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Appendix E: Comparison of Results Across Dynamic Pricing and Time-Based Rate Pilot Programs

Quantifying the Benefits of Dynamic Pricing In the Mass Market

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APPENDIX E. COMPARISON OF RESULTS ACROSS DYNAMIC PRICING AND TIME-BASED RATE PILOT PROGRAMS

This appendix compares the results of several dynamic pricing pilots with each other and with those from the California statewide pricing pilot (SPP). In addition, to provide historical perspective, we provide a summary of results from 16 pricing pilots that were carried out under the auspices of the U.S. Department of Energy and its predecessor agency, the Federal Energy Administration, during the 1970s and 1980s. We use the term "dynamic pricing" to refer to pricing signals that are triggered based on actual wholesale market prices and not set in advance. (For example, a time-of-use (TOU) rate is not a dynamic price, because the peak period rate and timing are set in advance. Critical peak pricing (CPP) is dynamic, because while the rate may be set in advance, the critical days are called based on wholesale market conditions.)

Comparative results are presented for the following pilots and studies:

- Public Service Electric and Gas Co. (PSE&G) Residential Pilot Program, "Residential Time-of-Use with Critical Peak Pricing Pilot Program: Comparing Customer Response between Educate-Only and Technology Assisted Pilot Segments." 2007.
- Ontario Energy Board Smart Price Pilot, "Ontario Energy Board Smart Price Pilot." Final Report, 2007.
- Anaheim Critical Peak Pricing Experiment, "Residential Customer Response to Real-time Pricing: Anaheim Critical Peak Pricing Experiment." 2007.
- Idaho Residential Pilot Program, "2006 Analysis of the Residential Time-of-Day and Energy Watch Pilot Programs." Final Report, 2006.
- Energy Australia's Network Tariff Reform, "Network Price Reform." 2006.
- The Community Energy Cooperative's Energy-Smart Pricing Plan, "Evaluation of the 2005 Energy-Smart Pricing Plan – Final Report." 2006.
- AmerenUE Residential TOU Pilot Study, "AmerenUE Critical Peak Pricing Pilot." 2006.
- California Automated Demand Response System Pilot, "Automated Demand Response System Pilot – Final Report." 2006.
- California Statewide Pricing Pilot, "Impact Evaluation of the California Statewide Pricing Pilot." 2005.
- AmerenUE Residential TOU Pilot Study, "AmerenUE Residential TOU Pilot Study Load Research Analysis: First Look Results." 2004.
- The Gulf Power Select Program, "Dynamic Pricing, Advanced Metering and Demand Response in Electricity Markets: Appendix B." 2002.
- *Journal of Econometrics*, "Consistency of Residential Customer Response in Time-of-Use Electricity Pricing Experiments." 1984.

- *Energy*, "The Residential Demand for Electricity by Time-of-Use: A Survey of Twelve Experiments with Peak Load Pricing." 1983.

Our review of these dynamic pricing pilots reveals that dynamic prices are effective in reducing electricity usage. In general, CPP programs supported with enabling technologies result in the largest reductions in load. However, CPP programs alone (without an enabling technology) also achieve significant reductions in load. TOU programs without enabling technologies reduce load somewhat. However, when TOU programs are supported with enabling technologies, the average load reduction is larger. Based on the pilot results, the combination of dynamic prices with enabling technologies appears to be the most effective program design for reducing electricity usage during high-priced periods. A summary of the impacts associated with the pilots reviewed in this appendix are shown in Figure E-2 at the end of this appendix (as well as other summary exhibits).

PSE&G Residential Pilot Program

PSE&G offered a residential TOU/CPP pilot pricing program in New Jersey during 2006 and 2007.[1] The PSE&G pilot had two subprograms. Under the first subprogram, myPower Sense, participants were educated about the TOU tariff and notified of the CPP event on a day-ahead basis, and the program assessed the reduction in energy use when a CPP event was called. Under the second subprogram, myPower Connection, also designed to assess the reduction in energy use when a CPP event was called, participants were given a free thermostat that received price signals from PSE&G and adjusted their central air conditioning (CAC) based on previously programmed set points. A total of 1,286 customers participated in the pilot program: 450 in the control group, 459 in myPower Sense, and 377 in myPower Connection.

The TOU/CPP tariff included an off-peak rate, a base rate, an on-peak rate, and a critical peak rate for the summer months as shown in Table 1.

Table 1: TOU/CPP Rate Design: Summer Months (June to September 2006)

Period	Charge	Applicable
Base Price	$0.09/kW	All hours
Night Discount	-$0.05/kWh	10 p.m.-9 a.m. daily
On Peak Adder	$0.08/kW	1 p.m.-6 p.m. weekdays
Critical Peak	$0.69/kW	1 p.m.-6 p.m. weekdays when called (added to the base price when called.)

Source: PSEG-CPP Pilot, page 3.

TOU/CPP program impacts are summarized in Tables 2 and 3. The results show that a 100 percent increase in the peak to off-peak price ratio leads to an 8.5 percent decrease in the peak to off-peak demand ratio for myPower Sense customers (i.e., a substitution elasticity of 0.085). Similarly, myPower Connection customers reduced their peak to off-peak consumption ratio by 13.7 percent when the peak to off-peak price ratio increased by 100 percent. The results also show reductions of 1.1 and 2.1 kW per hour during CPP events for myPower Sense and myPower Connection, respectively. Achieved reductions in peak demand were reported to be 12 percent for myPower Sense and 18 percent for myPower Connection customers.

[1] PSE&G and Summit Blue Consulting, "Residential Time-of-Use with Critical Peak Pricing Pilot Program: Comparing Customer Response between Educate-Only and Technology Assisted Pilot Segments." 2007.

The higher reductions for myPower Connection customers are not surprising since these customers had an enabling technology (i.e., the smart thermostat), whereas the myPower Sense customers did not.

Table 2: Estimated Substitution Elasticity

Impact Estimate	Coefficient	90% Confidence Interval
myPower Sense	-0.085	-0.079 to -0.090
myPower Connection	-0.137	-0.131 to -0.142

Source: PSEG-CPP Pilot, page 4.

Table 3: Estimated CPP Event Impacts (average kW per hour)

Impact Estimate	Coefficient	90% Confidence Interval
myPower Sense	1.11	0.133 to 2.08
myPower Connection	2.12	1.09 to 3.17

Source: PSEG-CPP Pilot, page 4.

Ontario Energy Board Smart Price Pilot

The Ontario Energy Board operated the residential Ontario Energy Board Smart Price Pilot (OSPP) between August 2006 and March 2007.[2] The OSPP used a sample of Hydro Ottawa residential customers and tested the impacts from three different price structures:

- The existing Regulated Price Plan (RPP) TOU: The RPP TOU rates are shown in Table 4.
- RPP TOU rates with a CPP component (TOU CPP). The CPP was set at $0.30 per kWh based on the average of the 93 highest hourly Ontario electricity prices in the previous year. The RPP TOU off-peak price was decreased to $0.031 (from $0.035) per kWh to offset the increase in the critical peak price. The maximum number of critical day events was set at nine days; however, only seven CPP days were called during the pilot.
- RPP TOU rates with a critical peak rebate (TOU CPR): The CPR provided participants with a $0.30 per kWh rebate for each kWh of reduction from estimated baseline consumption. The CPR baseline consumption was defined as the average usage during the same hours over the participants' last five nonevent weekdays, increased by 25 percent.

[2] Ontario Energy Board, "Ontario Energy Board Smart Price Pilot Final Report." 2007.

Table 4: Regulated Price Plan (RPP) TOU Rate Design

Season	Time	Charge	Applicable
Summer (Aug 1- Oct 31)	Off-peak	$0.035/kWh	10 p.m.- 7 a.m. weekdays, all day on weekends and holidays.
Summer (Aug 1- Oct 31)	Mid-peak	$0.075/kWh	7 a.m.- 11 a.m. and 5 p.m.- 10 p.m. weekdays.
Summer (Aug 1- Oct 31)	On-peak	$0.105/kWh	11 a.m.- 5 p.m. weekdays.

Source: Ontario Energy Board Smart Price Pilot, page 2.

A total of 373 customers participated in the pilot: 124 in TOU-only, 124 in TOU-CPP, and 125 in TOU-CPR. The control group had 125 participants with installed smart meters but who continued to pay non-TOU rates.

The OSPP results show that:

- The load shift during the critical hours of the four summer CPP events ranged between 5.7 percent and 25.4 percent.[3]
- The load shift during the entire peak period of the four summer CPP events ranged between 2.4 percent and 11.9 percent.

Table 5 shows the shift in load during a CPP event as a percentage of the load in critical peak hours and of the entire peak period. It is important to note that the percentage reductions for the TOU-only customers are not significant at the 90 percent confidence level.

Table 5: Percentage Shift in Load During the Four Summer CPP Events Under Different RPP Structures

Period	TOU- only	TOU- CPP	TOU- CPR
Shift as % of critical peak hours	5.7%	25.4%	17.5%
Shift as % of all peak hours	2.4%	11.9%	8.5%

Source: Ontario Energy Board Smart Price Pilot, page 5.

This study also analyzed the total conservation impact during the full pilot period. The total reduction in electricity consumption due to program impacts is reported in Table 6. The average conservation impact across all customers was 6 percent.

[3] Under the OSPP, three to four hours of the peak period were defined as critical on a CPP day.

Table 6: Total Conservation Effect for the Full Pilot Duration (Treatment Compared to Control Group)

Program	% Reduction in Electricity
TOU-only	6.0
TOU-	4.7% (ns)
TOU-	7.4
Average Impact	6.0

Source: Ontario Energy Board Smart Price Pilot, page 5.
Note: ns refers to "not significant at the 90% confidence level."

Anaheim Critical Peak Pricing Experiment

The City of Anaheim Public Utilities (APU) conducted a residential Critical Peak Pricing Experiment between June 2005 and October 2005.[4] A total of 123 customers participated in the experiment: 52 in the control group and 71 in the treatment group. The CPP rate rewarded participants with a rebate of $0.35 for each kWh reduction below the reference level peak-period consumption on non-CPP days (i.e., the baseline consumption). Table 7 presents the rate design.

Table 7: City of Anaheim CPP Rate Design

Group	Charge	Applicable
Control	Standard increasing-block residential tariff: $0.0675/kWh if consumption <=240kWh per month $0.1102/kWh if consumption >240kWh per month	All Hours
Treatment	Standard increasing-block residential tariff	All Hours except except peak hours (12 a.m. - 6 p.m.) on CPP days
Treatment	$0.35 rebate for each kWh reduction relative to their typical peak consumption on non-CPP days.	Peak hours (12 a.m. - 6 p.m.) on CPP days

Source: Anaheim Critical Peak Pricing Experiment, page 1-2.

The results show that:

- The treatment group used 12 percent less electricity on average during the peak hours of the CPP days than the control group.
- The reduction in consumption by customers in the treatment group was greater on higher temperature CPP days.

[4] Wolak, Frank A., "Residential Customer Response to Real-Time Pricing: Anaheim Critical Peak Pricing Experiment," UCEI and Department of Economics, Stanford and NBER. 2007.

Idaho Residential Pilot Program[5]

Idaho Power initiated two residential pilot programs in the Emmett area of Idaho in the summers of 2005 and 2006: Time-of-day (TOD) and Energy Watch (EW).

Time-of-Day Pilot

The TOD pilot was designed as a conventional TOU program where the participants were charged different rates by time of the day as shown in Table 8. The TOD pilot included 85 treatment and 420 control group customers as of August 2006.

Table 8: Rate Design for the Time-of-Day Pilot

Period	Charge	Applicable
On-Peak	$0.083/kWh	Weekdays from 1pm to 9pm
Mid-Peak	$0.061/kWh	Weekdays from 7am to 1pm
Off-Peak	$0.045/kWh	Weekdays from 9pm to 7am and all hours on weekends and holidays

Source: 2006 Analysis of the Residential TOD and EW Pilot Programs, page 1.

As shown in Table 9, the results from the TOD pilot for summer 2006 show that, on average, the peak period percentage of total summer usage was the same for the treatment and control groups – about 22 percent. In fact, the percentage of usage during the mid-peak and off-peak periods was also the same between the two groups. This indicates that the TOD rates had no effect on shifting usage. However, given the very low ratio of on-peak to off-peak rates (about 1.84), this result is not so surprising. It indicates that a higher ratio of peak to off-peak rates is needed to induce customers to shift usage from peak to off-peak periods.

Table 9: Summer 2006 (June-August) Usage Under the TOD Pilot

	Average Use (kWh)		% of Total Summer Use			
Period	Treatment	Control	Treatment	Control	Difference	T-stat
On-Peak	800	763	22%	22%	-36.46	0.66
Mid-Peak	591	568	16%	16%	-22.43	0.52
Off-Peak	2307	2162	62%	62%	-145.78	0.99
Summer 06 Usage	3698	3493	100%	100%	-204.67	0.87

Source: 2006 Analysis of the Residential TOD and EW Pilot Programs, page 14.

[5] Idaho Power Co., "2006 Analysis of the Residential Time-of-Day and Energy Watch Pilot Programs: Final Report." 2006.

Energy Watch Pilot

The EW pilot was designed as a CPP pilot where the participants were notified of the CPP event on a day-ahead basis. A total of 10 EW days was called during summer 2006. EW was designed as follows:

- CPP hours from 5 p.m. to 9 p.m.
- Day-ahead notification
- CPP energy price of $0.20/kWh
- Non-CPP energy price of $0.054/kWh

The EW pilot included 68 treatment and 355 control group customers as of August 2006.

Table 10 shows the reduction in load (kW) on CPP days for each of the event days. Average hourly demand reduction ranged from 0.64 kW (on June 29) to 1.70 kW (on July 27). Average hourly load reduction for all 10 event days was 1.26 kW. The average total load reduction for a four-hour event was 5.03 kW.

Table 10: Energy Watch Day: Load Reductions (kW)

Hour Beginning	Hour Ending	29-Jun	11-Jul	14-Jul	18-Jul	19-Jul	25-Jul	27-Jul	3-Aug	9-Aug	15-Aug	Average
5pm	6pm	0.64	1.31	1.09	1.39	1.2	1.33	1.58	1.14	0.83	1.02	1.17
6pm	7pm	0.69	1.5	1.17	1.43	1.32	1.45	1.62	1.27	1.14	1.15	1.29
7pm	8pm	0.77	1.58	1.16	1.57	1.41	1.55	1.7	1.24	1.02	0.96	1.33
8pm	9pm	0.8	1.48	1.11	1.47	1.27	1.4	1.6	1.13	0.95	0.89	1.25
4-Hour Total		2.89	5.87	4.53	5.85	5.2	5.74	6.5	4.77	3.94	4.02	5.03
Average Hourly		0.72	1.47	1.13	1.46	1.3	1.43	1.62	1.19	0.99	1.01	1.26
Min Temp		68	65	65	61	62	75	68	59	62	67	65
Max Temp		85	100	98	94	98	99	104	92	85	92	95
Avg Temp		75	84	83	79	80	87	87	76	73	80	80

Source: 2006 Analysis of the Residential TOD and EW Pilot Programs, page 20.

Energy Australia's Network Tariff Reform

The Time of Use (TOU) pricing program is the largest demand management project by Energy Australia.[6] Recent price elasticity estimates from the TOU tariffs are presented in Table 11.

Table 11: TOU Price Elasticity Estimates

Type	Season	Peak Own Price Elasticity	Peak to Shoulder Cross Price Elasticity	Peak to Off-Peak Cross Price Elasticity
Residential	Summer 2006	-030 to -0.38	-0.07	-0.04
	Winter 2006	-0.47	-0.12	#N/A
Business (less than 40 MWh)	Summer 2006	-0.16 to -0.18 (ns)	-0.03	#N/A
	Winter 2006	-0.2 (ns)	#N/A	#N/A
Business (40 MWh to 160 MWh)	Summer 2006	-0.03 to -0.13 (ns)	#N/A	#N/A
	Winter 2006	-0.02 to -0.09 (ns)	#N/A	#N/A

Source: Network Price Reform, page 10.
Notes: ns refers to "not statistically significant."

The TOU results show that:

- Slight energy conservation effects result from residential consumption under TOU rates (compared to domestic consumption under the flat tariffs).
- Conservation effects are larger in winter than in summer for the residential customers.
- Business customer elasticities are not statistically robust due to large estimation errors stemming from heterogeneity. Therefore, they should be interpreted with caution.

Energy Australia started the Strategic Pricing Study in 2005 that included 1,300 voluntary customers (50 percent business, 50 percent residential). The study tested seasonal, dynamic, and information-only tariffs and involved the use of in-house displays and online access to data. Study participants received dynamic price signals through Short Message Service (SMS), telephone, email, or the display unit.

Preliminary results available from three Dynamic Peak Pricing (DPP) events show that:

- Residential customers reduced their dynamic peak consumption by roughly 24 percent for DPP high rates ($2+/kWh) and roughly 20 percent for DPP medium rates ($1+/kWh).
- Response to the 2nd DPP event was greater than that to the 1st DPP event. This may be attributed to the day-ahead notification under the 2nd DPP event (versus day-of notification under the 1st DPP event) and/or temperature differences.
- Response to the 2nd event was also greater than to the 3rd DPP event. This may be explained by lower temperatures on the 3rd DPP event that may have led to fewer discretionary appliances to turn off.

[6] Harry Colebourn, "Network Price Reform," presented at BCSE Energy Infrastructure & Sustainability Conference. December 2006.

The Community Energy Cooperative's Energy-Smart Pricing Plan

The Community Energy Cooperative (CEC) Energy-Smart Pricing Plan (ESPP), a residential real-time pricing (RTP) program, started in Illinois in 2003.[7] ESPP initially included 750 participants and expanded to nearly 1,500 customers in 2005. ESPP is the only residential RTP program that has been tested at any scale. ESPP has a focus on low technology and tests the hypothesis that major benefits may result from RTP without expensive technology adoption. The ESPP design included:

- Day-ahead announcement of the hourly electricity prices for the next day (i.e., customers were charged the day-ahead hourly prices)
- High-price day notification via phone or email when the price of electricity was over $0.10 per kWh
- A price limit hedge of $0.50 per kWh for participants, meaning that the maximum hourly price was set at $0.50 per kWh during their participation in the program
- Energy usage education for participants

The main goals of the pilot were to determine the price elasticity of demand and the overall impact on energy conservation. A regression-based analysis was conducted to estimate the price elasticity of demand for the summer months. Overall price elasticity was estimated to be -0.047. Automatic cycling of the central air conditioners using an enabling technology during high-price periods increased the overall price elasticity to -0.069. The largest response occurred on high-price notification days. For instance, on the day with the highest prices of summer 2005, participants reduced their peak hour consumption by 15 percent compared to what they would have consumed under the flat CEC residential rate. Price responsiveness varied over the course of a day. Price elasticities by time of day are presented in Table 12.

Table 12: Elasticity Estimates from ESPP

Time of the Day	Elasticity Estimate
Daytime (8 a.m. to 4 p.m.)	-0.02
Late afternoon/evening hours (4 p.m. to midnight)	-0.03
Daytime+ High-Price Notification	-0.02
Late Daytime/Evening+High-Price Notification	-0.05

Source: Evaluation of the 2005 Energy-Smart Pricing Plan-Final Report, page 11.

Results of the energy impact analysis indicate that ESPP participants consumed 35.2 kWh less per month during the summer months compared to what they would have consumed without the ESPP. These savings represent roughly 3 percent to 4 percent of the summer electricity usage. No statistically significant savings were found for the winter usage, which is not surprising since most high price days occur in the summer months in this area. Overall, ESPP resulted in a net decrease in monthly energy consumption.

[7] Summit Blue Consulting, "Evaluation of the 2005 Energy-Smart Pricing Plan-Final Report." 2006.

AmerenUE Critical Peak Pricing Pilot

First Year of the Pilot Program (2004)

AmerenUE in collaboration with Missouri Collaborative (formed by Office of Public Counsel (OPC), the Missouri Public Service Commission (MPSC), the Department of Natural Resources (DNR), and two industrial intervenor groups started a residential TOU pilot study in Missouri during spring 2004.[8] Program impacts associated with three different TOU programs were evaluated:

- TOU with peak, mid-peak, and off-peak rates
- TOU with a CPP component
- TOU with a CPP component and an enabling technology (smart thermostat)

Table 13 shows the rates evaluated in the pilot.

Table 13: Residential TOU Experiment Summer Rate Design

Program	Time	Charge	Applicable
TOU	Off Peak	$0.048/kWh	Weekday 10pm–10am, Weekends, Holidays
TOU	Mid Peak	$0.075/kWh	Weekdays 10am– 3pm and 7pm-10pm
TOU	Peak	$0.183/kWh	Weekday 3pm – 7pm
TOU-CPP	Off Peak	$0.048/kWh	Weekday 10pm–10am, Weekends, Holidays
TOU-CPP	Mid Peak	$0.075/kWh	Weekdays 10am– 3pm and 7pm-10pm
TOU-CPP	Peak	$0.168/kWh	Weekday 3pm – 7pm
TOU-CPP	CPP	$0.30/kWh	Weekday 3pm – 7pm, 10 times per summer

Source: AmerenUE Residential TOU Pilot Study Load Research Analysis: First Look Results, page 10.

Table 14 shows the number of participants in the treatment and control groups by type of rate.

Table 14: Experiment Sample Allocation

Treatment	Treatment Sample Size	Control Sample Size
TOU	88	89
TOU-CPP	85	89
TOU-CPP-Tech	77	117
Total	250	295

[8] Discussion of the 2004 results are based on RLW Analytics, "AmerenUE Residential TOU Pilot Study Load Research Analysis: First Look Results." 2004.

The following results are based on the data compiled from the pilot between June 1, 2004, and September 30, 2004. The results show that:

- Participants in the TOU and TOU-CPP group do not shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods. As shown in Table 15, under both TOU and TOU-CPP programs, off-peak consumption increases and peak consumption decreases only slightly for the treatment group compared to the control group. However, none of these differences in consumption between the treatment and control groups is statistically significant.
- Participants in the TOU-CPP-Tech group do shift a statistically significant amount of load from the on-peak to off-peak or mid-peak periods. As shown in Table 15, the average treatment customer under this program increases off-peak consumption while decreasing mid-peak and peak consumption compared to the corresponding values for the control group. The difference is statistically significant.

Average consumption by participants during the pilot is provided in Tables 15 and 16.

Table 15: Average Participant Use by Program and Pricing Time – 2004

Program	Time	Control Group (kWh)	Treatment Group (kWh)	Difference	t-test	Pr> |t|	Statistical Significance of the Difference
TOU	Off Peak	33.63	34.87	-1.24	-0.71	0.479	Not Significant.
TOU	Mid Peak	23.59	22.78	0.81	0.71	0.476	Not Significant.
TOU	On Peak	13.81	13.36	0.45	0.67	0.505	Not Significant.
TOU	Seasonal	60.00	60.34	-0.34	-0.12	0.905	Not Significant.
TOU-CPP	Off Peak	35.84	38.36	-2.52	-1.19	0.235	Not Significant.
TOU-CPP	Mid Peak	24.11	24.54	-0.43	-0.34	0.733	Not Significant.
TOU-CPP	On Peak	13.82	13.29	0.54	0.73	0.466	Not Significant.
TOU-CPP	CPP	19.8	18.85	0.95	0.86	0.390	Not Significant.
TOU-CPP	Daily	62.87	65.3	-2.43	-0.72	0.473	Not Significant.
TOU-CPP-Tech	Off Peak	37.61	33.31	4.3	2.44	0.002	Significant.
TOU-CPP-Tech	Mid Peak	25.86	22.47	3.39	3	0.003	Significant.
TOU-CPP-Tech	On Peak	14.86	12.77	2.09	3.09	0.002	Significant.
TOU-CPP-Tech	CPP	21.39	15.48	5.92	6.5	0.000	Significant.
TOU-CPP-Tech	Daily	66.63	58.28	8.35	2.88	0.000	Significant.

Source: AmerenUE Residential TOU Pilot Study Load Research Analysis: First Look Results page 17, 22, 28.

Table 16: Average Usage on the Six CPP Event Days in Summer 2004

Program	Control Group (kWh)	Treatment Group (kWh)	Difference	% Difference	t-test	Pr> |t|	Statistical Significance of the Difference
TOU-CPP	4.98	4.37	0.61	12%	2.09	0.038	Significant.
TOU-CPP-Tech	5.36	3.49	1.87	35%	8.09	0.000	Significant.

Source: AmerenUE Residential TOU Pilot Study Load Research Analysis: First Look Results page C.

Second Year of the Pilot Program (2005)

During the second year of the AmerenUE Critical Peak Pricing Pilot, the first year rate design described earlier remained in effect (see Table 13).[9] Table 17 summarizes the usage impact on eight CPP days in summer 2005.

Table 17: Average Usage on the Eight CPP Event Days in Summer 2005

Program	Control Group (kWh)	Treatment Group (kWh)	Difference	% Difference	t-test	Pr> |t|	Statistical Significance of the Difference
TOU-CPP	5.56	4.84	0.72	13%	3.9	0.0001	Significant.
TOU-CPP-Tech	5.29	4.05	1.14	24%	6.05	0.0001	Significant.

Source: AmerenUE Critical Peak Pricing Pilot, page 10.

Table 18: Average Participant Use by Program and Pricing Time – 2005

Program	Jun 1- Aug 31 Period	Control Group (kWh)	Treatment Group (kWh)	Difference	t-test	Pr> |t|	Statistical Significance of the Difference
TOU-CPP	Off Peak	4495	4450	45	0.28	0.78	Not Significant.
TOU-CPP	Mid Peak	2054	2019	35	0.54	0.59	Not Significant.
TOU-CPP	On Peak	927	896	31	0.96	0.34	Not Significant.
TOU-CPP	CPP	252	219	33	3.92	0.00	Significant.
TOU-CPP-Tech	Off Peak	4147	4017	130	0.91	0.37	Not Significant.
TOU-CPP-Tech	Mid Peak	1934	1901	33	0.46	0.65	Not Significant.
TOU-CPP-Tech	On Peak	884	863	21	0.64	0.52	Not Significant.
TOU-CPP-Tech	CPP	240	182	58	5.99	0.00	Significant.

Source: AmerenUE Critical Peak Pricing Pilot, page 11.

The results from Table 17 and 18 show that:

- In 2005, the TOU-CPP rate induced customers to reduce usage during CPP periods.
- In 2005, the TOU-CPP-Tech rate induced customers to reduce usage during CPP periods.

Automated Demand Response System Pilot

California's Automated Demand Response System (ADRS) pilot program was initiated in 2004 and extended through 2005.[10] ADRS operated under a critical peak pricing tariff that was supported with a residential-scale, automated demand response technology. Participants in the pilot installed the GoodWatts system, an advanced home climate control system that allowed users to web-program their preferences for the control of home appliances. Under the CPP tariff, prices were higher during the peak period (2 p.m. to 7 p.m. on weekdays). All other hours, weekends and holidays were subject to the base rate. When the "super peak events" were called, peak price was three times higher than the regular peak price.

[9] Discussions of the 2005 results are based on Voytas, R., "AmerenUE Critical Peak Pricing Pilot," presented at Demand Response Resource Center Conference. 2006.

[10] Rocky Mountain Institute, "Automated Demand Response System Pilot." 2006.

The results from the pilot show that:

- Participants achieved substantial load reductions in both 2004 and 2005 compared to the control group.
- Load reductions on super peak event days were consistently about twice the load reductions during the peak periods on nonevent days.
- Technology appears to be the main driver of the load reductions, especially on super peak event days and for the high consumption customers.
- Part of the reduction is attributable to time-varying rates. However, the load reductions of the ADRS participants are consistently larger than those of the participants of other demand response programs without the technology.

Table 19 shows the impact estimates from the ADRS for high consumption customers.

Table 19: Peak Period Load Reductions for High Consumption Customers

	Event Days		Non-Event Days	
Program Year	**Average Reduction (kW)**	**% Reduction**	**Average Reduction (kW)**	**% Reduction**
2004	1.84	51%	0.86	32%
2005	1.42	43%	0.73	27%

Source: ADRS Study, Executive Summary, pages 6,11.

Impact Evaluation of the California Statewide Pricing Pilot

California's three investor-owned utilities, together with the state's two regulatory commissions, conducted the Statewide Pricing Pilot (SPP) that ran from July 2003 to December 2004 to test the impact of TOU pricing.[11] The SPP included about 2,500 participants consisting of residential and small-to-medium commercial and industrial (C&I) customers. SPP tested several rate structures:

- TOU-only rate where the peak price was twice the value of the off-peak price
- CPP rate where the peak price during the critical days was roughly five times greater than the off-peak price. The SPP tested two variations of the CPP rates.
  - The CPP-F rate had a fixed period of critical peak and day-ahead notification. CPP-F customers did not have an enabling technology.
  - The CPP-V rate had a variable length of peak duration during critical days and day-of notification. CPP-V customers had the choice of adopting an enabling technology.

The SPP utilized demand models to identify the impact of different rate and information structures on energy use. In addition to estimation of impacts associated with the average prices used in SPP, these demand models allowed estimation of the impacts from other potential prices. A demand system of two equations was estimated for each different rate structure. One of these equations estimates daily energy use while the

[11] Charles River Associates, "Impact Evaluation of the California Statewide Pricing Pilot." 2005.

other predicts the share of daily energy use by rate period. These equations are described in detail in Appendix H.

In this appendix, we review the residential customer impacts for the three rates: CPP-F, TOU, and CPP-V.

CPP-F Impacts

The average price for customers on the standard rate was about $0.13 per kWh. Under the CPP-F rate, the average peak-period price on critical days was roughly $0.59 per kWh, the peak price on non-critical days was $0.22 per kWh, and the average off-peak price was $0.09 per kWh.

- On critical days, statewide average reduction in peak-period energy use was estimated to be 13.1 percent. Impacts varied across climate zones from a low of -7.6 percent to a high of -15.8 percent.
- The average peak-period impact on critical days during the inner summer months (July- September) was estimated to be -14.4 percent while the same impact was -8.1 percent during the outer summer months (May, June, and October).
- On normal weekdays, the average impact was -4.7 percent, with a range across climate zones from -2.2 percent to -6.5 percent.
- No change in total energy use across the entire year was found based on the average SPP prices.
- The impact of different customer characteristics on energy use by rate period was also examined. CAC ownership and college education are the two customer characteristics that were associated with the largest reduction in energy use on critical days.

Table 20: Residential CPP-F Rate Impacts on Critical Days for Inner Summer Months (July, August, September) for All Customers

		Start Value (kWh/hr)	Impact (kWh/hr)	Estimate	t-stat	Impact (%)
		2003				
Rate Period	Peak	1.28	-0.163	#N/A	-20.94	-12.71
	Off-peak	0.8	0.021	#N/A	7.8	2.57
	Daily	0.9	-0.018	#N/A	-6.88	-1.95
Elasticity	Substitution	#N/A	#N/A	-0.086	-20.51	#N/A
	Daily	#N/A	#N/A	-0.032	-6.8	#N/A
		2004				
Rate Period	Peak	1.28	-0.178	#N/A	-18.49	-13.93
	Off-peak	0.8	0.01	#N/A	2.95	1.25
	Daily	0.9	-0.029	#N/A	-8.7	-3.24
Elasticity	Substitution	#N/A	#N/A	-0.087	-16.84	#N/A
	Daily	#N/A	#N/A	-0.054	-8.55	#N/A

Source: Impact Evaluation of the California Statewide Pricing Pilot, pages 51-52.
Notes:
[1] Estimations are based on average customer approach.
[2] All the numbers are based on average critical day weather in 2003/2004.

TOU Impacts

The average price for customers on the standard rate was about $0.13 per kWh. Under the TOU rate, the average peak-period price was roughly $0.22 per kWh and the average off-peak price was $ 0.09 per kWh.

- The reduction in peak period energy use during the inner summer months of 2003 was estimated to be -5.9 percent. However, this impact completely disappeared in 2004.
- Due to small sample problems in the estimation of TOU impacts, normal weekday elasticities from the CPP-F treatment may serve as better predictors of the impact of TOU rates on energy demand than the TOU price elasticity estimates.

Table 21: Residential TOU Rate Impacts for Inner Summer Months for All Customers

		Start Value (kWh/hr)	Impact (kWh/hr)	Estimate	t-stat	Impact (%)
		2003				
Rate Period	Peak	1.125	-0.063	#N/A	-11.08	-5.6
	Off-peak	0.744	0.011	#N/A	7.08	1.44
	Daily	0.823	-0.005	#N/A	-6.28	-0.57
	Weekend Daily	0.867	0.013	#N/A	4.46	1.45
Elasticity	Substitution	#N/A	#N/A	-0.099	-10.17	#N/A
	Daily	#N/A	#N/A	-0.117	-6.26	#N/A
	Weekend Daily	#N/A	#N/A	-0.066	-4.49	#N/A
		2004				
Rate Period	Peak	1.125	-0.007	#N/A	#N/A	-0.6
	Off-peak	0.744	-0.005	#N/A	#N/A	-0.65
	Daily	0.823	-0.005	#N/A	#N/A	-0.64
	Weekend Daily	0.867	0.005	#N/A	#N/A	0.61
Elasticity	Substitution	#N/A	#N/A	0.001	0.06	#N/A
	Daily	#N/A	#N/A	-0.132	-4.42	#N/A
	Weekend Daily	#N/A	#N/A	-0.028	-1.36	#N/A

Source: Impact Evaluation of the California Statewide Pricing Pilot, pages 92,95, and 96.
Notes:
[1] Estimations are based on average customer approach.

CPP-V Impacts

The average price for customers on the standard rate was about $0.14 per kWh. Under the CPP-V rate, the average peak-period price on critical days was roughly $0.65 per kWh and the average off-peak price was $0.10 per kWh. This rate schedule was tested on two different treatment groups. Track A customers were drawn from a population with energy use greater than 600 kWh per month. In this group, average income and CAC saturation was much higher than the general population. Track A customers were given a choice of installing an enabling technology and about two-thirds of them opted for the enabling technology. The Track C group was formed from customers who previously volunteered for a smart thermostat pilot. All Track C

customers had CAC and smart thermostats. Hence, two-thirds of Track A customers and all Track C customers had enabling technologies.

- As shown in Table 22, Track A customers reduced their peak-period energy use on critical days by about 16 percent (about 25 percent higher than the CPP-F rate impact).
- Track C customers reduced their peak-period use on critical days by about 27 percent.

Comparing the CPP-F and the CPP-V results suggests that usage impacts are significantly larger with an enabling technology than without it.

Table 22: Residential CPP-V Rate Impacts for Summer for All Customers

		Start Value (kWh/hr)	Impact (kWh/hr)	Estimate	t-stat	Impact (%)
Track A						
Rate Period	Peak	2.14	-0.3374	#N/A	-10.89	-15.76
	Off-peak	1.33	0.0445	#N/A	4.26	3.34
	Daily	1.46	-0.0187	#N/A	-1.71	-1.28
	Weekend Daily	1.3	0.0173	#N/A	2.72	1.33
Elasticity	Substitution	#N/A	#N/A	-0.111	-11.76	#N/A
	Daily	#N/A	#N/A	-0.027	-1.7	#N/A
	Weekend Daily	#N/A	#N/A	-0.043	-2.74	#N/A
Track C						
Rate Period	Peak	2.33	-0.635	#N/A	-35.03	-27.23
	Off-peak	1.26	0.044	#N/A	3.19	3.52
	Daily	1.43	-0.059	#N/A	-9.85	-4.17
	Weekend Daily	1.34	0.016	#N/A	4.1	1.2
Elasticity	Substitution	#N/A	#N/A	-0.077	-10.61	#N/A
	Technology Impact-Substitution	#N/A	#N/A	-0.214	-24.04	#N/A
	Daily	#N/A	#N/A	-0.044	-3.49	#N/A
	Technology Impact-Daily	#N/A	#N/A	-0.019	-3.49	#N/A
	Weekend Daily	#N/A	#N/A	-0.041	-4.12	#N/A

Source: Impact Evaluation of the California Statewide Pricing Pilot, pages 105,106,109, and 110.
Notes:
[1] Estimations are based on average customer approach.
[2] Track A analysis was conducted for Summer 2004.
[3] Track C analysis pools summers 2003 and 2004 and estimates a single model.

The Gulf Power Select Program

In 2000, Gulf Power started a unique demand response program that provides customers with three different service options as described below. [12]

- The standard residential service (RS) pricing option, which involves a standard flat rate with no time-varying rates
- A conventional TOU pricing option (RST), which is a two-period TOU tariff
- The Residential Service Variable Price (RSVP) pricing option, which is a three-period CPP tariff

Under the RSVP option, the energy company provides the price signals and customers modify their usage patterns through a combination of the price signals and advanced metering and appliance control. Gulf Power markets the RSVP option under the GoodCents Select program and charges the participants a monthly participation fee. By the end of 2001, approximately 2,300 homes were served by the RSVP.

Table 23 shows the rates under the Gulf Power demand response program.

Table 23: Residential Tariffs for Summer Months

Program	Period	Charge	Applicable
RS	Base	$0.057/kWh	All Hours
RST	Off-peak	$0.027/kWh	12 a.m.-12 p.m. and 9 p.m.-12 a.m.
RST	Peak	$0.104/kWh	12 p.m.- 9 p.m.
RSVP	Off-peak	$0.035/kWh	12 a.m.-6 a.m. and 11 p.m.-12 a.m.
RSVP	Mid-peak	$0.046 /kWh	6 a.m.-11 a.m. and 8 p.m.-11 p.m.
RSVP	Peak	$0.093/kWh	11 a.m.-8 p.m.
RSVP	CPP	$0.29/kWh	When called.

Source: Dynamic Pricing, Advanced Metering and Demand Response in Electricity Markets, Appendix B, page B-4.

Gulf Power reports the base coincident peak demand as 6.1 kW per household (hh). RSVP program performance results presented in Table 24 show that RSVP program participants reduce their demand by 2.75 kW per household during the critical peak period. This corresponds to a 41 percent reduction in energy usage during the critical peak period.

[12] Borenstein, S., M. Jaske, and A. Rosenfeld, "Dynamic Pricing, Advanced Metering and Demand Response in Electricity Markets." UCEI 2002.

Table 24: RSVP Program Performance by Period

Demand Reduction by Period	Performance
Average demand reduction (during peak period)	2.1 kW/hh
Average demand reduction (during critical peak period)	2.75 kW/hh
Average energy reduction (during peak period)	22%
Average energy reduction (during critical peak period)	41%

Source: Dynamic Pricing, Advanced Metering and Demand Response in Electricity Markets, Appendix B, page B-8.

Consistency of Residential Customer Response in Time-of-Use Electricity Pricing Experiments

This study compiles data from five residential TOU experiments conducted by Carolina Power & Light, Connecticut Light and Power, Los Angeles Department of Water and Power, Southern California Edison, and Wisconsin Public Service, and estimates a consumer demand model for each of these with a goal to test the hypothesis that the substitution elasticities are identical across experiments.[13] Results of the study provide support for this hypothesis, and therefore provide a general model for estimating the residential response to TOU pricing. Since all five experiments used in this study featured some form of mandatory participation, results cannot be generalized to voluntary TOU settings. Selected findings from the study are the following:

- The price differential between peak and off-peak usage is the primary factor that determines the degree of customer response.
- The roles played by appliance holdings, customer characteristics, and climate are discernible, but they do not affect the magnitude of customer response nearly as much as the price differential.
- The elasticity of substitution varies with appliance holdings, customer characteristics, and climate, but, after controlling for these factors, it does not vary across areas.
- The elasticity of substitution between weekdays and weekends is smaller than that between peak and off-peak periods on weekdays.
- The results show that TOU rates lead to a reduction in the overall electricity usage.
- The typical customer in the typical climate has a substitution elasticity of -0.14. Substitution elasticity estimates for different customer characteristics and climate zones are shown in Table 25.
- Estimation of the results for the system peak days revealed no different response on these days compared to an average weekday.

[13] Caves, D. W., L. R. Christensen, and J. A. Herriges. 1984. "Consistency of Residential Customer Response in Time-of-Use Electricity Pricing Experiments." Journal of Econometrics 26:179-203.

Table 25: Elasticity of Substitution Estimates for Summer Months (Peak to Off-Peak Usage)

Type of Climate	No Appliances	Typical Appliances	All Appliances	Typical Appliances except	
				No AC Ownership	AC Ownership
Cool	0.09	0.12	0.16	0.13	0.11
Typical	0.07	0.14	0.21	0.11	0.16
Hot	0.05	0.15	0.25	0.1	0.21

Source: Consistency of Residential Customer Response in Time-of-Use Electricity Pricing Experiments, page 198.

The Residential Demand for Electricity by Time of Use: A Survey of 12 Experiments with Peak Load Pricing

This study reviews the empirical evidence from 12 of 15 residential pricing experiments that were funded and managed by DOE during late 1970s.[14] Based on the review of the pricing experiments:

- TOU pricing generally reduces peak energy consumption. Off-peak consumption stays the same or rises slightly.
- TOU pricing generally reduces daily energy consumption. Explicit load shifting from peak to off-peak is rarely observed.
- Customer response on average weekdays and system peak days differs only slightly.
- High usage customers are more responsive to TOU rates than are low usage customers.
- Peak and off-peak own-price elasticities range from 0 to -0.4. In a given experiment, elasticities vary across customers due to variation in total usage, appliance portfolio, and other factors. Across the experiments, these elasticities vary due to rate differences, variation in climate conditions, etc.
- There is little difference between elasticity estimates derived from single equations or demand systems.

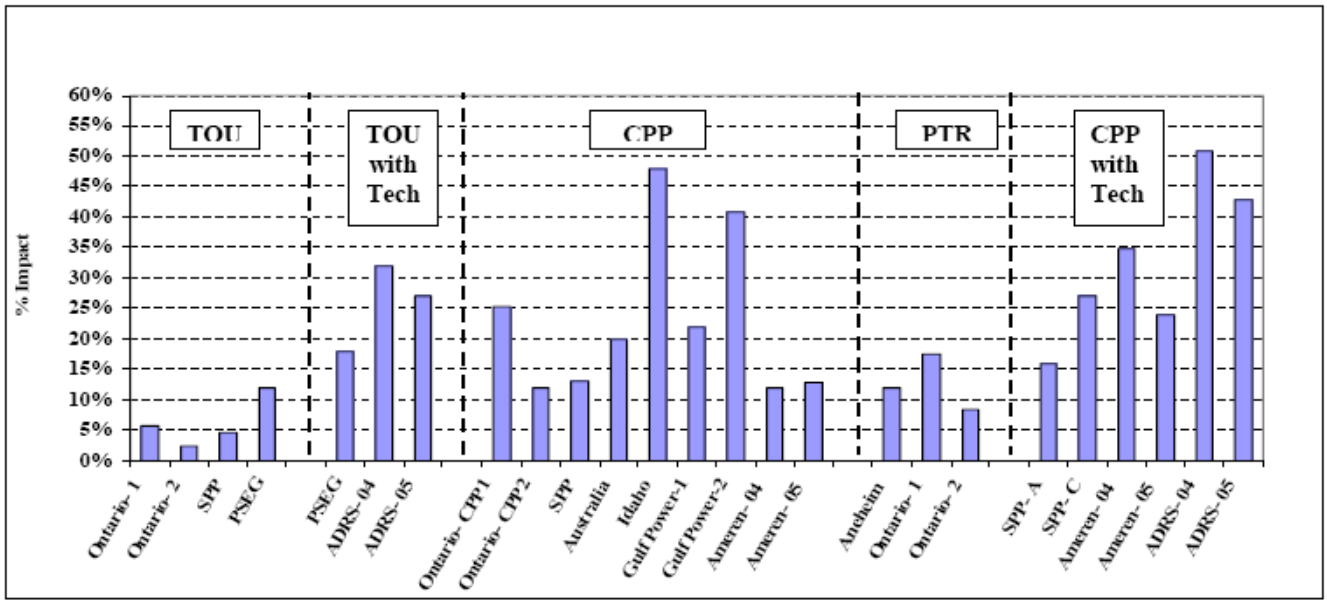
[14] Faruqui, A and J. R. Malko. 1983. "The Residential Demand for Electricity by Time-of-Use: A Survey of Twelve Experiments with Peak Load Pricing." Energy Vol. 8: 781-795.

SUMMARY EXHIBITS

Table E-1: CAC Saturations from the Studies Reviewed in Appendix E

Pilot	Program	CAC Saturation
PSEG	CPP	62%
	CPP w/ Tech	100%
Ontario	TOU, CPP, and PTR	85%
SPP	TOU, CPP-F, and CPP-V	Average= 38 % CAC= 100 % No-CAC= 0 %

Figure E-2: Estimates of Percentage Reduction in Load (*) from the Studies Reviewed in Appendix E



Notes:

*Percentage reduction in load is defined relative to the different bases in different pilots. The following notes are intended to clarify these different definitions. TOU impacts are defined relative to the usage during peak hours unless otherwise noted. CPP impacts are defined relative to the usage during peak hours on CPP days unless otherwise is noted.

1- Ontario-1 refer to the percentage impacts during the critical hours that represent only 3-4 hours of the entire peak period on a CPP day. Ontario-2 refer to the percentage impacts of the programs during the entire peak period on a CPP day.
2- TOU impact from the SPP study uses the CPP-F treatment effect for normal weekdays as recommended by the study.
3- PSEG programs are represented in the TOU section even though they are CPP programs. The reason is that there were only two CPP events during the entire pilot period and more importantly, percentage impacts were only provided for the peak period on non-CPP days.
4- ADRS-04 and ADRS-05 refer to the 2004 and 2005 impacts. ADRS impacts on nonevent days are represented in the TOU with Tech section.
5- CPP impact for Idaho is derived from the information provided in the study. Average of kW consumption per hour during the CPP hours (for all 10 event days) is approximately 2.5 kW for a control group customer. This value is 1.3kW for a treatment group customer. Percentage impact from the CPP treatment is calculated as 48 percent.
6- Gulf Power-1 refers to the impact during peak hours on non-CPP days while Gulf Power-2 refers to the impact during CPP hours on CPP days.
7- Ameren-04 and Ameren-05 refer to the impacts respectively from the summers of 2004 and 2005.
8- SPP-A refers to the impacts from the CPP-V program on Track A customers. Two-thirds of Track A customers had some form of enabling technologies.
9- SPP-C refers to the impacts from the CPP-V program on Track C customers. All Track C customers had smart thermostats.

Table E-3: Summary of the Tariffs from the Studies Reviewed in Appendix E

Study	Control Group Tariff	Applicable Hours	Treatment Group Tariff	Applicable Hours
PSEG	$0.092/kWh	All hours	**CPP/** Night: $0.042/kWh	10 p.m.-9a.m. daily.
			CPP/ Peak: $0.172/kWh	1p.m.-6p.m. weekdays.
			CPP/ CPP: $0.78/kWh	1p.m.-6p.m. weekdays when called.
Ontario	$0.058/kWh	Usage<= 600 kWh per month	**TOU/** Off-peak: $0.035/kWh	10 p.m.- 7 a.m. weekdays, all day on weekends and holidays.
	$0.067/kWh	Usage>600 kWh per month	**TOU/** Mid-peak: $0.075/kWh	7 a.m.- 11 a.m. and 5 p.m.- 10 p.m. weekdays.
			TOU/ On-peak: $0.105/kWh	11 a.m.- 5 p.m. weekdays.
			CPP/ same as TOU except that there is a CPP component set at $0.30/kWh and off-peak price is decreased to $0.031/kWh	CPP days when called, otherwise same as TOU.
			PTR/ same as TOU with PTR at $0.30/kWh for each kWh reduction from the baseline	CPP days when called, otherwise same as TOU.
Anaheim	$0.0675/kWh	Usage<=240kWh per month	**PTR/** Control group tariff	All hours except 12a.m.- 6p.m. on CPP days.
	$0.1102/kWh	Usage>240kWh per month	**PTR/** $0.35/kWh rebate for each kWh reduction from baseline	12a.m.- 6p.m. on CPP days.
AmerenUE	#N/A	#N/A	**TOU/** Off-peak: $0.048/kWh	10p.m.–10a.m. weekdays, all day on weekends.
			TOU/ Mid-peak: $0.075/kWh	10a.m.– 3p.m. and 7p.m.-10p.m. weekdays.
			TOU/ On-peak: $0.1831/kWh	3p.m. – 7p.m. weekdays.
			CPP/ same as TOU except that there is a CPP component set at $0.30/kWh and peak price is decreased to $0.1675 /kWh	CPP days when called, otherwise same as TOU.
SPP	$0.13/kWh.	All hours	**TOU/** Off-peak: $0.09/kWh	12a.m.- 2 p.m. and from 7 p.m. until 12a.m. weekdays, all day on weekends.
			TOU/ Peak: $0.22/kWh	2 p.m. to 7 p.m. weekdays.
			CPP-F/ Off-peak: $0.09/kWh	12a.m.- 2 p.m. and from 7 p.m. until 12a.m. weekdays, all day on weekends.
			CPP-F/ Peak: $0.22/kWh	2 p.m. to 7 p.m. weekdays.
			CPP-F/ CPP: $0.59/kWh	2 p.m. to 7 p.m. weekdays when called.
			CPP-V/ Off-peak: $0.10/kWh	12a.m.- 2 p.m. and from 7 p.m. until 12a.m. weekdays, all day on weekends.
			CPP-V/ Peak: $0.22/kWh	2 p.m. to 7 p.m. weekdays.
			CPP-V/ CPP: $0.65 /kWh	2 or 5 hours during 2 p.m. to 7 p.m., weekdays when called.
Idaho	$0.054/kWh	Usage<= 300 kWh per month	**TOU/** Off-peak: $0.045/kWh	9p.m. to 7a.m. weekdays, all day on weekends.
	$0.061/kWh	Usage>300 kWh per month	**TOU/** Mid-peak: $0.061 /kWh	7a.m. to 1p.m. weekdays.
			TOU/ On-peak: $ 0.083/kWh	1p.m. to 9p.m. weekdays.
			CPP/ Non-CPP hours: $0.054/kWh	All hours except CPP hours.
			CPP/ CPP: $0.20/kWh	5 p.m. to 9 p.m. on CPP days.
Gulf Power	$0.057/kWh	All hours	**RST/** Off-peak: $0.027/kWh	12 a.m.-12p.m. and 9p.m.-12a.m.
			RST/ Peak: $0.104/kWh	12p.m.- 9p.m.
			RSVP/ Off-peak: $0.035/kWh	12a.m.-6a.m. and 11p.m.-12a.m.
			RSVP/ Mid-peak: $0.046 /kWh	6a.m.-11a.m. and 8p.m.-11p.m.
			RSVP/ Peak: $0.093/kWh	11a.m.-8p.m.
			RSVP/ CPP: $0.29/kWh	Assigned hours on CPP days.

Table E-4: Summary of the Elasticities from the Studies Reviewed in Appendix E

Study	Program	Substitution Elasticity	Own Price Elasticity	Cross Price Elasticity
PSEG	CPP	-0.085	#N/A	#N/A
	CPP w/ Tech.	-0.137	#N/A	#N/A
Chicago	RTP	#N/A	-0.047 (overall)	#N/A
	RTP	#N/A	-0.069 (overall with AC cycling)	#N/A
	RTP	#N/A	-0.015 (daytime)	#N/A
	RTP	#N/A	-0.026 (late daytime/evening)	#N/A
	RTP	#N/A	-0.02 (daytime+high price notification)	#N/A
	RTP	#N/A	-0.048 (late daytime/evening+high price notification)	#N/A
Australia	TOU	#N/A	-0.30 to -0.38	-0.07 (peak to shoulder)
	TOU	#N/A	#N/A	-0.04 (peak to off-peak)
SPP	CPP-F	-0.087	-0.054 (daily)	#N/A
	CPP-V/ Track A	-0.111	-0.027 (daily)	#N/A
	CPP-V/ Track A	#N/A	-0.043 (weekend daily)	#N/A
	CPP-V/ Track C	-0.154 (*)	-0.044 (daily)	#N/A
	CPP-V/ Track C	#N/A	-0.041 (weekend daily)	#N/A
Faruqui &Malko (1983)	TOU	#N/A	0 to -0.4 (range for peak and off-peak)	#N/A
Caves et al. (1984)	TOU	-0.09 (cool+no appliances)	#N/A	#N/A
	TOU	-0.07 (typical+no appliances)	#N/A	#N/A
	TOU	-0.05 (hot+no appliances)	#N/A	#N/A
	TOU	-0.12 (cool+typical appliances)	#N/A	#N/A
	TOU	-0.14 (typical+typical appliances)	#N/A	#N/A
	TOU	-0.15 (hot+typical appliances)	#N/A	#N/A
	TOU	-0.16 (cool+all appliances)	#N/A	#N/A
	TOU	-0.21 (typical+all appliances)	#N/A	#N/A
	TOU	-0.25 (hot+all appliances)	#N/A	#N/A

Note:
(*) Elasticity of substitution for CPP-Track C customers is estimated to be -0.077 and excludes the impact of technology (-0.214).
We calculated substitution elasticity including the impact of technology as -0.154 through simulation.

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