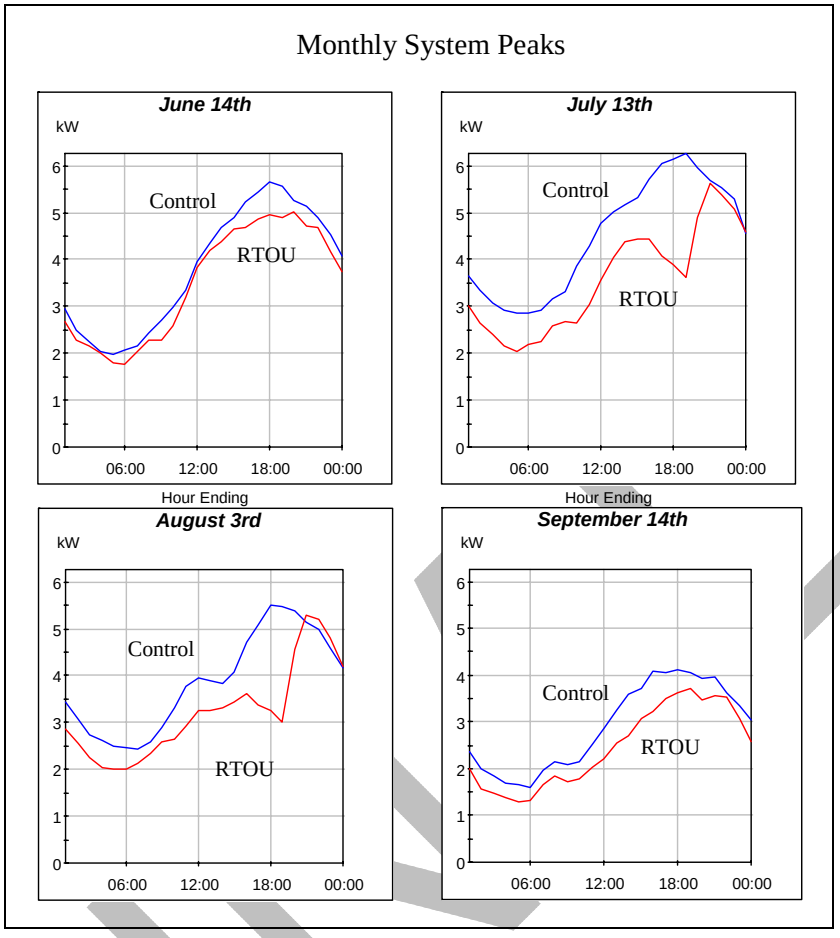

Figure 15 – Monthly System Peaks: CPP-THERM Treatment

To test whether or not there is a significant difference we conducted a T-test under the null hypothesis that the two means were equal. Table 20~~Table 20~~ presents the outcome of the analysis. We are able to reject the hypothesis that the two means are equal indicating that the demand for the RTOU group is statistically smaller on each of the four summer peak days.

System Peak		Control Group	RTOU Group	Difference Control-RTOU			
Date	Time	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
14-Jun-2004	5pm	5.45	4.70	0.74	2.24	0.003	Reject
13-Jul-2004	5pm	6.05	4.07	1.99	6.82	0.000	Reject
3-Aug-2004	6pm	5.51	3.24	2.28	8.11	0.000	Reject
14-Sep-2004	5pm	4.05	3.48	0.57	2.14	0.033	Reject

Table 20 – T-Test for System Peak Demand: CPP-THERM Treatment

4.3.4 CPP Event Day Analysis

During the pilot test a total of six CPP events were called for a total of 24 hours. The CPP events were invoked on days when the forecasted temperature was expected to exceed 90° F. The CPP event lasted the entire four-hour on-peak period (i.e., hour beginning 3pm to hour ending 7pm. Table 21~~Table 21~~ presents the dates and times associated with the CPP events.

Date	Hour Ending		Total Hours
	Start	End	
13-Jul-2004	3:00 PM	6:59 PM	4
20-Jul-2004	3:00 PM	6:59 PM	4
21-Jul-2004	3:00 PM	6:59 PM	4
3-Aug-2004	3:00 PM	6:59 PM	4
18-Aug-2004	3:00 PM	6:59 PM	4
27-Aug-2004	3:00 PM	6:59 PM	4
Total Event Hours			24

Table 21 – CPP Event Day Schedule

Figure 16~~Figure 16~~ presents a comparison of the actual hourly load for the RTOU group versus the baseline load calculated from the Control group. The solid black lines drawn parallel to the y-axis highlight the event period. In this figure, the graph highlights the difference between the RTOU group and the control in yellow. Clearly, the RTOU group shows a substantially lower level of load during the entire event period. Figures for each of the event days are contained in Appendix A.

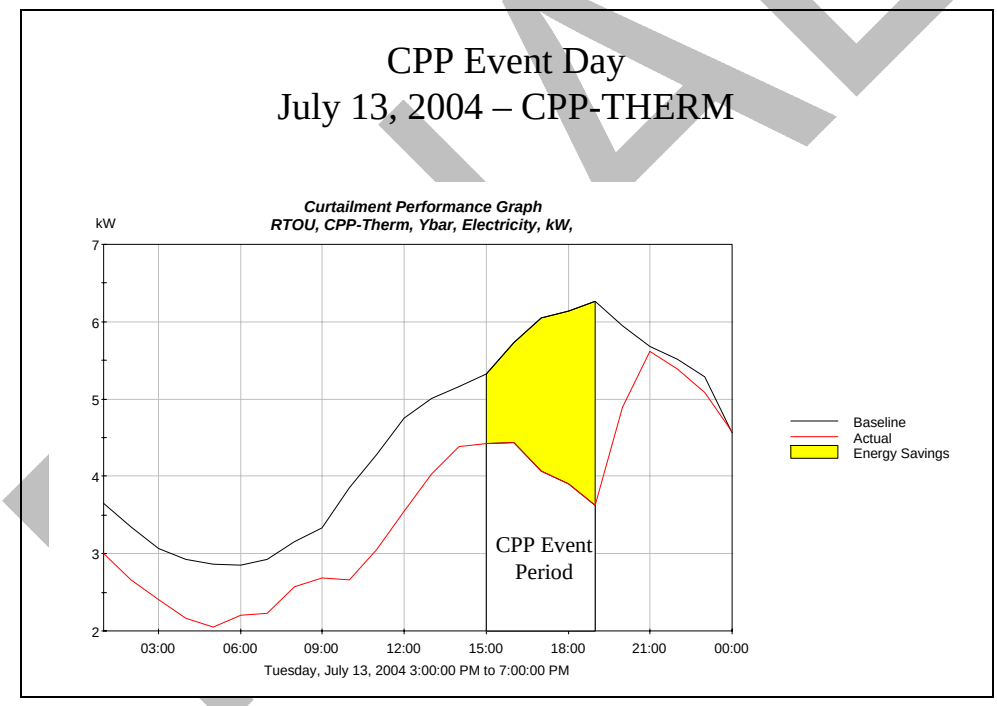

Figure 16 – CPP Event Day July 13, 2004: CPP-THERM Treatment

To determine if there is a statistically significant difference between the RTOU and Control group we set up and conducted a T-Test. For this analysis, we calculate and compare the average demand across the entire CPP event period. The CPP event day analysis results are presented in Table 22~~Table 22~~. The RTOU participants demonstrated a statistically lower demand when compared to their Control group counterparts in all six events. In addition, the average demand across all event hours was deemed to be significantly lower for the RTOU group.

CPP Event			Control Group	RTOU Group	Difference Control-RTOU			
	Hour Ending							
Date	Start	End	(kW)	(kW)	(kW)	T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	3:00 PM	6:59 PM	6.05	4.01	2.04	7.52	0.000	Reject
20-Jul-2004	3:00 PM	6:59 PM	5.30	3.44	1.86	7.44	0.000	Reject
21-Jul-2004	3:00 PM	6:59 PM	5.79	3.87	1.93	7.04	0.000	Reject
3-Aug-2004	3:00 PM	6:59 PM	5.19	3.29	1.90	7.27	0.000	Reject
18-Aug-2004	3:00 PM	6:59 PM	5.10	3.26	1.83	6.63	0.000	Reject
27-Aug-2004	3:00 PM	6:59 PM	4.75	3.09	1.65	6.88	0.000	Reject
Average			5.36	3.49	1.87	8.09	0.000	Reject

Table 22 – T-Test for CPP Event Day Demands: CPP-THERM Treatment

4.3.5 Time-Of-Use Energy Analysis

Time-of-use (TOU) periods consistent with the TOU rate tariff were constructed and analyzed by the project team. These periods and their definitions are as follows:

- Average daily summer energy use: This value was defined as the average daily energy use across the periods June 1, 2004 through September 30, 2004.
- Average on-peak summer energy use: This value was defined as the four hour period beginning at 3pm through hour ending 7pm on summer weekdays. Summer weekdays are defined as Monday through Friday excluding holidays.
- Average on-peak summer energy use during CPP events: This value was defined as the four hour period beginning at 3pm through hour ending 7pm during the six called CPP events.
- Average mid-peak summer energy use: This value was defined as an eight-hour weekday period. The period encompasses the five hours beginning at 10am through hour ending 3pm and the three-hour period beginning at 7pm through hour ending 10pm.
- Average off-peak summer energy use: This value was defined as all weekend hours, all holiday hours (defined as July 4, 2004 and September 6, 2004), and all remaining weekday hours (i.e., the twelve hour period beginning at 10pm through hour ending 10am).

Once again, a T-test analysis was conducted for each variable of interest. The results of the analysis are displayed in Table 16~~Table 16~~. In every instance we are able to reject the null hypothesis that the means of the two groups are equal. This indicates that the RTOU group does appear to shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods.

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	66.63	58.28	8.35	2.88	0.000	Reject
Off-Peak Use	37.61	33.31	4.30	2.44	0.002	Reject
Mid-Peak Use	25.86	22.47	3.39	3.00	0.003	Reject
On-Peak Use	14.86	12.77	2.09	3.09	0.002	Reject
CPP Use	21.39	15.48	5.92	6.50	0.000	Reject

Table 23 – T-Test for Average Summer Use by TOU Period: CPP-THERM Treatment

Table 17~~Table 17~~ presents summer seasonal use information by time-of-use period. The average energy used in the CPP periods is estimated to be 203 kWh for the control group and 16% less, i.e., 170 kWh, for the treatment group.

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	8,129	7,110	1,019	2.88	0.000	Reject
Off-Peak Use	4,588	4,063	525	2.44	0.002	Reject
Mid-Peak Use	2,224	1,932	292	3.00	0.003	Reject
On-Peak Use	1,189	1,022	167	3.09	0.002	Reject
CPP Use	128	93	36	6.50	0.000	Reject

Table 24 – T-Test for Total Summer Use by TOU Periods: CPP-THERM Treatment

Figure 13~~Figure 13~~ displays the percentage of summer seasonal use by time-of-use period. The treatment group (i.e., RTOU) increases their off-peak consumption slightly while decreasing their on-peak usage.

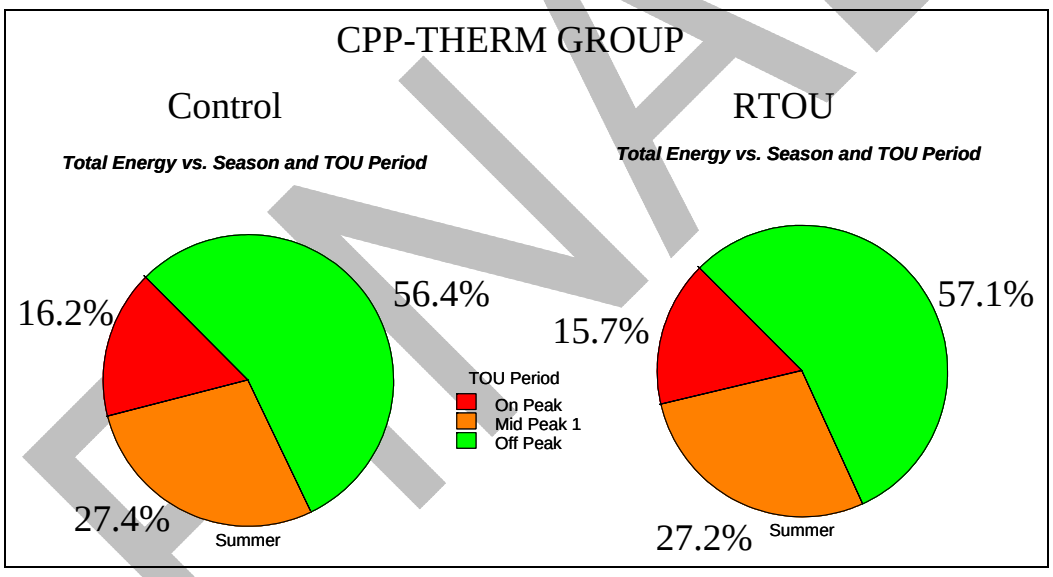

Figure 17 – Time-Of-Use Periods: CPP-THERM Treatment

4.3.6 Payback Analysis

Payback is defined as the average demand for the three-hour period immediately following a critical peak-pricing (CPP) event. Table 18~~Table 18~~ presents the analysis for the payback. The table indicates that the payback for the RTOU group following the CPP event was moderate and not statistically different than the load following the CPP period for the control group. On all but two events the "payback" load for the RTOU group is actually lower than the corresponding load for the control group.

CPP Event			Control Group (kW)	RTOU Group (kW)	Difference Control-RTOU (kW)			
	Payback Period							
Date	Start	End				T-Test	Pr>|t|	Ho: Control=RTOU
13-Jul-2004	7pm	10pm	5.72	5.30	0.42	1.67	0.096	Reject
20-Jul-2004	7pm	10pm	5.15	5.04	0.11	0.45	0.653	Cannot Reject
21-Jul-2004	7pm	10pm	5.40	4.96	0.44	1.79	0.075	Reject
3-Aug-2004	7pm	10pm	5.17	5.00	0.18	0.70	0.487	Cannot Reject
18-Aug-2004	7pm	10pm	4.86	4.92	(0.06)	(0.24)	0.807	Cannot Reject
27-Aug-2004	7pm	10pm	3.90	4.20	(0.30)	(1.33)	0.186	Cannot Reject
Average			5.03	4.90	0.13	0.45	0.639	Cannot Reject

Table 25 – T-Test for Payback Analysis: CPP-THERM Treatment

4.4 Supplemental Analysis

4.4.1 Backdrop

We were surprised over the steep reductions in load for the CPP-Therm treatment group. While we expected to see the participants reduce or shift load from the on-peak period to the mid-peak or off-peak periods, the analysis indicated that these customers reduced load in all associated periods including overall daily use, off-peak use and on-peak use. Interestingly, the test and control groups demonstrated no statistically difference based on either seasonal usage during the June 2003 through August 2003 period or annual 2003 use. We felt that it was important to investigate these results further.

For the CPP-THERM treatment, we began our investigation by examining periods of time when the air conditioning load should not have been in operation. This included selected weekdays and weekends in October and November when the average temperature was less than 70 ^{o}F. Initial results indicated that there was not a statistical difference between the test and control groups. However, when additional days were brought into the mix, the results indicated that the periods were statistically different (see Table 26~~Table 26~~).

TOU Period	Control Group (kWh)	RTOU Group (kWh)	Difference Control-RTOU (kWh)	T-Test	Pr>|t|	Ho: Control=RTOU
Daily Use	37.27	33.74	3.53	1.78	0.077	Reject
Off-Peak Use	20.16	18.30	1.85	1.68	0.094	Reject
Mid-Peak Use	15.76	14.33	1.43	1.58	0.115	Cannot Reject
On-Peak Use	9.15	8.13	1.01	2.10	0.037	Reject

Table 26 – T-Test for 35 "Cool Days": CPP-THERM Treatment

Since the results tended to vary depending on the number and configuration of days (i.e., the number of weekdays and weekends) selected we decided to conduct additional analyses. In our effort to investigate the robustness of the results further, we elected to do a more comprehensive and systematic analysis on the veracity of the control groups.

In this supplemental analysis we began by examining each treatment group versus the composite control group. Next, we constructed alternative control groups using from the full complement of participants from the control group pool. These groups were chosen by selecting one or more control group customers for each test group customer based on the percent deviation between 2003 summer consumption. In this analysis we hoped to better

match the control group to the RTOU test group. Additionally, we felt this analysis would provide valuable insight into the stability of our findings.

4.4.2 NO-CPP Treatment Group

Table 27~~Table 27~~ presents the supplemental analysis results for the No-CPP treatment group. A total of seven control groups are constructed. These include the original, the composite (i.e., all customers), and control groups based on "best" matches selecting one through five customers and eliminating duplicates. Significant differences are highlighted. The table includes the 2003 summer use, 2003 annual use, average daily use, average off-peak use, average mid-peak use, and average on-peak use. For the CPP and CPP-Therm treatment groups the table also includes the average CPP use.

For the No-CPP treatment group only two cells demonstrate a significant difference. These results suggest no further study is required for the No-CPP treatment group. We would recommend using the existing RTOU test and control groups as potential control group participants for any additional analysis conducted on the CPP and CPP-THERM treatment groups.

		Control Group Configurations						
Variable of Interest	RTOU NO CPP (n=91)	Original (n=91)	Composite (n=295)	Select "1" No Dups (n=69)	Select "2" No Dups (n=116)	Select "3" No Dups (n=156)	Select "4" No Dups (n=184)	Select "5" No Dups (n=201)
2003 Summer Use (Jun-Aug)	5,795	5,906	5,983	5,929	5,847	5,828	5,831	5,839
Absolute Difference		111	188	134	52	33	36	44
Percent Difference		1.9%	3.2%	2.3%	0.9%	0.6%	0.6%	0.8%
T-Stat (Summer Use)		0.47	1.16	0.35	0.24	0.17	0.2	0.25
p-value (Summer Use)		0.64	0.25	0.72	0.81	0.87	0.85	0.80
2003 Annual Use	19,058	18,371	18,690	18,553	18,449	18,523	18,554	18,552
Absolute Difference		(687)	(368)	(505)	(609)	(535)	(504)	(506)
Percent Difference		-3.6%	-1.9%	-2.6%	-3.2%	-2.8%	-2.6%	-2.7%
T-Stat Annual Use)		-0.74	-0.57	-0.73	-0.7	-0.66	-0.66	-0.68
p-value Annual Use)		0.46	0.57	0.46	0.49	0.51	0.51	0.49
Average Daily Use	60.34	60.00	62.70	63.14	61.59	61.56	61.38	61.57
Absolute Difference		(0.35)	2.36	2.80	1.24	1.22	1.03	1.23
Percent Difference		-0.6%	3.9%	4.6%	2.1%	2.0%	1.7%	2.0%
T-Stat Annual Use)		-0.12	1.19	0.79	0.46	0.50	0.46	0.56
p-value Annual Use)		0.90	0.23	0.43	0.64	0.62	0.65	0.57
Off Peak Use	34.50	33.31	35.04	35.58	34.50	34.49	34.40	34.60
Absolute Difference		(1.18)	0.54	1.08	0.00	(0.01)	(0.10)	0.11
Percent Difference		-3.4%	1.6%	3.1%	0.0%	0.0%	-0.3%	0.3%
T-Stat Annual Use)		-0.71	0.43	0.44	-0.02	-0.03	-0.10	0.06
p-value Annual Use)		0.48	0.66	0.66	0.99	0.98	0.92	0.96
Mid Peak Use	22.78	23.59	24.36	24.24	23.89	23.86	23.76	23.78
Absolute Difference		0.81	1.58	1.46	1.11	1.08	0.99	1.00
Percent Difference		3.5%	6.9%	6.4%	4.9%	4.7%	4.3%	4.4%
T-Stat Annual Use)		0.71	2.04	1.2	1.06	1.15	1.12	1.17
p-value Annual Use)		0.48	0.04	0.23	0.29	0.25	0.26	0.24
On Peak Use	13.36	13.81	14.39	14.20	14.05	14.06	14.02	13.99
Absolute Difference		0.46	1.03	0.84	0.69	0.70	0.66	0.64
Percent Difference		3.4%	7.7%	6.3%	5.2%	5.3%	4.9%	4.8%
T-Stat Annual Use)		0.67	2.19	1.15	1.08	1.22	1.22	1.21
p-value Annual Use)		0.51	0.03	0.25	0.28	0.22	0.22	0.23

Table 27 – Alternative Control Group Comparisons: NO CPP

4.4.3 CPP Treatment Group

Table 28~~Table 28~~ presents similar results for the CPP treatment group. The results for this group are a bit mixed. While the comparison to the original control group indicates that there were no statistical differences, alternative control group configurations suggest otherwise. There is sufficient evidence to indicate that the CPP group does indeed move load from the CPP periods to other periods. While the on-peak periods are consistently higher for the control group they do are not statistically different.

		Control Group Configurations						
Variable of Interest	RTOU CPP (n=87)	Original (n=89)	Composite (n=295)	Select "1" No Dups (n=67)	Select "2" No Dups (n=118)	Select "3" No Dups (n=151)	Select "4" No Dups (n=177)	Select "5" No Dups (n=221)
2003 Summer Use (Jun-Aug)	6,415	6,121	5,983	6,125	6,171	6,103	6,043	6,047
Absolute Difference		(294)	(432)	(290)	(244)	(312)	(372)	(368)
Percent Difference		-4.6%	-6.7%	-4.5%	-3.8%	-4.9%	-5.8%	-5.7%
T-Stat (Summer Use)		-0.95	-2.17	-0.83	-0.83	-1.17	-0.15	-1.55
p-value (Summer Use)		0.34	0.03	0.41	0.41	0.24	0.88	0.12
2003 Annual Use	20,296	19,649	18,690	19,470	19,423	19,178	18,981	18,999
Absolute Difference		(647)	(1,606)	(826)	(873)	(1,118)	(1,315)	(1,297)
Percent Difference		-3.2%	-7.9%	-4.1%	-4.3%	-5.5%	-6.5%	-6.4%
T-Stat Annual Use)		-0.52	-2.13	-0.63	-0.79	-1.10	0.64	-1.43
p-value Annual Use)		0.60	0.03	0.53	0.43	0.27	0.52	0.15
Daily Use	65.30	62.87	62.70	65.01	65.34	64.74	63.99	63.96
Absolute Difference		(2.43)	(2.60)	(0.29)	0.04	(0.56)	(1.31)	(1.35)
Percent Difference		-3.7%	-4.0%	-0.4%	0.1%	-0.9%	-2.0%	-2.1%
T-Stat Annual Use)		-0.72	-1.18	-0.08	0.01	-0.19	-0.48	-0.51
p-value Annual Use)		0.47	0.24	0.94	0.99	0.85	0.63	0.61
Off Peak Use	37.91	35.48	35.04	36.71	37.04	36.65	36.08	36.06
Absolute Difference		(2.43)	(2.87)	(1.20)	(0.88)	(1.26)	(1.83)	(1.85)
Percent Difference		-6.4%	-7.6%	-3.2%	-2.3%	-3.3%	-4.8%	-4.9%
T-Stat Annual Use)		-1.16	-2.11	-0.51	-0.44	-0.69	-1.08	-1.13
p-value Annual Use)		0.25	0.04	0.61	0.66	0.49	0.28	0.26
Mid Peak Use	24.54	24.11	24.36	25.18	25.06	24.90	24.71	24.72
Absolute Difference		(0.43)	(0.19)	0.64	0.51	0.36	0.16	0.17
Percent Difference		-1.8%	-0.8%	2.6%	2.1%	1.5%	0.7%	0.7%
T-Stat Annual Use)		-0.41	-0.33	0.39	0.36	0.24	0.07	0.08
p-value Annual Use)		0.68	0.74	0.70	0.72	0.81	0.94	0.94
On Peak Use	13.29	13.82	13.95	14.00	14.11	13.98	13.92	13.89
Absolute Difference		0.54	0.66	0.71	0.82	0.69	0.64	0.60
Percent Difference		4.0%	5.0%	5.3%	6.2%	5.2%	4.8%	4.5%
T-Stat Annual Use)		0.67	1.33	0.87	1.18	1.09	1.05	1.03
p-value Annual Use)		0.50	0.18	0.39	0.24	0.28	0.30	0.30
CPP Use	18.85	19.80	20.30	20.68	20.86	20.58	20.54	20.45
Absolute Difference		0.95	1.46	1.83	2.01	1.73	1.69	1.60
Percent Difference		5.0%	7.7%	9.7%	10.7%	9.2%	9.0%	8.5%
T-Stat Annual Use)		0.86	1.95	1.48	1.94	1.82	1.87	1.83
p-value Annual Use)		0.39	0.05	0.14	0.05	0.07	0.06	0.07

Table 28 – Alternative Control Group Comparisons: CPP

4.4.4 CPP-THERM Treatment Group

Finally, Table 29~~Table 29~~ presents the results for the CPP-THERM group. These results show compelling evidence that the on-peak CPP rate coupled with the thermostat results in a reduction in use during the on-peak and CPP usage periods. The single concern is that the test group shows lower use in almost all other periods as well. This suggests further study is required for the 2005 summer season. We would suggest selecting approximately one-half (n=40) of the control group and transferring them into the CPP-THERM program for the

2005 summer season. Here again, this would provide a powerful pre/post experimental design component to go along with the current test/control environment. The control group would come from a composite of the current control group and the RTOU test and control group participants.

		Control Group Configurations						
Variable of Interest	RTOU CPP-Therm (n=78)	Original (n=117)	Composite (n=295)	Select "1" No Dups (n=69)	Select "2" No Dups (n=123)	Select "3" No Dups (n=164)	Select "4" No Dups (n=196)	Select "5" No Dups (n=221)
2003 Summer Use (Jun-Aug)	5,886	6,149	5,983	5,832	5,942	5,875	5,858	5,862
Absolute Difference		263	97	(54)	56	(11)	(28)	(24)
Percent Difference		4.5%	1.6%	-0.9%	1.0%	-0.2%	-0.5%	-0.4%
T-Stat (Summer Use)		1.00	0.6	-0.21	0.26	-0.06	-0.16	-0.14
p-value (Summer Use)		0.32	0.55	0.83	0.80	0.95	0.88	0.89
2003 Annual Use	18,007	18,847	18,690	18,250	18,292	18,330	18,378	18,512
Absolute Difference		840	683	243	285	323	371	505
Percent Difference		4.7%	3.8%	1.3%	1.6%	1.8%	2.1%	2.8%
T-Stat Annual Use)		1.08	1.27	0.31	0.42	0.52	0.65	0.88
p-value Annual Use)		0.28	0.21	0.76	0.68	0.60	0.52	0.38
Daily Use	58.28	66.63	62.70	59.95	61.23	61.38	61.74	61.69
Absolute Difference		8.35	4.43	1.67	2.96	3.10	3.46	3.41
Percent Difference		14.3%	7.6%	2.9%	5.1%	5.3%	5.9%	5.8%
T-Stat Annual Use)		2.88	2.36	0.57	1.16	1.38	1.63	1.70
p-value Annual Use)		0.00	0.02	0.57	0.25	0.17	0.10	0.09
Off Peak Use	32.87	37.23	35.04	33.15	33.72	34.01	34.32	34.40
Absolute Difference		4.36	2.17	0.28	0.84	1.14	1.44	1.52
Percent Difference		13.3%	6.6%	0.9%	2.6%	3.5%	4.4%	4.6%
T-Stat Annual Use)		2.50	1.91	0.16	0.56	0.84	1.13	1.26
p-value Annual Use)		0.01	0.05	0.87	0.58	0.40	0.26	0.21
Mid Peak Use	22.47	25.86	24.36	23.38	24.14	24.08	24.13	24.03
Absolute Difference		3.39	1.89	0.91	1.67	1.62	1.67	1.56
Percent Difference		15.1%	8.4%	4.1%	7.4%	7.2%	7.4%	6.9%
T-Stat Annual Use)		2.91	2.45	0.69	1.54	1.67	1.85	1.83
p-value Annual Use)		0.00	0.01	0.49	0.12	0.10	0.06	0.07
On Peak Use	12.77	14.86	13.95	13.74	13.95	13.86	13.84	13.76
Absolute Difference		2.09	1.18	0.97	1.18	1.09	1.07	0.99
Percent Difference		16.4%	9.2%	7.6%	9.2%	8.5%	8.4%	7.7%
T-Stat Annual Use)		3.09	2.68	1.35	1.94	2.01	2.12	2.05
p-value Annual Use)		0.00	0.01	0.18	0.05	0.05	0.03	0.04
CPP Use	15.48	21.39	20.30	19.91	20.56	20.07	20.23	20.20
Absolute Difference		5.92	4.83	4.43	5.08	4.60	4.76	4.73
Percent Difference		38.2%	31.2%	28.6%	32.8%	29.7%	30.7%	30.5%
T-Stat Annual Use)		6.50	7.61	4.12	5.76	5.81	6.49	6.77
p-value Annual Use)		0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 29 – Alternative Control Group Comparisons: CPP-THERM

5 APPENDIX A – CPP EVENT DAY GRAPHS

5.1 CPP Treatment Group

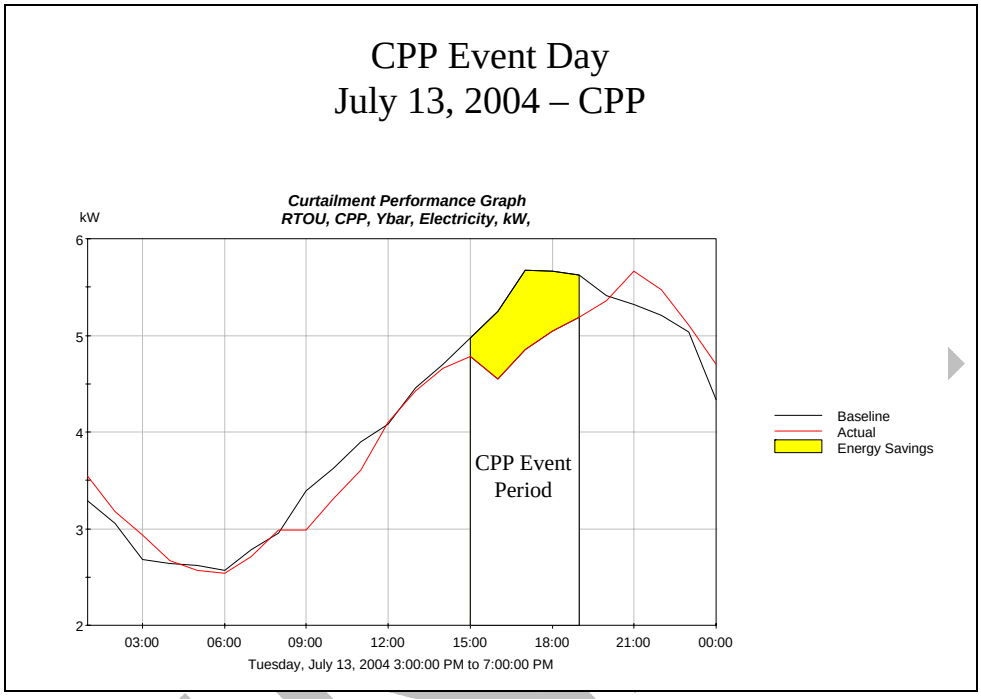

Figure 18 – July 13, 2004: CPP Group

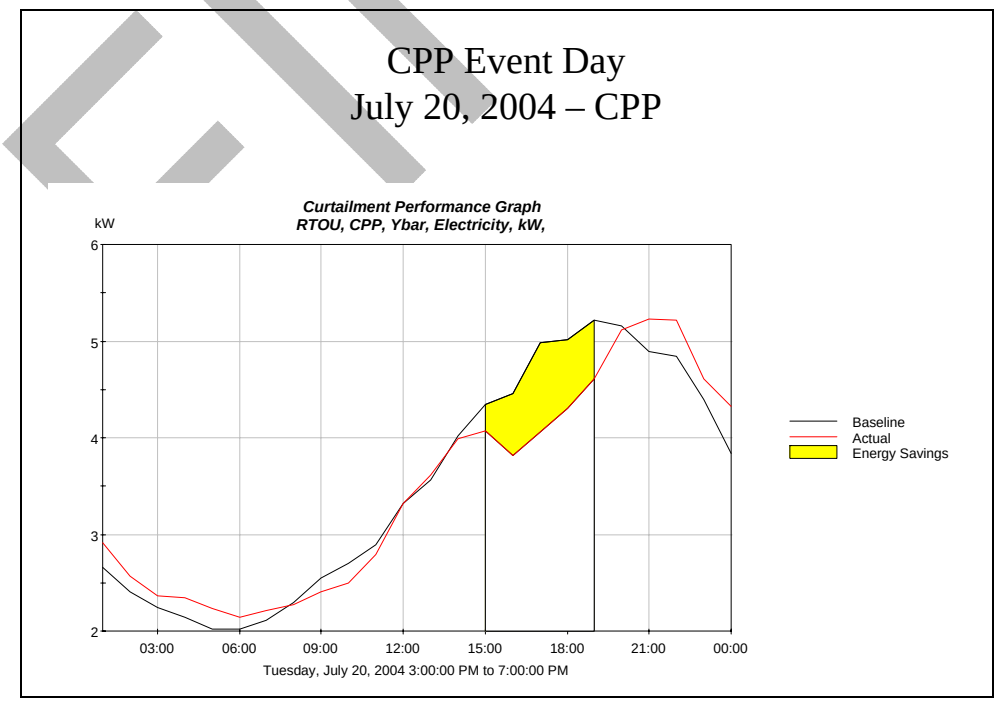

Figure 19 – July 20, 2004: CPP Group

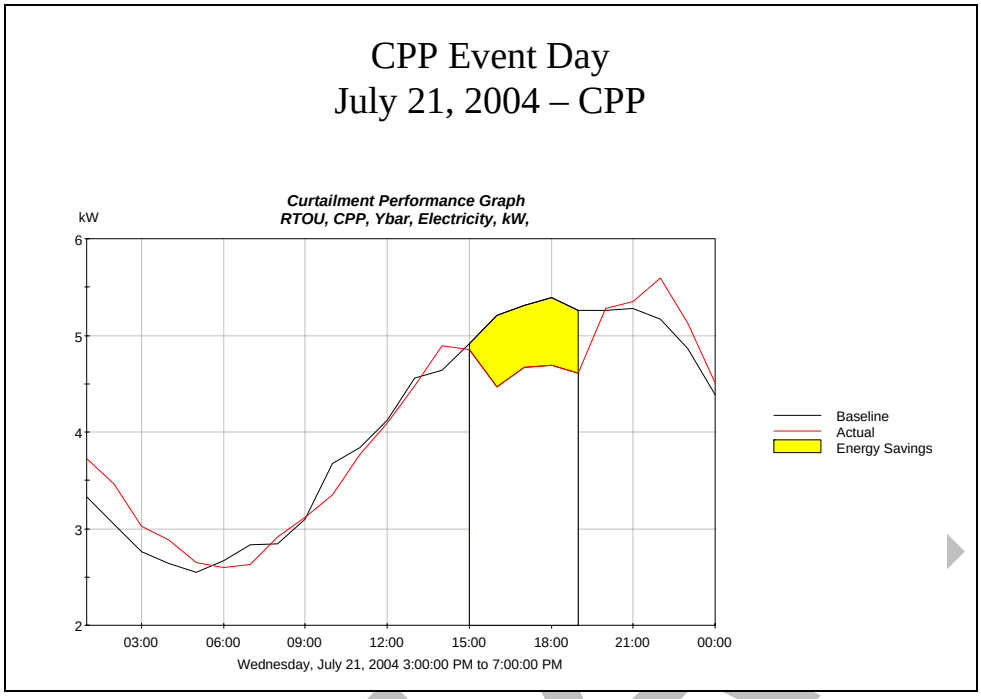

Figure 20 – July 21, 2004: CPP Group

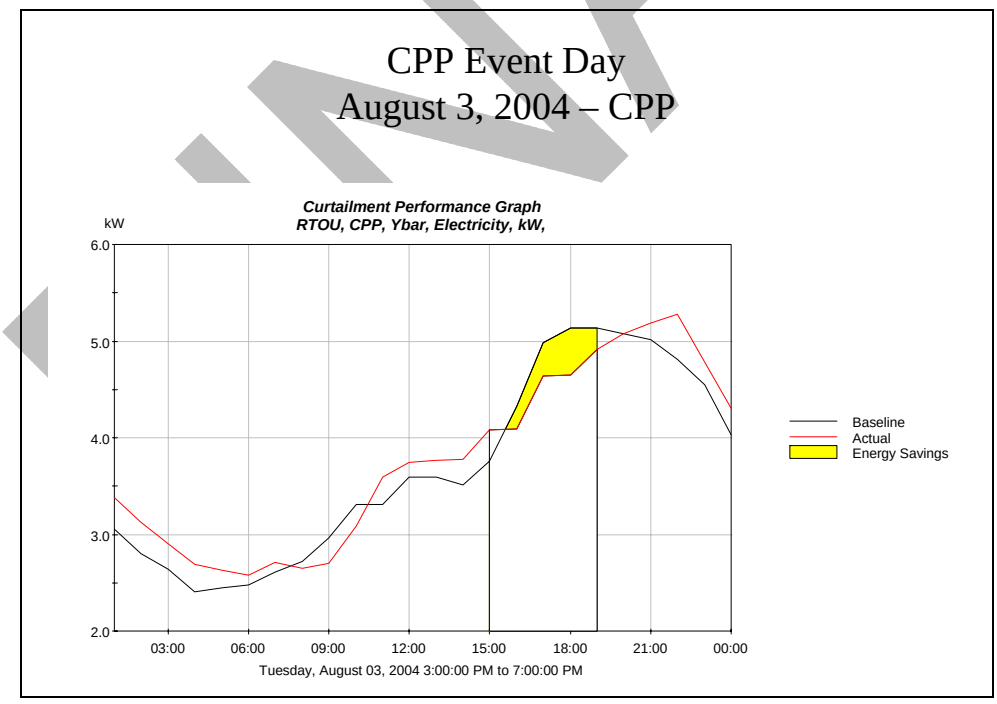

Figure 21 – August 3, 2004: CPP Group

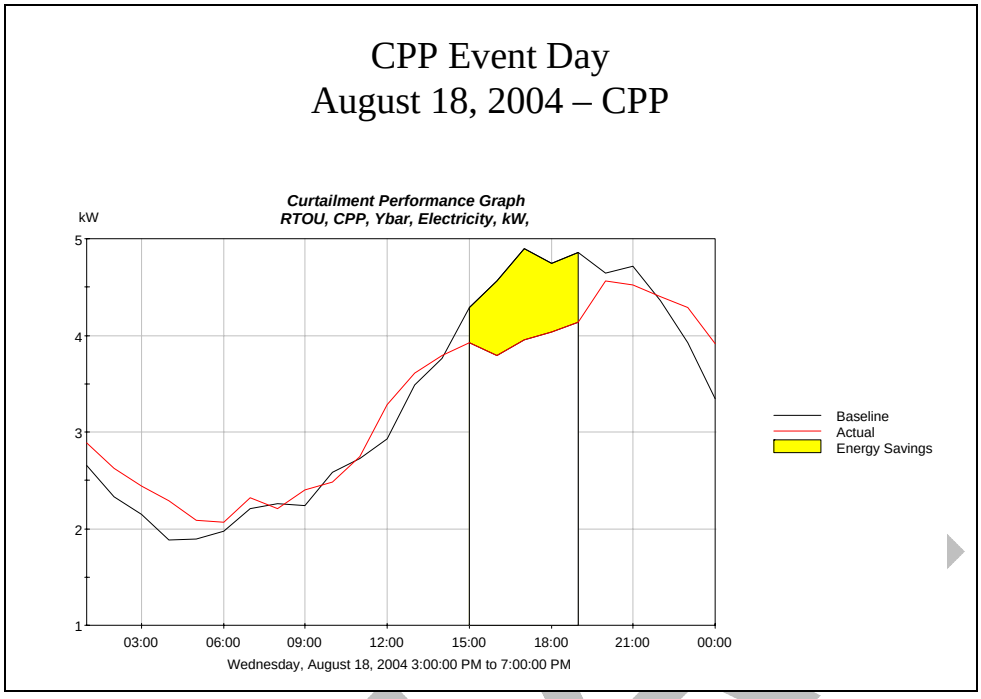

Figure 22 – August 18, 2004: CPP Group

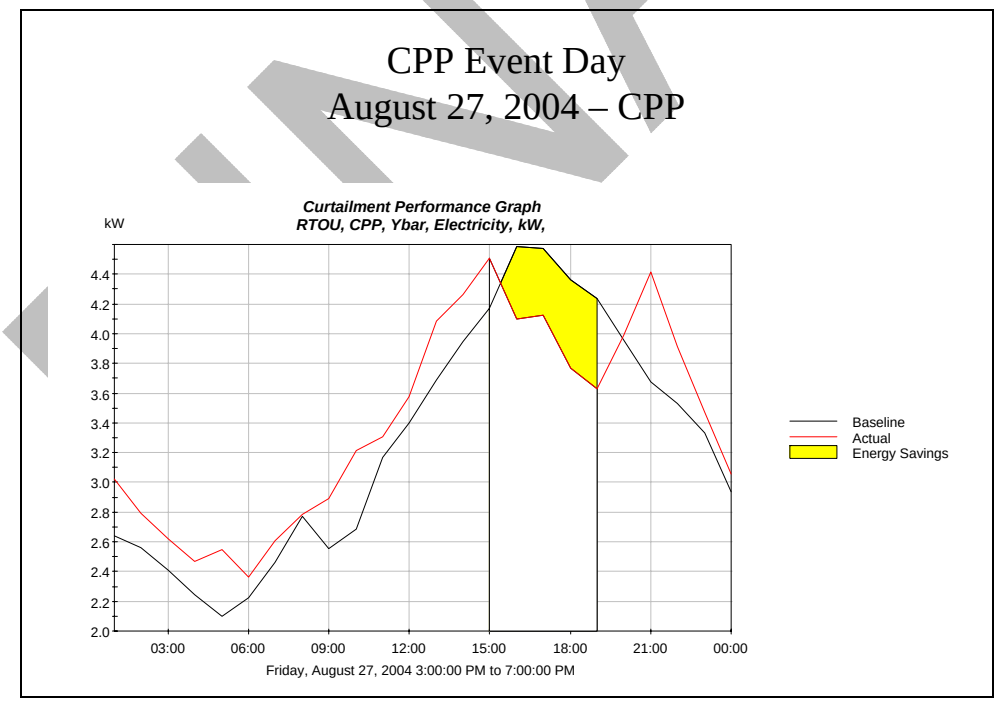

Figure 23 – August 27, 2004: CPP Group

5.2 CPP-THERM Treatment Group

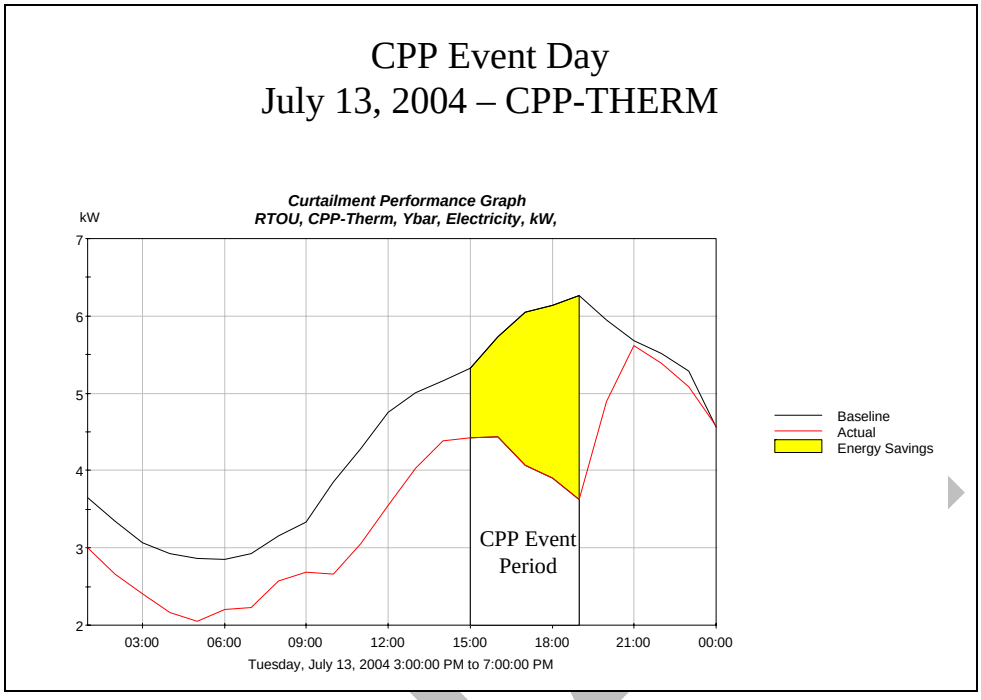

Figure 24 – July 13, 2004: CPP-THERM Group

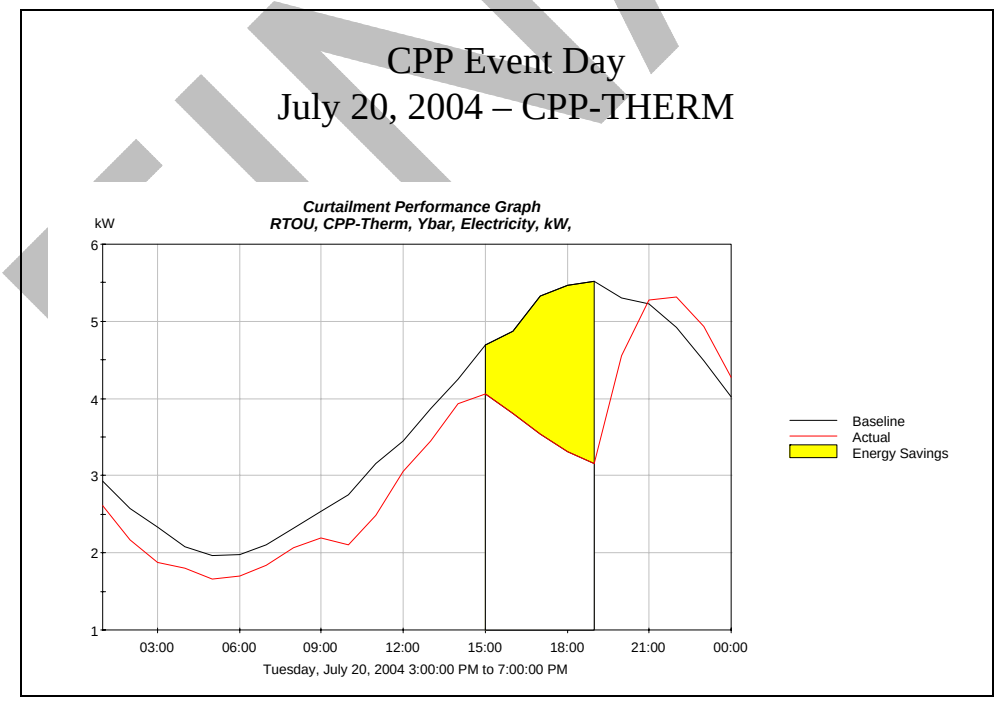

Figure 25 – July 20, 2004: CPP-THERM Group

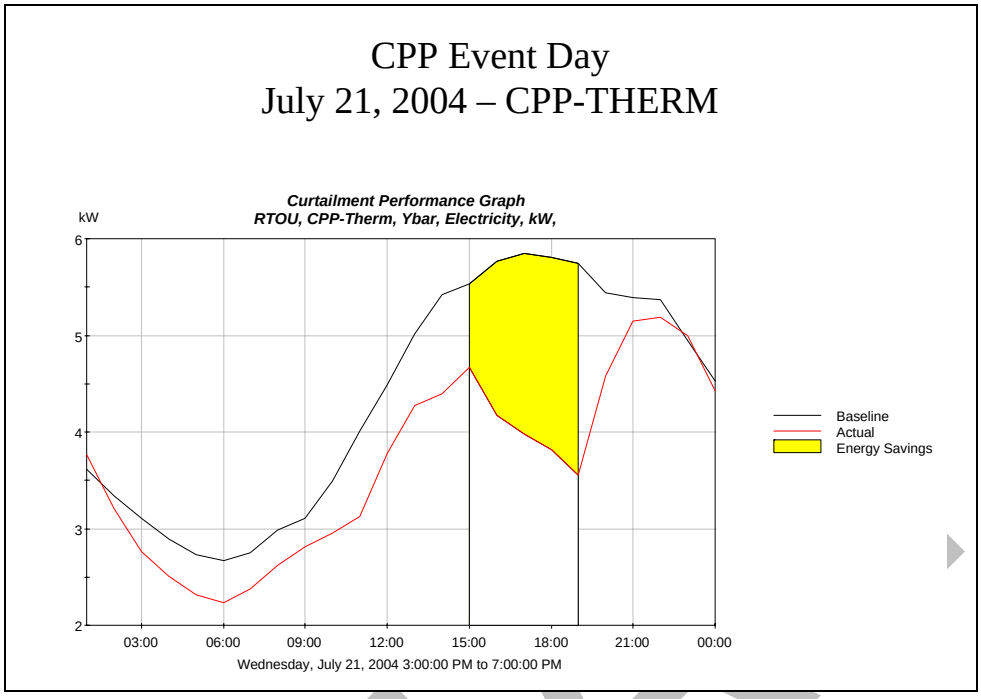

Figure 26 – July 21, 2004: CPP-THERM Group

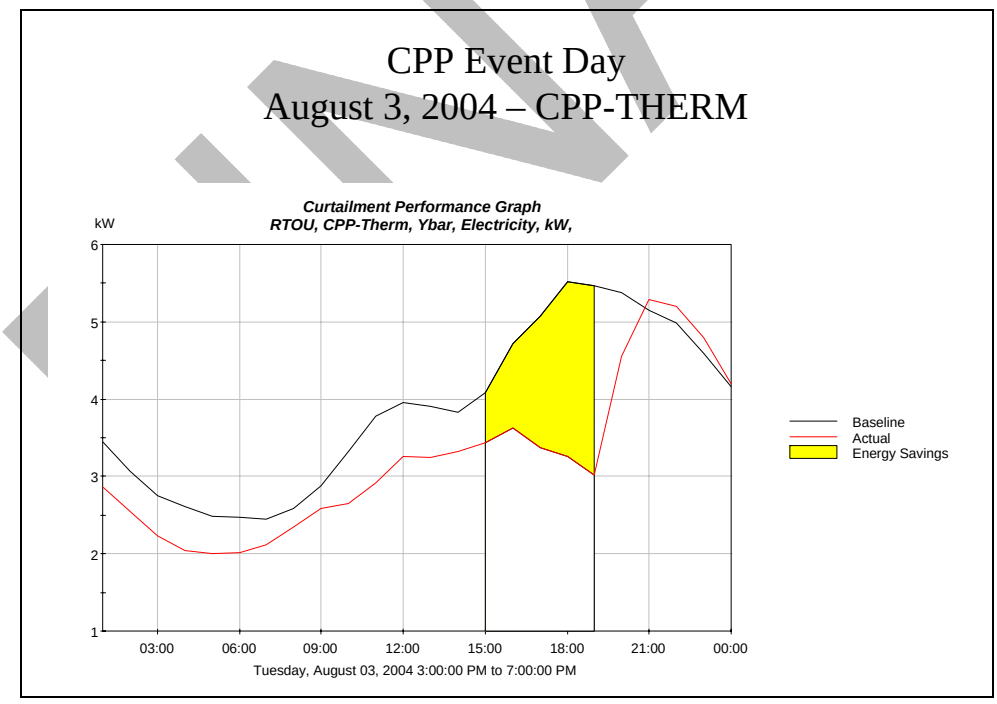

Figure 27 – August 3, 2004: CPP-THERM Group

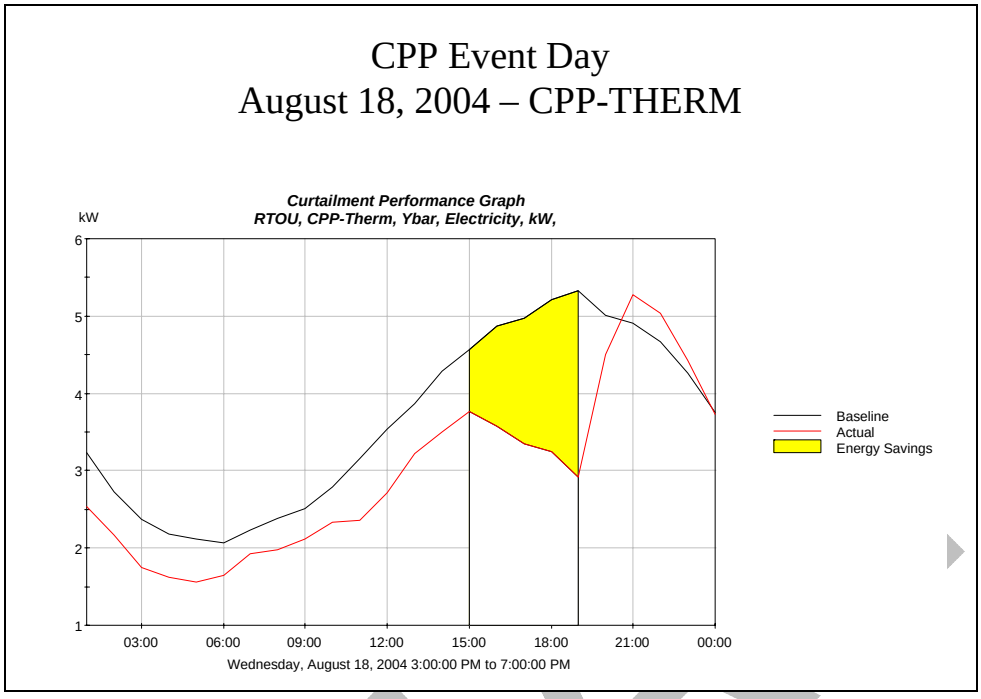

Figure 28 – August 18, 2004: CPP-THERM Group

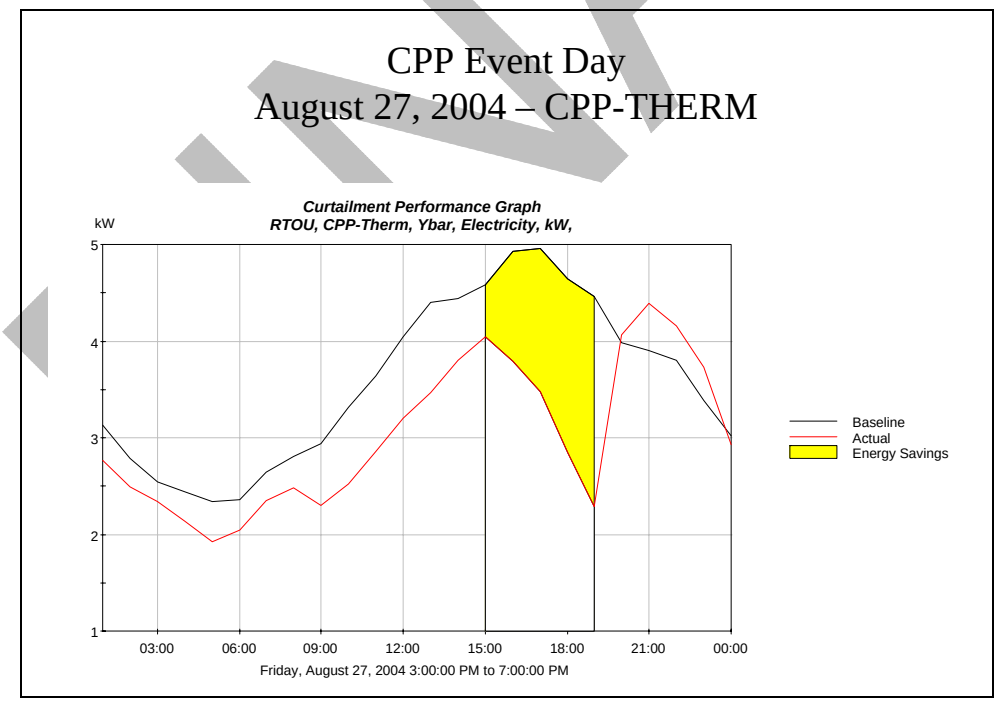

Figure 29 – August 27, 2004: CPP-THERM Group