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Impact Evaluation of BGE's SEP 2009 Pilot (Residential Class- Persistence Analysis)

Presented to:
Baltimore Gas and Electric Company

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Outline

1. **Executive Summary**

2. **Background**

3. **Period-Specific Impact Analysis**

4. **Hour-Specific Impact Analysis**

5. **Appendix**

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Executive Summary

BGE repeated its Smart Energy Pricing (SEP) Program for the second time in the Summer of 2009

- ♦ Treatment period covered June-September 2009 whereas pre-treatment period covered March-May 2009

- ♦ Twelve event days were called in June-August, and none in September. For that reason, we do not use the September data in our analysis

- ♦ Final residential sample as of August 2009 consisted of 912 customers of which 734 were treatment and 178 were control

1. **When prices are tested in conjunction with enabling technologies, what is the *incremental impact of pricing* over and above technology impacts?**

2. **When price responsiveness of customers is compared between this summer and last summer, is there a persistence in customers' price responsiveness?**

This presentation answers the second question

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Estimation results show that there is persistence in customers' price responsiveness

Substitution Elasticity Comparison: SEP 2008 vs SEP 2009

Elasticity	SEP 2008 (thi_diff= 6.65)	SEP 2009 (thi_diff= 5.25)	SEP 2009 (thi_diff= 6.65)
Price only	-0.096	-0.121	-0.153
Price+ORB	-0.136	-0.152	-0.193
Price+ORB+TECH	-0.180	-0.184	-0.233

Daily Elasticity Comparison: SEP 2008 vs SEP 2009

Elasticity	SEP 2008 (ln_thi= 4.31)	SEP 2009 (ln_thi= 4.31)
Daily	-0.039	-0.039

♦ Comparison of SEP 2008 and SEP 2009 substitution elasticities reveal that 2009 elasticities are higher although average CPP day weather measured by the THI_DIFF variable is lower in 2009
- When we calculate SEP 2009 elasticities using the 2008 THI_DIFF value, we obtain higher elasticities compared to the SEP 2008 elasticities

♦ Comparison of SEP 2008 and SEP 2009 daily elasticities reveal that the daily elasticity takes the same value for both years
- There are two reasons for this: (1) we have seen that daily price responsiveness parameter did not change between 2008 and 2009 (2) weather variable (ln_thi) takes the same value for both years

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Demand Response Impacts

Event Days - Peak (% of original consumption)

	PTR	PTR_ORB	PTR_ORB_ET
Impact averaged over peak period based on average event day weather	-22.6%	-26.9%	-31.0%
Impact based on Hour 17 and WTHI of 83	-28.0%	-33.3%	-37.5%

Event Days - Peak (kWh/hr load reduction)

	Base Load	PTR	PTR_ORB	PTR_ORB_ET
Impact averaged over peak period based on average event day weather	2.41	0.55	0.65	0.75
Impact based on Hour 17 and WTHI of 83	3.05	0.85	1.02	1.14

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Summary of Impacts

♦ Average impact reaches 22.6% for the average peak period and 28% for hour 17 and WTHI of 83 degrees, when there is no technology involved

♦ Average impact reaches 26.9% for the average peak period and 33.3% for hour 17 and WTHI of 83 degrees, when price and orb are activated together

♦ Average impact reaches 31.0% for the average peak period and 37.5% for hour 17 and WTHI of 83 degrees, when price, orb and A/C switch are activated together

♦ Total monthly consumption decreases by 0.8% across all programs

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♦ Final residential sample as of August 2009 consisted of 912 customers of which 734 were treatment and 178 were control group customers

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SEP 2009 tested PTR in conjunction with several technology options. The effectiveness of the technologies were tested by enabling certain customers with one of these technology options and comparing their load profiles with those of other customers who did not have these enabling technologies

Treatment customers in the SEP 2009 can be segregated into four large groups:

- PTR only
- PTR + TECH ("A and B customers")
- PTR + ORB
- PTR + ORB + TECH

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1. **What is the incremental impact of pricing over and above technology impacts?**

2. **Is there a persistence in customers' price responsiveness?**

In this presentation, we will try to answer the second question by analyzing non- A&B customers who participated in both SEP 2008 and SEP 2009 pilots

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Substitution elasticity measures the change in load shape caused by changing peak-to-off peak prices

♦ Percent change in the ratio of peak to off-peak consumption when there is one percent change in the ratio of peak to off-peak prices

Daily (price) elasticity measures the change in daily energy consumption caused by changing daily prices

♦ Percent change in the daily average consumption when there is one percent change in the daily average price

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We estimated a pooled model combining SEP 2008 and SEP 2009 data

In order to address the persistence question, we combined 2008 and 2009 SEP data together and estimated a pooled regression

- ♦ We created a dummy variable for 2009 and interacted it with all variables of the model. When these variables are used together with the un-interacted variables, they capture the difference between the SEP 2008 and SEP 2009 coefficients

- ♦ We restricted the sample to the customers who participated in both SEP 2008 and SEP 2009 pilots

- ♦ All 657 non-A&B customers in the SEP 2009 pilot were also the participants of the SEP 2008 pilot

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Substitution Equation

Dependent Variable: ln (peak_kwh/offpeak_kwh)

VARIABLES	Excludes A&B Apr-2008/2009 RESID, Average CPP Days
ln_price_ratioxthi_diff	-0.017**
	(0.000)
ln_price_ratioxthi_diffx2009	-0.006**
	(0.006)
ln_price_ratioxORBxthi_diff	-0.006**
	(0.008)
ln_price_ratioxORBxthi_diffx09	-0.002
	(0.603)
ln_price_ratioxORB_TECHxthi_diff	-0.012**
	(0.000)
ln_price_ratioxORB_TECHxthi_diffx09	0.002
Observations	294303
R-squared	0.114
Number of customerid	838

Robust p-values in parentheses
** p<0.01, * p<0.05

Daily Equation

Dependent Variable: ln (average_daily_consumption)

VARIABLES	Excludes A&B Apr-2008/2009 RESID, Average CPP Days
ln_pricexln_thi	-0.009**
	(0.000)
ln_pricexln_thix2009	-0.004
Observations	293973
R-squared	0.101
Number of customerid	838
Rho	0.652

Robust p-values in parentheses
** p<0.01, * p<0.05

Full estimation results can be found in the Appendix

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Estimation results show that there is persistence in customers' price responsiveness

♦ **Substitution equation shows that:**

- Price_only customers have become more price responsive in 2009 compared to 2008

- Incremental responsiveness that can be attributed to ORB and ORB+TECH have not changed between 2008 and 2009

- Overall responsiveness of price+ORB and price+ORB+TECH customers have also increased between 2008 and 2009

♦ **Daily equation shows that:**

- Customers daily price responsiveness have not changed between 2008 and 2009

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Since the elasticity terms are weather dependent, we need to evaluate them at the average CPP day weather condition

Summary Statistics of Weather Terms for CPP days

ID	CPP Date	Minimum THI	Average THI	Maximum THI	Average Peak THI	Average OffPeak THI	THI_DIFF	Minimum Drybulb	Average Drybulb	Maximum Drybulb
CPP Day 1	6/26/2009	68.8	73.8	79.7	78.7	72.6	6.1	70	78.4	89
CPP Day 2	7/7/2009	64.7	70.8	76.9	75.5	69.5	6.0	64	76.4	88
CPP Day 3	7/16/2009	68.8	75.1	81.3	80.4	73.7	6.8	71	81.9	93
CPP Day 4	7/17/2009	69.6	73.2	76.7	74.1	72.9	1.2	70	77.2	85
CPP Day 5	7/28/2009	69.8	74.2	79.4	77.9	73.3	4.6	70	77.5	87
CPP Day 6	7/30/2009	69.6	74.2	78.0	77.4	73.4	4.0	70	78.3	86
CPP Day 7	8/4/2009	67.4	73.8	79.2	78.6	72.5	6.1	67	77.7	88
CPP Day 8	8/10/2009	69.8	76.7	83.2	82.1	75.3	6.8	71	82.5	94
CPP Day 9	8/11/2009	69.8	75.1	79.9	79.5	74.0	5.5	70	79.3	88
CPP Day 10	8/18/2009	70.0	74.6	82.7	79.2	73.4	5.8	71	78.7	92
CPP Day 11	8/19/2009	71.5	75.3	78.9	78.4	74.5	3.9	72	78.9	85
CPP Day 12	8/26/2009	68.5	73.8	79.3	78.8	72.5	6.3	69	78.2	88
Average (CPP1-CPP12)	-	-	**74.21**	-	-	-	**5.25**	-	**78.75**	-

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SEP 2009- Substitution & Daily Elasticities

	PTR PROGRAMS		
VARIABLES	**Parameter Estimate**	**Evaluated at thi_diff= 5.25**	**Interpretation**
ln_price_ratioxthi_diff	-0.023** (0.000)	**-0.121**	1% increase in the peak/offpeak price ratio leads to 0.121% change in the peak/offpeak quantity ratio *when there is no technology involved*
ln_price_ratioxORBxthi_diff	-0.029** (0.000)	**-0.152**	1% increase in the peak/offpeak price ratio leads to 0.152% change in the peak/offpeak quantity ratio *when price and orb are activated together*
ln_price_ratioxORB_TECHxthi_diff	-0.035** (0.000)	**-0.184**	1% increase in the peak/offpeak price ratio leads to 0.184% decrease in the peak/offpeak quantity ratio *when price, orb and technology are activated together*

	PTR PROGRAMS		
VARIABLES	**Parameter Estimate**	**Evaluated at thi_diff= 4.31**	**Interpretation**
ln_pricexln_thi	-0.009** (0.000)	**-0.039**	1% increase in the average daily price leads to 0.039% decrease in the average daily quantity

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Comparison of Elasticities: SEP 2008 vs. SEP 2009

Substitution Elasticity Comparison: SEP 2008 vs SEP 2009

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Price only	-0.096	-0.121	-0.153
Price+ORB	-0.136	-0.152	-0.193
Price+ORB+TECH	-0.180	-0.184	-0.233

Daily Elasticity Comparison: SEP 2008 vs SEP 2009

Elasticity	SEP 2008 (ln_thi= 4.31)	SEP 2009 (ln_thi= 4.31)
Daily	-0.039	-0.039

♦ Comparison of SEP 2008 and SEP 2009 substitution elasticities reveal that 2009 elasticities are higher although average CPP day weather measured by the THI_DIFF variable is lower in 2009

- When we calculate SEP 2009 elasticities using the 2008 THI_DIFF value, we obtain much higher elasticities compared to the SEP 2008 elasticities

♦ Comparison of SEP 2008 and SEP 2009 daily elasticities reveal that the daily elasticity takes the same value for both years

- There are two reasons for this: (1) we have seen that customers' daily price responsiveness did not change between 2008 and 2009 (2) weather variable (ln_thi) takes the same value for both years

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Similar to the methodology followed in SEP 2008, we update PRISM model to reflect BGE customer characteristics

♦ **We generate BGE PRISM.2009 by updating for the following:**

- Program cells tested in SEP 2009
- Price level tested in SEP 2009
- Typical residential customer load characteristics in 2009
- Price elasticities based on SEP 2009

♦ **SEP 2009 tested only one price level**

- On average (June-August), control customers as well as treatment customers on non-event hours paid an all-in rate of $0.164/kWh. During the event hours, treatment customers effectively paid an all-in price of $1.664 ($0.164+$1.50) for each kWh consumption

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We use average 2009 load profile for R and RH customers weighted by their share in the population to obtain average consumption by day-type and period

Typical Residential Customer Load (kWh/hr)

	Event Days		Non-Event Days	
	Peak	Off-Peak	Peak	Off-Peak
Average Customer	2.41	1.58	1.47	1.34

Demand Response Impacts Non A & B Customers (Period-Specific Impacts)

	PTR	PTR_ORB	PTR_ORB_ET
Critical Days - Peak (% of original consumption)	**-22.6%**	**-26.9%**	**-31.0%**
Critical Days - Off-Peak (% of original consumption)	2.3%	4.0%	5.6%
Non-Critical Days - Peak (% of original consumption)	0.0%	0.0%	0.0%
Non-Critical Days - Off-Peak (% of original consumption)	0.0%	0.0%	0.0%
Total Change in Consumption (%/month)	**-0.8%**	**-0.8%**	**-0.8%**

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Summary of Period-Specific Impacts

♦ Customers without enabling technology reduced their peak demand by 22.6%

♦ Customers with an ORB reduced their peak demand by 26.9%

♦ Customers with an ORB and an enabling technology (A/C switch or thermostat) reduced their peak demand by 31.0%

♦ Total monthly consumption decreased by 0.8% as a result of the programs

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Hour-Specific Impact Estimation

In the previous section, we estimated *period-specific* substitution elasticities that represent the rate of average load shifting behavior between peak and off-peak periods based on the ratio of average peak to off-peak prices

Similar to our impact evaluation of the SEP 2008, we also estimate another set of substitution elasticities that are *hour-specific*

♦ We estimated a separate substitution equation for each hour between hours 15 through 19 as well as two hours prior to the event and one hour after the event, that controls for the same parameters used to estimate the period-specific substitution elasticities

We will employ hour-specific elasticities to generate impacts that vary by hour and WTHI

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Full estimation results can be found in the appendix

VARIABLES	Excludes A&B Apr-2008/2009 Hour 13	Excludes A&B Apr-2008/2009 Hour 14	Excludes A&B Apr-2008/2009 Hour 15	Excludes A&B Apr-2008/2009 Hour 16	Excludes A&B Apr-2008/2009 Hour 17	Excludes A&B Apr-2008/2009 Hour 18	Excludes A&B Apr-2008/2009 Hour 19	Excludes A&B Apr-2008/2009 Hour 20
ln_price_ratioxthi_diff	-0.028**	-0.019**	-0.017**	-0.019**	-0.018**	-0.017**	-0.015**	-0.016**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln_price_ratioxthi_diffx2009	-0.021*	0.013	-0.003	-0.005*	-0.005*	-0.006*	-0.009**	-0.015**
	(0.022)	(0.132)	(0.131)	(0.029)	(0.034)	(0.016)	(0.000)	(0.001)
ln_price_ratioxORBxthi_diff	-0.013	-0.010	-0.006*	-0.006*	-0.006*	-0.007*	-0.007**	-0.009*
	(0.056)	(0.190)	(0.012)	(0.011)	(0.013)	(0.011)	(0.006)	(0.010)
ln_price_ratioxORBxthi_diffx09	-0.003	0.029*	-0.002	-0.001	-0.001	-0.000	-0.002	-0.005
	(0.823)	(0.026)	(0.568)	(0.744)	(0.819)	(0.976)	(0.611)	(0.515)
ln_price_ratioxORB_TECHxthi_diff	-0.028**	-0.017*	-0.011**	-0.011**	-0.011**	-0.011**	-0.011**	-0.025**
	(0.000)	(0.015)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln_price_ratioxORB_TECHxthi_diffx09	0.010	0.039**	0.000	0.002	0.004	0.004	0.003	-0.000
	(0.338)	(0.924)	(0.396)	(0.832)	(0.776)	(0.716)	(0.028)	(0.429)
Constant	0.287**	0.160	-0.393**	-0.176	0.009	0.154	0.322	0.061
	(0.000)	(0.281)	(0.009)	(0.478)	(0.937)	(0.234)	(0.091)	(0.369)
Observations	293967	294048	294104	294084	294028	294041	294005	293956
R-squared	0.019	0.020	0.097	0.100	0.089	0.071	0.054	0.035
Number of customerid	838	838	838	838	838	838	838	838

Robust p-values in parentheses
** $p<0.01$, * $p<0.05$

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We estimated hour by hour regressions between load and WTHI on 12 CPP days for hours 13 through 20

- We use the average 2009 load profile for R and RH customers weighted by their share in the population to estimate the equations

	REGRESSION OUTPUT					
VARIABLES	WTHI	s.e.	Constant	s.e.	Observations	R-squared
Hour 13	0.112**	(0.023)	-6.764**	(1.784)	12	0.705
Hour 14	0.125**	(0.013)	-7.689**	(1.047)	12	0.897
Hour 15	0.170**	(0.018)	-11.149**	(1.435)	12	0.897
Hour 16	0.146**	(0.029)	-9.107**	(2.267)	12	0.718
Hour 17	0.138**	(0.028)	-8.404**	(2.221)	12	0.705
Hour 18	0.146**	(0.018)	-8.841**	(1.425)	12	0.865
Hour 19	0.120**	(0.031)	-6.685*	(2.351)	12	0.606
Hour 20	0.123**	(0.031)	-6.950*	(2.352)	12	0.614

** $p < 0.01$

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Estimated Base Load Values (kWh/hour) before Demand Response

Hour Ending	BASE LOAD WTHI													
	85.5	85.0	84.5	84.0	83.5	83.0	82.5	82.0	81.5	81.0	80.5	80.0	79.5	79.0
Hour 13	2.81	2.76	2.70	2.64	2.59	2.53	2.48	2.42	2.36	2.31	2.25	2.20	2.14	2.08
Hour 14	3.00	2.94	2.87	2.81	2.75	2.69	2.62	2.56	2.50	2.44	2.37	2.31	2.25	2.19
Hour 15	3.40	3.31	3.23	3.14	3.06	2.97	2.89	2.80	2.72	2.63	2.55	2.46	2.38	2.29
Hour 16	3.38	3.30	3.23	3.16	3.08	3.01	2.94	2.87	2.79	2.72	2.65	2.57	2.50	2.43
Hour 17	3.40	3.33	3.26	3.19	3.12	3.05	2.98	2.91	2.84	2.77	2.71	2.64	2.57	2.50
Hour 18	3.64	3.57	3.50	3.42	3.35	3.28	3.20	3.13	3.06	2.99	2.91	2.84	2.77	2.69
Hour 19	3.58	3.52	3.46	3.40	3.34	3.28	3.22	3.16	3.10	3.04	2.98	2.92	2.86	2.80
Hour 20	3.57	3.51	3.44	3.38	3.32	3.26	3.20	3.14	3.07	3.01	2.95	2.89	2.83	2.77

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PTR (Rebate level : $1.5 /kWh)

PTR	% IMPACT													
Hour Ending	**THI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	8.7%	8.7%	8.7%	8.8%	8.8%	8.8%	8.9%	8.9%	8.9%	9.0%	9.0%	9.0%	9.1%	9.1%
Hour 14	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%	1.1%
Hour 15	-29.2%	-28.5%	-27.7%	-26.9%	-26.1%	-25.3%	-24.5%	-23.7%	-22.9%	-22.1%	-21.2%	-20.4%	-19.5%	-18.7%
Hour 16	-34.1%	-33.3%	-32.5%	-31.7%	-31.0%	-30.2%	-29.4%	-28.6%	-27.7%	-26.9%	-26.1%	-25.3%	-24.4%	-23.6%
Hour 17	-31.3%	-30.7%	-30.0%	-29.3%	-28.7%	-28.0%	-27.3%	-26.6%	-25.9%	-25.2%	-24.5%	-23.8%	-23.1%	-22.4%
Hour 18	-32.0%	-31.4%	-30.8%	-30.2%	-29.6%	-29.0%	-28.3%	-27.7%	-27.1%	-26.5%	-25.8%	-25.2%	-24.6%	-23.9%
Hour 19	-32.4%	-31.9%	-31.4%	-30.9%	-30.4%	-29.8%	-29.3%	-28.8%	-28.3%	-27.7%	-27.2%	-26.7%	-26.1%	-25.6%
Hour 20	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.5%	4.5%

PTR	LOAD REDUCTION (kWh/Hour)													
Hour Ending	**WTHI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	-0.24	-0.24	-0.24	-0.23	-0.23	-0.22	-0.22	-0.22	-0.21	-0.21	-0.20	-0.20	-0.19	-0.19
Hour 14	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02
Hour 15	0.99	0.94	0.89	0.84	0.80	0.75	0.71	0.66	0.62	0.58	0.54	0.50	0.46	0.43
Hour 16	1.15	1.10	1.05	1.00	0.95	0.91	0.86	0.82	0.77	0.73	0.69	0.65	0.61	0.57
Hour 17	1.06	1.02	0.98	0.94	0.89	0.85	0.81	0.77	0.74	0.70	0.66	0.63	0.59	0.56
Hour 18	1.16	1.12	1.08	1.03	0.99	0.95	0.91	0.87	0.83	0.79	0.75	0.72	0.68	0.64
Hour 19	1.16	1.12	1.08	1.05	1.01	0.98	0.94	0.91	0.88	0.84	0.81	0.78	0.75	0.72
Hour 20	-0.15	-0.15	-0.15	-0.15	-0.14	-0.14	-0.14	-0.14	-0.14	-0.13	-0.13	-0.13	-0.13	-0.12

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PTR_ORB (Rebate level : $1.5 /kWh)

PTR_ORB	% IMPACT													
Hour Ending	**THI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	8.7%	8.7%	8.7%	8.8%	8.8%	8.8%	8.9%	8.9%	8.9%	9.0%	9.0%	9.0%	9.1%	9.1%
Hour 14	-8.1%	-8.1%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.2%	-8.3%
Hour 15	-36.7%	-35.7%	-34.7%	-33.7%	-32.7%	-31.7%	-30.7%	-29.7%	-28.6%	-27.6%	-26.5%	-25.4%	-24.3%	-23.2%
Hour 16	-40.2%	-39.3%	-38.4%	-37.5%	-36.6%	-35.7%	-34.7%	-33.8%	-32.8%	-31.8%	-30.8%	-29.8%	-28.8%	-27.8%
Hour 17	-37.3%	-36.5%	-35.7%	-34.9%	-34.1%	-33.3%	-32.5%	-31.7%	-30.8%	-30.0%	-29.1%	-28.3%	-27.4%	-26.5%
Hour 18	-39.0%	-38.3%	-37.6%	-36.8%	-36.1%	-35.3%	-34.6%	-33.8%	-33.1%	-32.3%	-31.5%	-30.7%	-30.0%	-29.2%
Hour 19	-39.2%	-38.6%	-38.0%	-37.4%	-36.8%	-36.2%	-35.5%	-34.9%	-34.3%	-33.6%	-33.0%	-32.3%	-31.7%	-31.0%
Hour 20	6.6%	6.6%	6.6%	6.7%	6.7%	6.7%	6.7%	6.7%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%

PTR_ORB	LOAD REDUCTION (kWh/Hour)													
Hour Ending	**WTHI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	-0.24	-0.24	-0.24	-0.23	-0.23	-0.22	-0.22	-0.22	-0.21	-0.21	-0.20	-0.20	-0.19	-0.19
Hour 14	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.19	0.19	0.18
Hour 15	1.25	1.18	1.12	1.06	1.00	0.94	0.89	0.83	0.78	0.73	0.67	0.63	0.58	0.53
Hour 16	1.36	1.30	1.24	1.18	1.13	1.07	1.02	0.97	0.92	0.87	0.82	0.77	0.72	0.68
Hour 17	1.27	1.21	1.16	1.11	1.06	1.02	0.97	0.92	0.88	0.83	0.79	0.75	0.70	0.66
Hour 18	1.42	1.37	1.31	1.26	1.21	1.16	1.11	1.06	1.01	0.96	0.92	0.87	0.83	0.79
Hour 19	1.40	1.36	1.31	1.27	1.23	1.18	1.14	1.10	1.06	1.02	0.98	0.94	0.90	0.87
Hour 20	-0.24	-0.23	-0.23	-0.23	-0.22	-0.22	-0.21	-0.21	-0.21	-0.20	-0.20	-0.20	-0.19	-0.19

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PTR_ORB_ET (Rebate level : $1.5 /kWh)

PTR_ORB_ET	% IMPACT													
Hour Ending	**THI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	14.6%	14.6%	14.6%	14.7%	14.7%	14.8%	14.8%	14.9%	14.9%	15.0%	15.0%	15.0%	15.1%	15.1%
Hour 14	-5.8%	-5.8%	-5.8%	-5.8%	-5.8%	-5.8%	-5.8%	-5.8%	-5.8%	-5.9%	-5.9%	-5.9%	-5.9%	-5.9%
Hour 15	-42.4%	-41.3%	-40.2%	-39.1%	-37.9%	-36.8%	-35.6%	-34.4%	-33.2%	-32.0%	-30.7%	-29.5%	-28.2%	-26.9%
Hour 16	-45.0%	-44.0%	-43.0%	-42.0%	-41.0%	-40.0%	-38.9%	-37.9%	-36.8%	-35.7%	-34.6%	-33.5%	-32.4%	-31.2%
Hour 17	-41.9%	-41.0%	-40.2%	-39.3%	-38.4%	-37.5%	-36.6%	-35.7%	-34.7%	-33.8%	-32.8%	-31.9%	-30.9%	-29.9%
Hour 18	-42.8%	-42.0%	-41.2%	-40.4%	-39.6%	-38.8%	-38.0%	-37.2%	-36.3%	-35.5%	-34.6%	-33.8%	-32.9%	-32.0%
Hour 19	-42.9%	-42.2%	-41.6%	-40.9%	-40.2%	-39.6%	-38.9%	-38.2%	-37.5%	-36.8%	-36.1%	-35.4%	-34.7%	-34.0%
Hour 20	10.4%	10.4%	10.5%	10.5%	10.5%	10.5%	10.5%	10.6%	10.6%	10.6%	10.6%	10.7%	10.7%	10.7%

PTR_ORB_ET	LOAD REDUCTION (kWh/Hour)													
Hour Ending	**WTHI**													
	85.5	**85.0**	**84.5**	**84.0**	**83.5**	**83.0**	**82.5**	**82.0**	**81.5**	**81.0**	**80.5**	**80.0**	**79.5**	**79.0**
Hour 13	-0.41	-0.40	-0.40	-0.39	-0.38	-0.37	-0.37	-0.36	-0.35	-0.35	-0.34	-0.33	-0.32	-0.32
Hour 14	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13
Hour 15	1.44	1.37	1.30	1.23	1.16	1.09	1.03	0.96	0.90	0.84	0.78	0.72	0.67	0.62
Hour 16	1.52	1.45	1.39	1.33	1.26	1.20	1.14	1.09	1.03	0.97	0.92	0.86	0.81	0.76
Hour 17	1.42	1.37	1.31	1.25	1.20	1.14	1.09	1.04	0.99	0.94	0.89	0.84	0.79	0.75
Hour 18	1.56	1.50	1.44	1.38	1.33	1.27	1.22	1.16	1.11	1.06	1.01	0.96	0.91	0.86
Hour 19	1.53	1.48	1.44	1.39	1.34	1.30	1.25	1.21	1.16	1.12	1.07	1.03	0.99	0.95
Hour 20	-0.37	-0.37	-0.36	-0.35	-0.35	-0.34	-0.34	-0.33	-0.33	-0.32	-0.31	-0.31	-0.30	-0.30

Summary of the Hour-Specific Impacts

♦ Customers without enabling technology reduced their peak demand by 28.0% for hour 17 and WTHI of 83, which corresponds to 0.85 kWh/hr load reduction

♦ Customers with an ORB reduced their peak demand by 33.3%, which corresponds to 1.02 kWh/hr load reduction

♦ Customers with an ORB and enabling technology (A/C switch/thermostat) reduced their peak demand by 37.5%, which corresponds to 1.14 kWh/hr load reduction

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Outline

1. Executive Summary
2. Background
3. Period-Specific Impact Analysis
4. Hour-Specific Impact Analysis
5. **Appendix**

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Substitution Equations (Period-Specific)

VARIABLES	Excludes A&B Apr-2008/2009 RESID, Average CPP Days
thi_diff	–0.024**
	(0.000)
thi_diffxapril	0.013**
	(0.000)
thi_diffxaprilx09	–0.000
	(0.974)
thi_diffxmay	0.020**
	(0.000)
thi_diffxmayx09	0.006**
	(0.000)
thi_diffxjune	0.049**
	(0.000)
thi_diffxjunex09	–0.001
	(0.790)
thi_diffxjuly	0.060**
	(0.000)
thi_diffxjulyx09	–0.012**
	(0.000)
thi_diffxaug	0.065**
	(0.000)
thi_diffxaugx09	–0.001
	(0.662)
thi_diffxsep	0.041**
	(0.000)
TreatPeriod	
TreatPeriodx09	0.115*
	(0.035)
TreatCustomer	0.000
	(.)
TreatCustomerx09	–0.002
	(0.896)
TreatCustomerxTreatPeriod	–0.048**
	(0.009)
TreatCustomerxTreatPeriodx09	–0.002
	(0.891)
ln_price_ratioxthi_diff	–0.017**
	(0.000)
ln_price_ratioxthi_diffx2009	–0.006**
	(0.006)
ln_price_ratioxORBxthi_diff	–0.006**
	(0.008)
ln_price_ratioxORBxthi_diffx09	–0.002
	(0.603)
ln_price_ratioxORB_TECHxthi_diff	–0.012**
	(0.000)
ln_price_ratioxORB_TECHxthi_diffx09	0.002
	(0.210)
Constant	0.045
	(0.417)
Observations	294303
R-squared	0.114
Number of customerid	838

Robust p-values in parentheses
** p<0.01, * p<0.05

Note: Other variables are also controlled for but suppressed here due to limited space.

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VARIABLES	Excludes A&B Apr-2008/2009 Hour 13	Excludes A&B Apr-2008/2009 Hour 14	Excludes A&B Apr-2008/2009 Hour 15	Excludes A&B Apr-2008/2009 Hour 16	Excludes A&B Apr-2008/2009 Hour 17	Excludes A&B Apr-2008/2009 Hour 18	Excludes A&B Apr-2008/2009 Hour 19	Excludes A&B Apr-2008/2009 Hour 20
thi_diff	-0.013**	-0.013**	-0.027**	-0.027**	-0.023**	-0.023**	-0.021**	-0.007**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
thi_diffxapril	0.002	0.003	0.027**	0.024**	0.017**	0.009**	0.002	0.024**
	(0.598)	(0.499)	(0.000)	(0.000)	(0.000)	(0.000)	(0.289)	(0.000)
thi_diffxaprilx09	-0.006	-0.008	-0.006**	-0.005**	-0.003	0.001	0.004*	-0.034**
	(0.113)	(0.051)	(0.003)	(0.004)	(0.122)	(0.511)	(0.045)	(0.000)
thi_diffxmay	0.017**	0.017**	0.024**	0.026**	0.020**	0.020**	0.016**	0.009**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
thi_diffxmayx09	0.000	0.008*	0.011**	0.009**	0.007**	0.006**	0.005**	0.017**
	(0.960)	(0.017)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
thi_diffxjune	0.044**	0.045**	0.058**	0.055**	0.047**	0.042**	0.044**	0.041**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
thi_diffxjunex09	-0.017**	-0.012**	-0.004	-0.003	0.002	0.002	-0.006**	-0.019**
	(0.000)	(0.000)	(0.139)	(0.306)	(0.484)	(0.302)	(0.003)	(0.000)
thi_diffxjuly	0.050**	0.045**	0.054**	0.068**	0.058**	0.065**	0.062**	0.019**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
thi_diffxjulyx09	0.006	0.006	-0.015**	-0.032**	-0.013**	-0.013**	-0.016**	-0.003
	(0.103)	(0.255)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.608)
thi_diffxaug	0.045**	0.041**	0.062**	0.072**	0.071**	0.063**	0.051**	0.033**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
thi_diffxaugx09	0.010*	0.014**	0.007*	-0.016**	-0.012**	0.006	0.013**	-0.007
	(0.011)	(0.000)	(0.033)	(0.000)	(0.000)	(0.058)	(0.000)	(0.246)
thi_diffxsep	0.053**	0.051**	0.038**	0.043**	0.040**	0.041**	0.042**	0.027**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TreatPeriod	-0.058**	0.075	0.000	0.000	0.000	0.000	0.000	-0.181**
	(0.005)	(0.615)	(.)	(.)	(.)	(.)	(.)	(0.008)
TreatPeriodx09	0.000	0.000	-0.115	0.182	0.275*	0.146	0.238	
	(.)	(.)	(0.444)	(0.466)	(0.017)	(0.252)	(0.210)	
o.TreatCustomer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
TreatCustomerx09	0.012	0.015	-0.017	-0.008	-0.000	-0.005	-0.001	-0.012
	(0.465)	(0.316)	(0.332)	(0.626)	(0.992)	(0.785)	(0.957)	(0.443)
TreatCustomerxTreatPeriod	0.026	0.014	-0.082**	-0.068**	-0.050*	-0.048*	-0.043*	-0.053**
	(0.208)	(0.431)	(0.000)	(0.003)	(0.029)	(0.025)	(0.024)	(0.001)
TreatCustomerxTreatPeriodx09	-0.010	-0.015	-0.000	-0.004	-0.009	0.005	-0.002	0.015
	(0.640)	(0.392)	(0.982)	(0.853)	(0.682)	(0.837)	(0.913)	(0.347)
ln_price_ratioxthi_diff	-0.028**	-0.019**	-0.017**	-0.019**	-0.018**	-0.017**	-0.015**	-0.016**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln_price_ratioxthi_diffx2009	-0.021*	0.013	-0.003	-0.005*	-0.005*	-0.006*	-0.009**	-0.015**
	(0.022)	(0.132)	(0.131)	(0.029)	(0.034)	(0.016)	(0.000)	(0.001)
ln_price_ratioxORBxthi_diff	-0.013	-0.010	-0.006*	-0.006*	-0.006*	-0.007*	-0.007**	-0.009*
	(0.056)	(0.190)	(0.012)	(0.011)	(0.013)	(0.011)	(0.006)	(0.010)
ln_price_ratioxORBxthi_diffx09	-0.003	0.029*	-0.002	-0.001	-0.001	-0.001	-0.000	-0.005
	(0.823)	(0.026)	(0.568)	(0.744)	(0.819)	(0.976)	(0.611)	(0.515)
ln_price_ratioxORB_TECHxthi_diff	-0.028**	-0.017*	-0.011**	-0.011**	-0.011**	-0.011**	-0.011**	-0.025**
	(0.000)	(0.015)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln_price_ratioxORB_TECHxthi_diffx09	0.010	0.039**	0.000	0.002	0.004	0.004	0.003	-0.000
	(0.338)	(0.924)	(0.396)	(0.832)	(0.776)	(0.716)	(0.028)	(0.429)
Constant	0.287**	0.160	-0.393**	-0.176	0.009	0.154	0.322	0.061
	(0.000)	(0.281)	(0.009)	(0.478)	(0.937)	(0.234)	(0.091)	(0.369)
Observations	293967	294048	294104	294084	294028	294041	294005	293956
R-squared	0.019	0.020	0.097	0.100	0.089	0.071	0.054	0.035
Number of customerid	838	838	838	838	838	838	838	838

Robust p-values in parentheses
** p<0.01, * p<0.05

Note: Other variables are also controlled for but suppressed here due to limited space.

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Daily Equations

VARIABLES	Excludes A&B Apr-2008/2009
ln_thi	-0.670**
	(0.000)
ln_thixapril	0.127**
	(0.000)
ln_thixaprilx09	0.269**
	(0.000)
ln_thixmay	0.892**
	(0.000)
ln_thixmayx09	0.347**
	(0.000)
ln_thixjune	4.059**
	(0.000)
ln_thixjunex09	-1.260**
	(0.000)
ln_thixjuly	4.080**
	(0.000)
ln_thixjulyx09	-0.666**
	(0.000)
ln_thixaug	3.775**
	(0.000)
ln_thixaugx09	0.513**
	(0.000)
ln_thixsep	3.171**
	(0.000)
TreatPeriod	0.367*
	(0.035)
TreatPeriodx09	
o.TreatCustomer	
TreatCustomerx09	0.040**
	(0.001)
TreatCustomerxTreatPeriod	-0.012
	(0.262)
TreatCustomerxTreatPeriodx09	-0.036*
	(0.013)
ln_pricexln_thi	-0.009**
	(0.000)
ln_pricexln_thix2009	-0.004
	(0.053)
Constant	-0.137**
	(0.000)
Observations	293973
R-squared	0.101
Number of customerid	838

Robust p-values in parentheses
** p<0.01, * p<0.05

Note: Other variables are also controlled for but suppressed here due to limited space.

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