

BGE's Smart Energy Pricing Pilot: Summer 2008

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By:

Cheryl Hindes, Director Load Analysis and Settlement
cheryl.a.hindes@bge.com

Agenda

- ❑ Why Smart Energy Pricing?
- ❑ Pilot Design
 - Critical Events
 - Peak Time Rebate
 - Dynamic Peak Pricing
 - BGE pilot design
- ❑ Impact Analysis and Survey Results

Why Smart Energy Pricing?

- Capacity constraints could cause issues in PJM as early as 2012, with the potential for rolling black outs in the absence of any demand response and/or major transmission build out
- Rising capacity and energy prices in the PJM market are enabling demand response programs to make economical sense
- AMI can enable dynamic pricing programs that can save customers money and reduce peak demand
- EmPOWER Maryland Act charges Utilities in Maryland to reduce per capita consumption by 15% by the year 2015

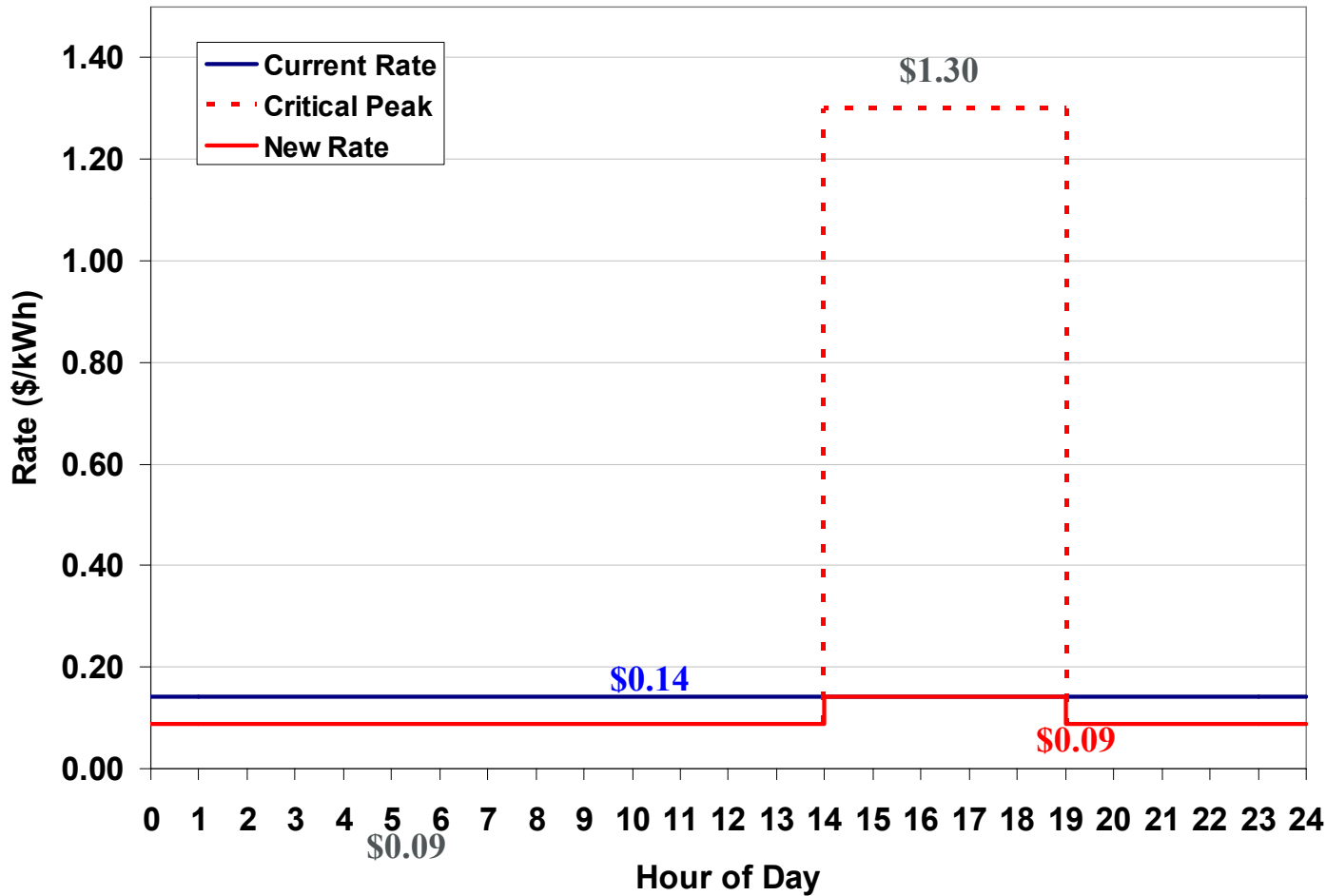
Smart Energy Pricing Pilot Objectives

- Determine customers' acceptance and satisfaction with new pricing programs
- Confirm peak load reductions resulting from two flavors of innovative rate programs (PTR and DPP), with and without enabling technology
- Develop statistically valid data to support monetizing SEP load reductions in PJM Capacity and Energy markets
- Support Smart Grid business case using impact analysis, and deriving net benefit of Smart Energy Pricing programs

Smart Energy Pricing

PILOT DESIGN

Dynamic Peak Pricing - Overview



**Pilot Pricing
All-in Rate***

Critical \$1.30425
Peak \$0.14425
Off-Peak \$0.09425

* Includes generation, transmission and delivery



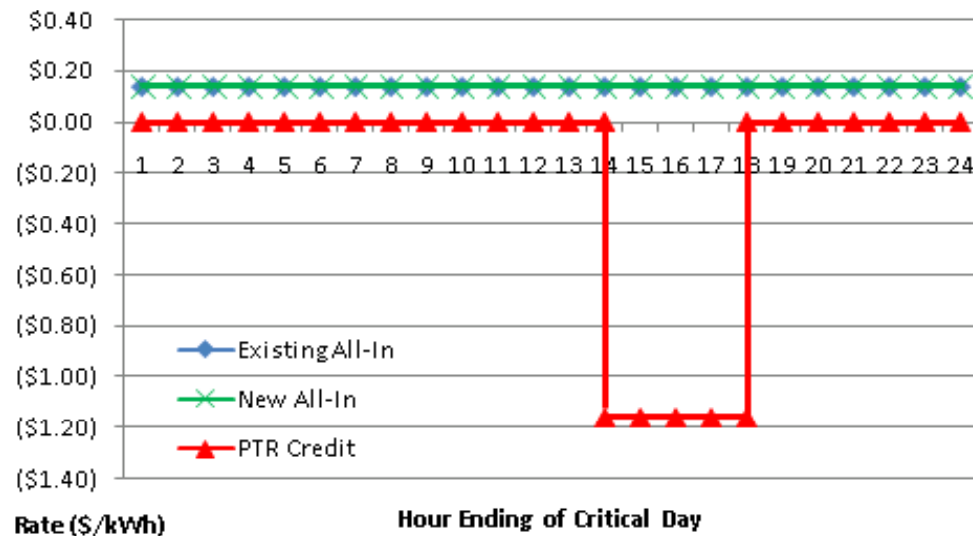
Peak Time Rebate - Overview

A Mirror Image of the DPP Rate

- Schedule R summer rates are \$0.14 / kWh for all summer hours
- Up to 12 critical peak days will be called by 6 p.m. the prior day
- Customers who use less during the critical period (2 – 7 p.m.) on any critical peak day will receive a rebate. Two levels being tested:

– \$1.75/kWh

– \$1.16/kWh




Summer 2008 Pilot

Dispatch Notification of Critical Peak Event

- Customers choose to be notified by up to 15 total methods
 - Recorded Telephonic Message (up to 5 phone numbers)
 - E-mail (up to 5 addresses)
 - SMS Text Messages (up to 5 cell phones)
- Subset of customers were given Energy Orb
 - For DPP customers, Orb would indicate time period (OFF, ON and CRITICAL) through color signals of green, yellow and red
 - For PTR customers, Orb would signal upcoming Critical Events by pulsating before an event, and turning red during the event
- In a full deployment scenario, BGE also plans to alert the mass media of critical peak events



Summer 2008 Pilot Participant Segmentation

Group	Total	PTR Low (\$1.16/kWh)	PTR High (\$1.75/kWh)	Dynamic Peak Pricing	Control Group
Without Enabling Technology	675	125	125	125	300
With Orb Technology 	250	125	125	0	0
With Orb and AC Switch Technologies	375	125	125	125	0
Total	1300	375	375	250	300

1,300 accounts is a sample size that produces statistically reliable results

Smart Energy Pricing 2008 Critical Events

June 2008						
Sun						
1	2	3				
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

High Temp

July 2008						
Sun						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 2008						
Sun						
				1	2	
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 2008						
Sun						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Smart Energy Pricing

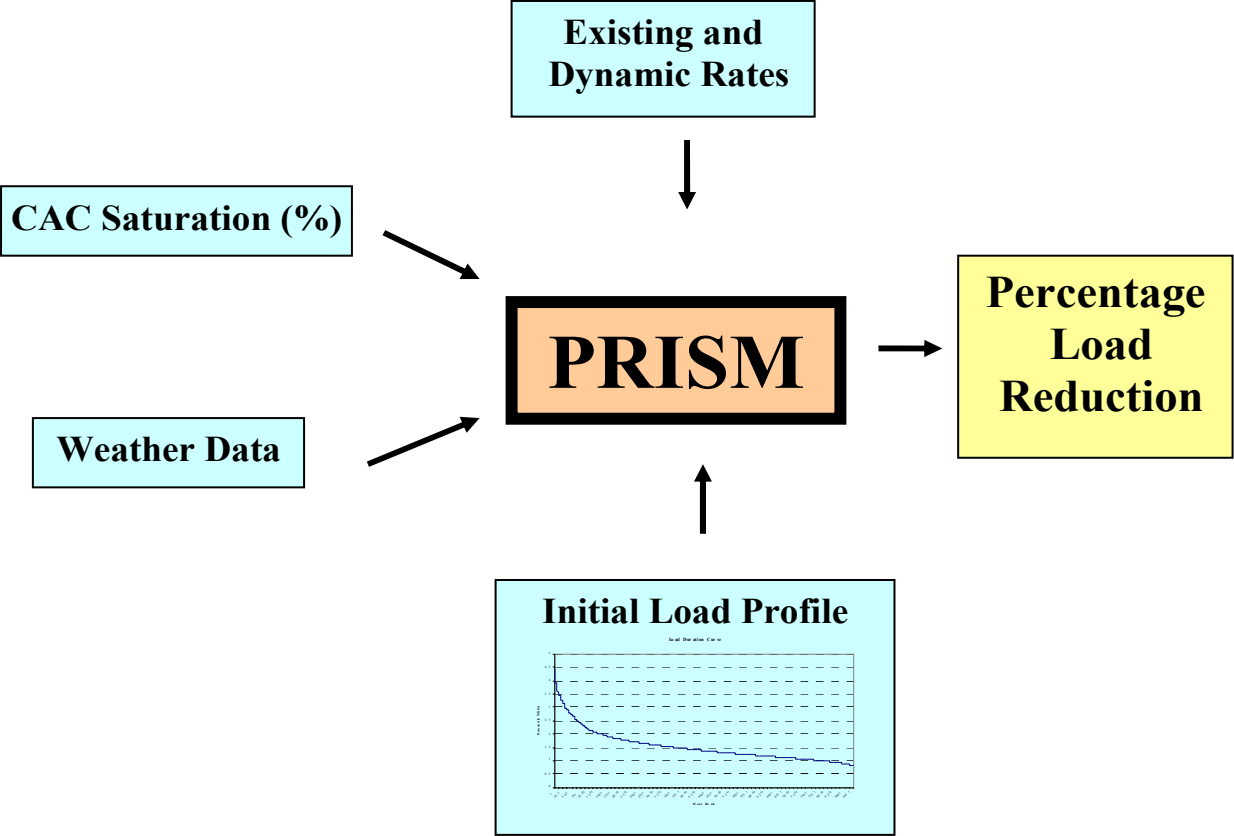
Impact Analysis and Survey Results

Summer 2008 Pilot

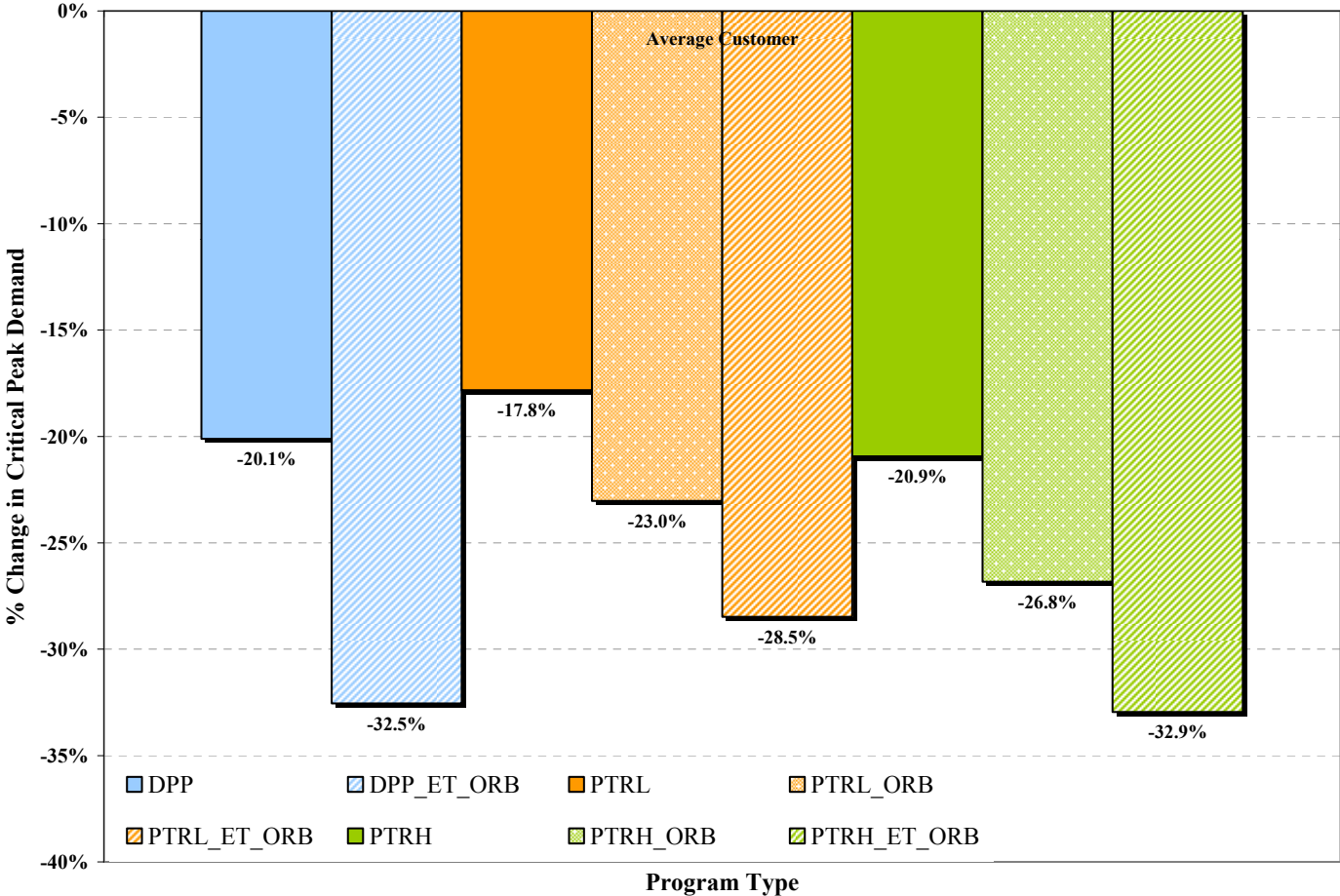
The Brattle Group Load Impact Analysis

- *Brattle Group* final report delivered to BGE on April 26, 2009
- *The Brattle Group* simulated customer response to BGE's eight program types at the customer level
- Final Metrics included:
 - Peak demand reductions at PJM peak conditions
 - Percent change in peak and off-peak consumption on days when critical peak events were dispatched
 - Percent change in peak and off-peak consumption on days when critical peak events were not dispatched
 - Percent change in total monthly consumption

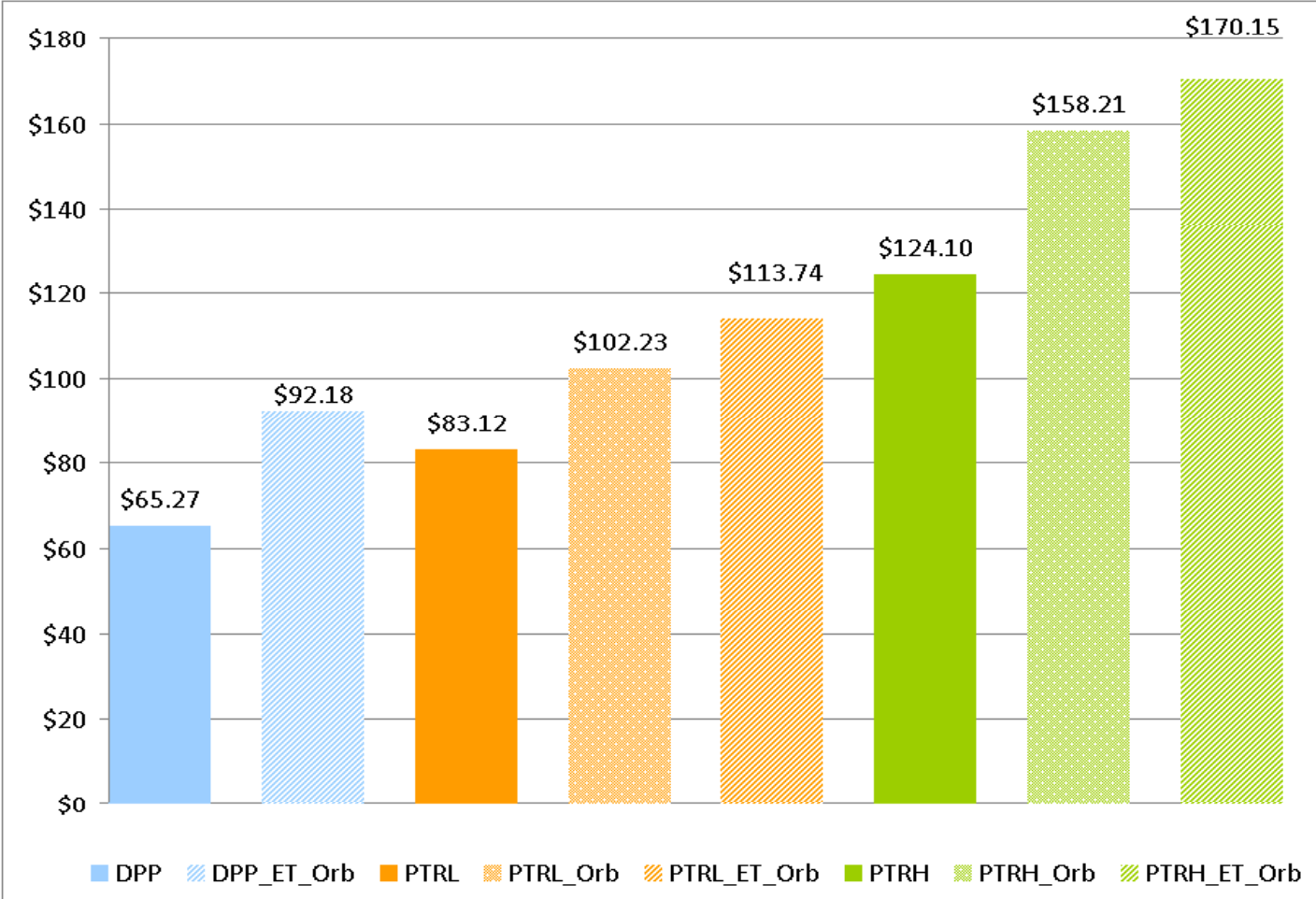
PRISM Model predicts the impact of alternative rate designs



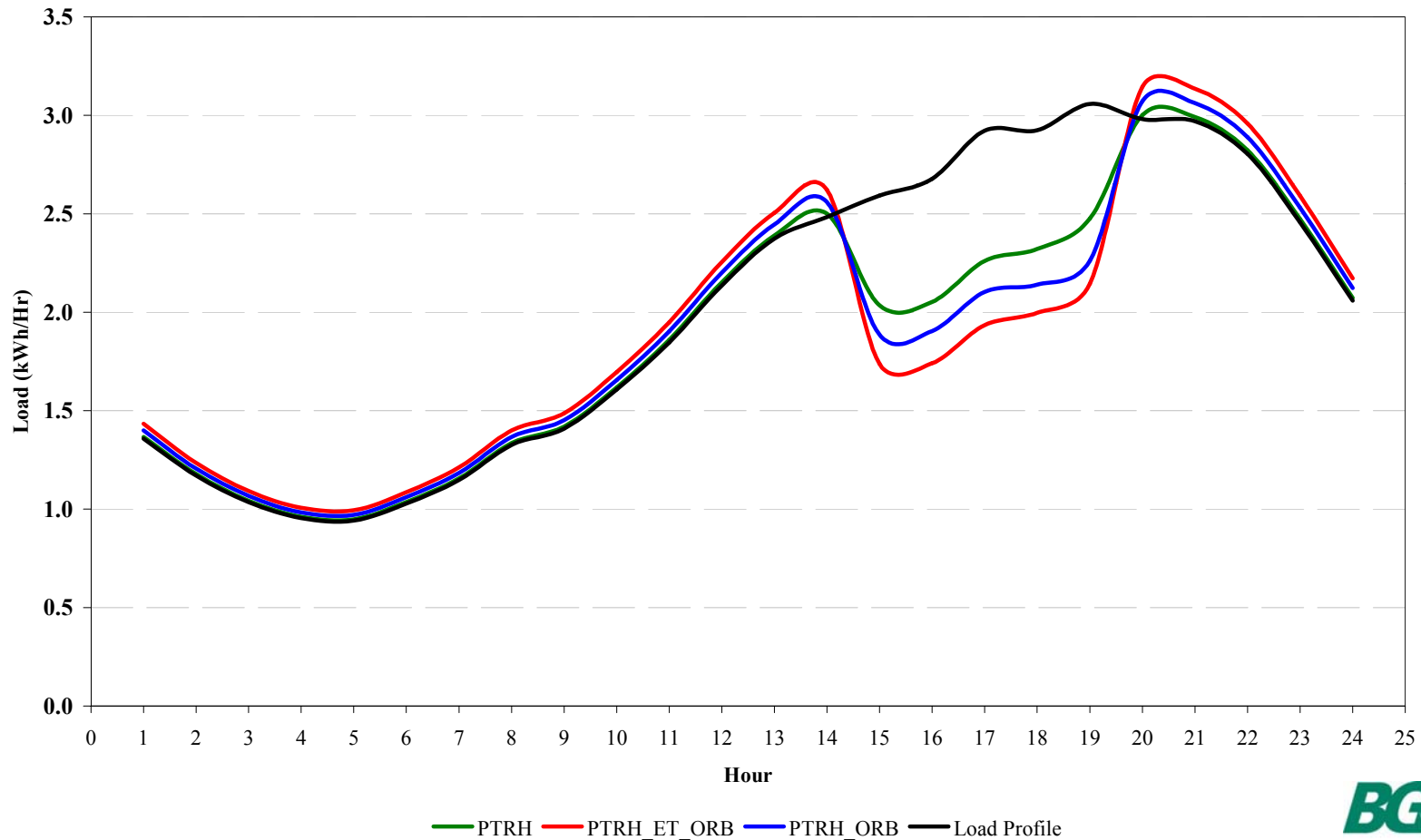
Demand Response Impact Summary (Based on Average Critical Peak Day Weather)



Smart Energy Pricing - Summary of Bill Savings



Summer 2008 Pilot Actual Load Shapes for Participants and Control Group on July 17, 2008 Critical Peak Event



Methodology

A post-pilot “experience” survey was conducted during November with the population of just over 1,000 Smart Energy Pricing (SEP) Pilot participants.

Participants were asked about their overall experience with the SEP pilot program, which ran from June 1 to Sept. 30, 2008. Topical areas included:

- Program Participation and Satisfaction,
- Program Behavior,
- Communication with BGE, and
- Bill Impacts.

Both on-line and mail survey methods were used to gather data.

A total of 785 surveys were completed, including 279 on-line and 506 mail, producing a response rate of 78%.

At a confidence level of 95% the margin of error for the overall results is +/- 1.65%.

Executive Summary

SEP program participants were overwhelmingly satisfied with their program experience with over 93% reporting that they were either 'very satisfied' (62%) or 'satisfied' (31%). The mean satisfaction score was 4.5 on the 1 to 5 scale.

Peak Time Rebate customers had slightly higher satisfaction levels than did Dynamic Peak Pricing customers.

Saving money was the primary motivation for program participation, cited by 78% of respondents.

Ninety-seven percent of participants would be interested in continuing the same pricing structure in 2009.

Over 78% of respondents believe that variable rate programs should be standard for all BGE customers.

Sixty-five percent of participants considered Voicemail to be the most effective notification technique.

Executive Summary (cont)

Among those customers who called the SEP program support center, 80% were either 'very satisfied' or 'satisfied' with the service they received. The mean satisfaction score for the SEP program support center was 4.2 on the 5 point scale.

Over 91% of participants **expected** to achieve bill savings.

Over 96% of participants **achieved** bill savings.

Appendix

BGE's Smart Energy Pricing Pilot

Ahmad Faruqui and Sanem Sergici
The Brattle Group

Cheryl Hindes and Neel Gulhar
Baltimore Gas and Electric Company

BGE's Smart Energy Pricing (SEP) Pilot

SEP ran from June 1, 2008 through September 30, 2008

It involved some 1,375 residential customers of whom 1,021 were exposed to some type of dynamic pricing

The SEP featured three dynamic pricing rate designs, a critical peak rate design (called DPP) and two variations of a PTR rate design- one testing a low rebate level and the other testing a high rebate level

The SEP featured two enabling technologies, the Energy Orb and a switch for cycling central air conditioners (A/C Switch)

The SEP also collected data on treatment and control group customers both before and during the pilot period

Rate and Technology Combinations Tested in SEP

Rate Design	Enabling Technology	Abbreviation
DPP	None	DPP
DPP	Energy Orb and A/C Switch	DPP_ET_ORB
PTRL	None	PTRL
PTRL	Energy Orb Only	PTRL_ORB
PTRL	Energy Orb and A/C Switch	PTRL_ET_ORB
PTRH	None	PTRH
PTRH	Energy Orb Only	PTRH_ORB
PTRH	Energy Orb and A/C Switch	PTRH_ET_ORB

SEP (Concluded)

The SEP Pilot customers showed the same price responsiveness to DPP and PTR programs

Overall, reduction in critical peak period usage ranged from 18 to 33 percent

- DPP, PTRL, and PTRH programs *without enhancing technologies* yielded impacts in the 18-21 percent range
- DPP, PTRL, and PTRH programs *with the Orb technology* yielded impacts in the 23-27 percent range
- *Presence of both A/C switch and the Orb* almost doubled the impacts that were obtained from the rates alone and yielded impacts in the 28-33 percent range

The SEP featured the following “All-in” rates

SEP Program All-in Rates (\$/kWh)

	Original	Critical	Peak	Off-Peak
DPP	0.153	1.309	0.149	0.099
DPP_ET_ORB	0.153	1.309	0.149	0.099
PTRL	0.153	1.313	0.153	0.153
PTRL_ORB	0.153	1.313	0.153	0.153
PTRL_ET_ORB	0.153	1.313	0.153	0.153
PTRH	0.153	1.903	0.153	0.153
PTRH_ORB	0.153	1.903	0.153	0.153
PTRH_ET_ORB	0.153	1.903	0.153	0.153

Notes:

- 1- SEP DPP rates include electric supply, transmission, and distribution charges. Therefore, they are converted to all-in rates by adding the customer charges.
- 2- SEP PTRH and PTRL rates include electric supply charges only. They are converted to all-in rates by adding transmission, distribution and customer charges.
- 3- Critical PTRL price is calculated by adding peak time rebate to peak price (i.e. 1.16 plus 0.153)
- 4- Critical PTRH price is calculated by adding peak time rebate to peak price (i.e. 1.75 plus 0.153)
- 5- Original prices are calculated by taking the average prices across the pilot period

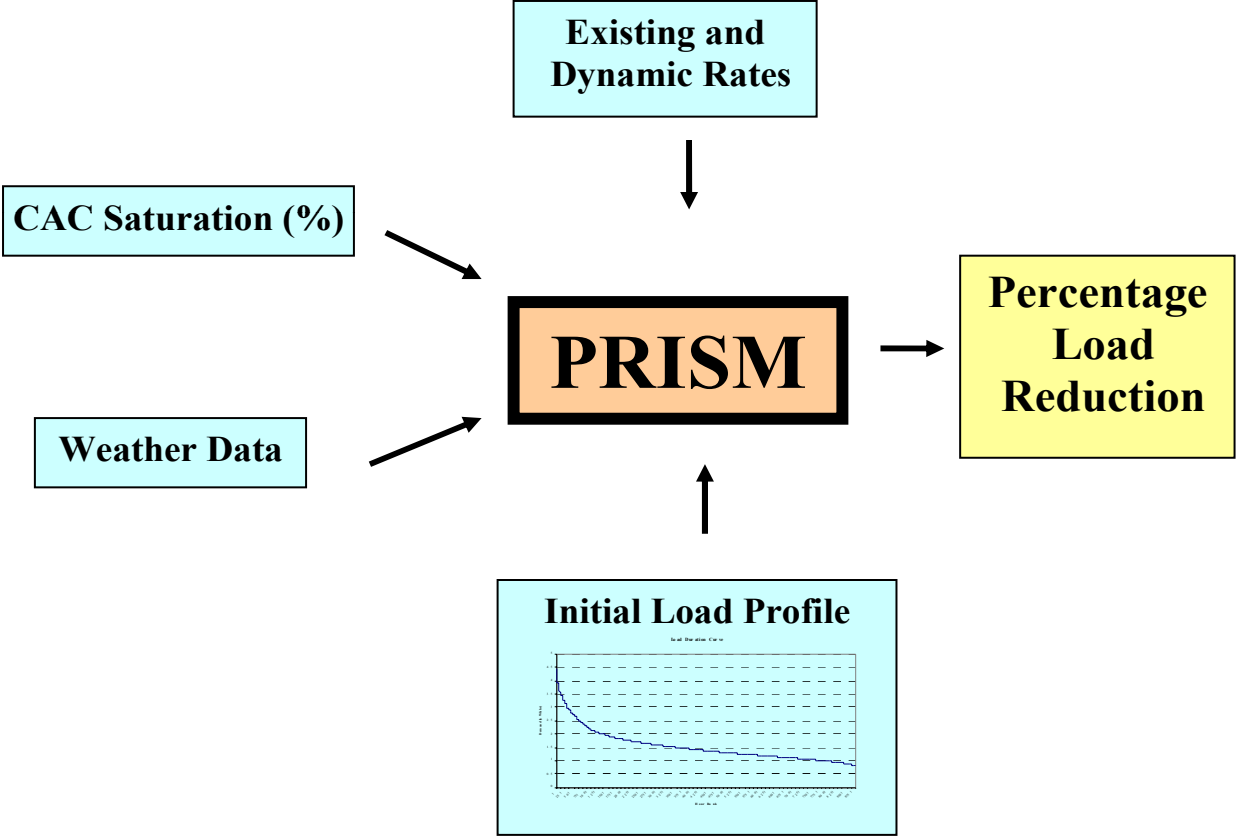
Estimation of Demand Equations

In order to predict consumption under new rate designs, we estimated a constant elasticity of substitution (CES) demand system that consists of two equations:

- Substitution Equation models changes in load shape caused by changing peak-to-off peak prices
- Daily Equation models changes in daily average consumption caused by changing daily prices

Using elasticities estimated by this system of two equations, we predict consumption by rate period using the architecture of the PRISM model (which originated in the SPP)

PRISM Model predicts the impact of alternative rate designs



Steps in the impact evaluation

- 1- We converted unbundled BGE rates into an “all-in” rates**
- 2- We estimated BGE substitution and daily elasticities using pretreatment and treatment period data on the treatment and control group customers**
- 3- We calibrated the PRISM Model to the BGE elasticities and the typical BGE residential customer load profile**
- 4- We estimated the demand response and the total consumption impacts**

Estimated price elasticities are weather dependent

We employ two variables to capture the impact of weather in our analyses:

1- THI : Temperature humidity index

2- THI_DIFF: Difference between average peak and off-peak THI values

Since the elasticities are based on the weather term, we identified three different levels for the weather variables to arrive at the elasticity values used in the PRISM model

1- Based on the Average Weather

- Uses the value of the weather term averaged over 10 Critical Peak Pricing (CPP) days (excludes 2 CPP days with low weather terms)

2- Based on the Minimum Weather

- Uses the value from the CPP day with the minimum THI_DIFF value (CPP 11 ~ 9/23/2008)

Substitution and daily price elasticities

BGE Substitution & Daily Elasticities

	Based on Minimum Weather	Based on Average Weather	Based on Maximum Weather
Price Only	-0.073	-0.096	-0.109
Price + ORB	-0.113	-0.136	-0.149
Price + ET_ORB	-0.157	-0.180	-0.193
Daily	-0.019	-0.039	-0.034

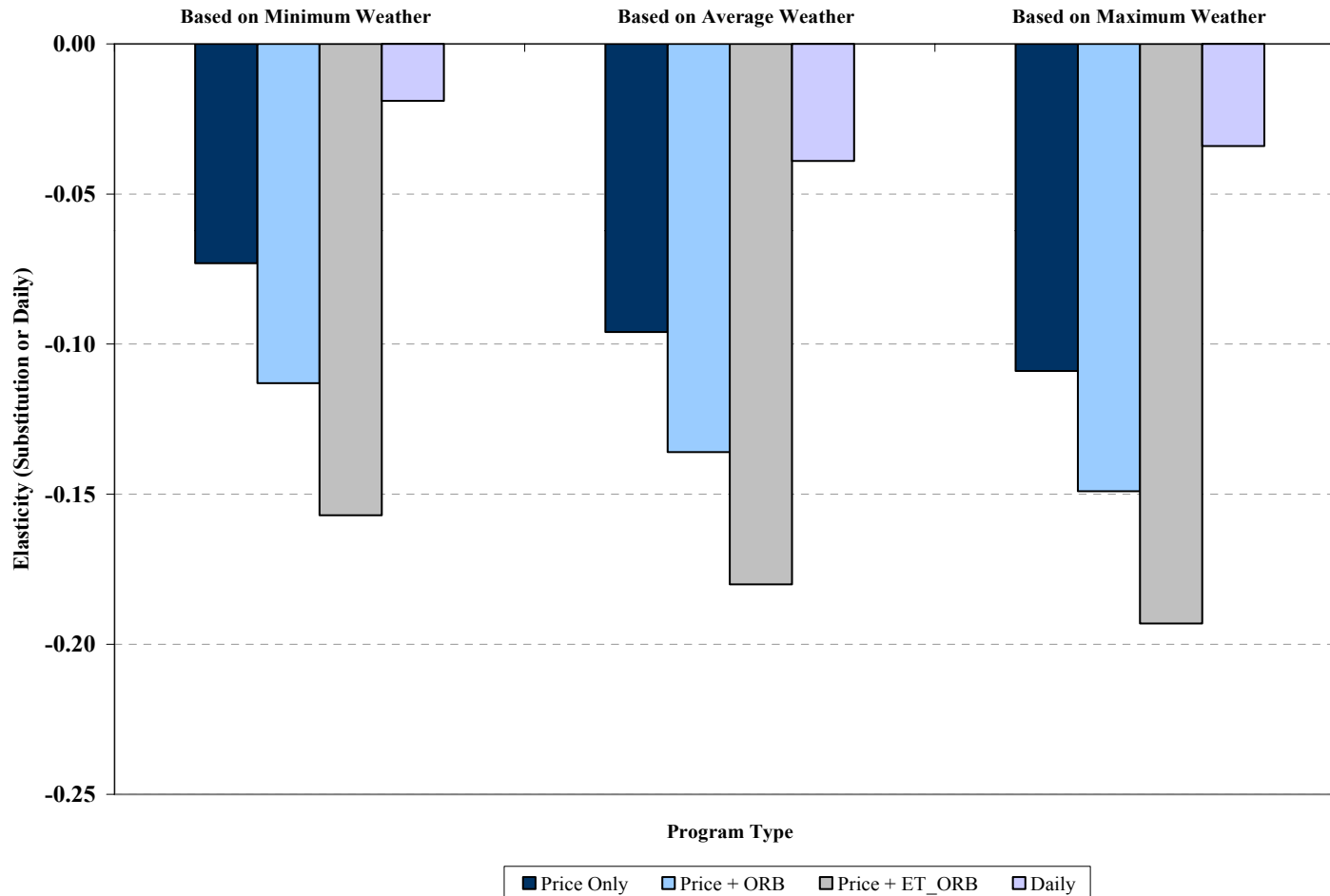
Substitution elasticity

- One percent increase in the ratio of peak to off-peak prices results in 0.096 percent decrease in the ratio of peak to off-peak consumption

Daily (price) elasticity

- One percent increase in the daily average price results in 0.039 percent decrease in the daily average consumption

The elasticities rise with technology and hot weather



The SEP Pilot also yielded evidence that the customers exhibit same price responsiveness to DPP and PTR rates

Estimation results show that the customers exhibit same price responsiveness to DPP, PTRL, and PTRH rates, i.e., the price elasticities are statistically indistinguishable from each other

- This implies that the customers perceive similar incentives from critical peak pricing and peak time rebate programs
- They respond to *carrot* and *stick* in the same fashion

However, resulting load impacts may be (and are) different from each other because the levels of underlying rates are different for DPP, PTRL, and PTRH programs

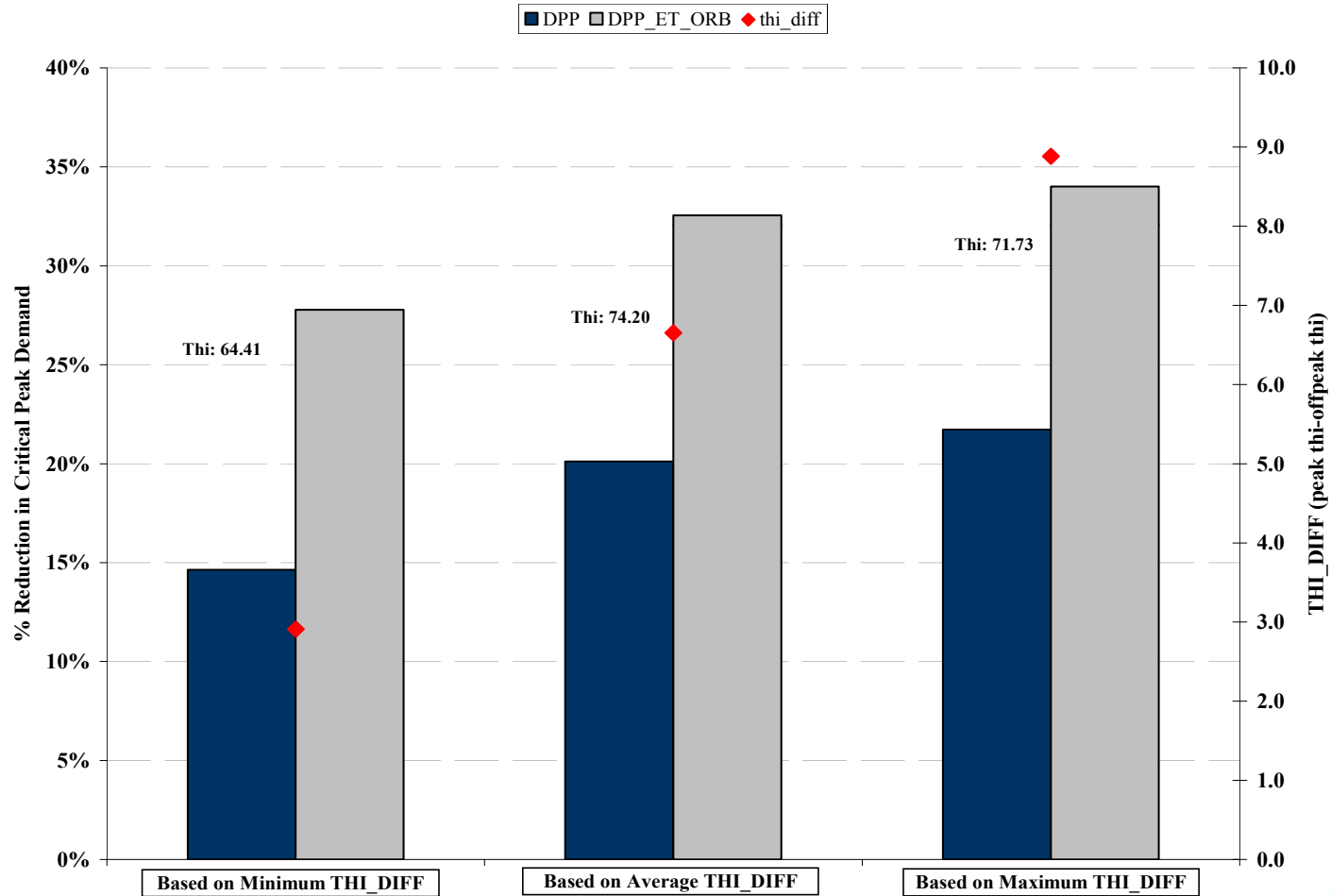
In the following slides, we report the average impacts achieved in the programs tested by BGE

For the average CPP day weather, the average reduction in critical peak period usage ranges from 18 to 33 percent

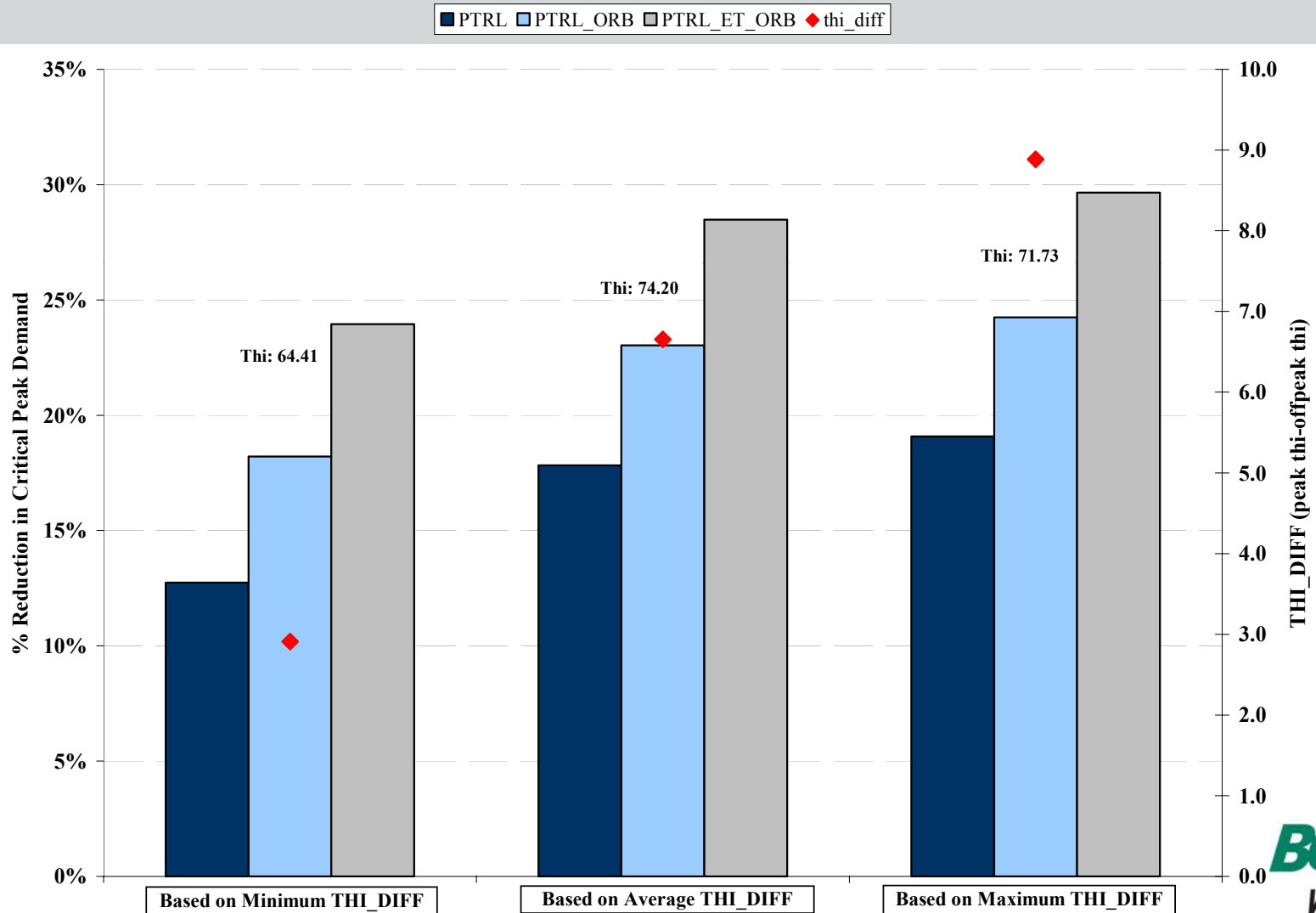
- DPP, PTRL, and PTRH programs *without enhancing technologies* yield impacts in the range of 18 to 21 percent
- DPP, PTRL, and PTRH programs *with orb technology* yields impacts in the range of 23 to 27 percent
- Presence of *both A/C switch and orb* almost doubles the impacts that are obtained from the rates alone and yields impacts in the range of 28 to 33 percent

Unless otherwise is noted, percent reductions are the averages over critical peak hours

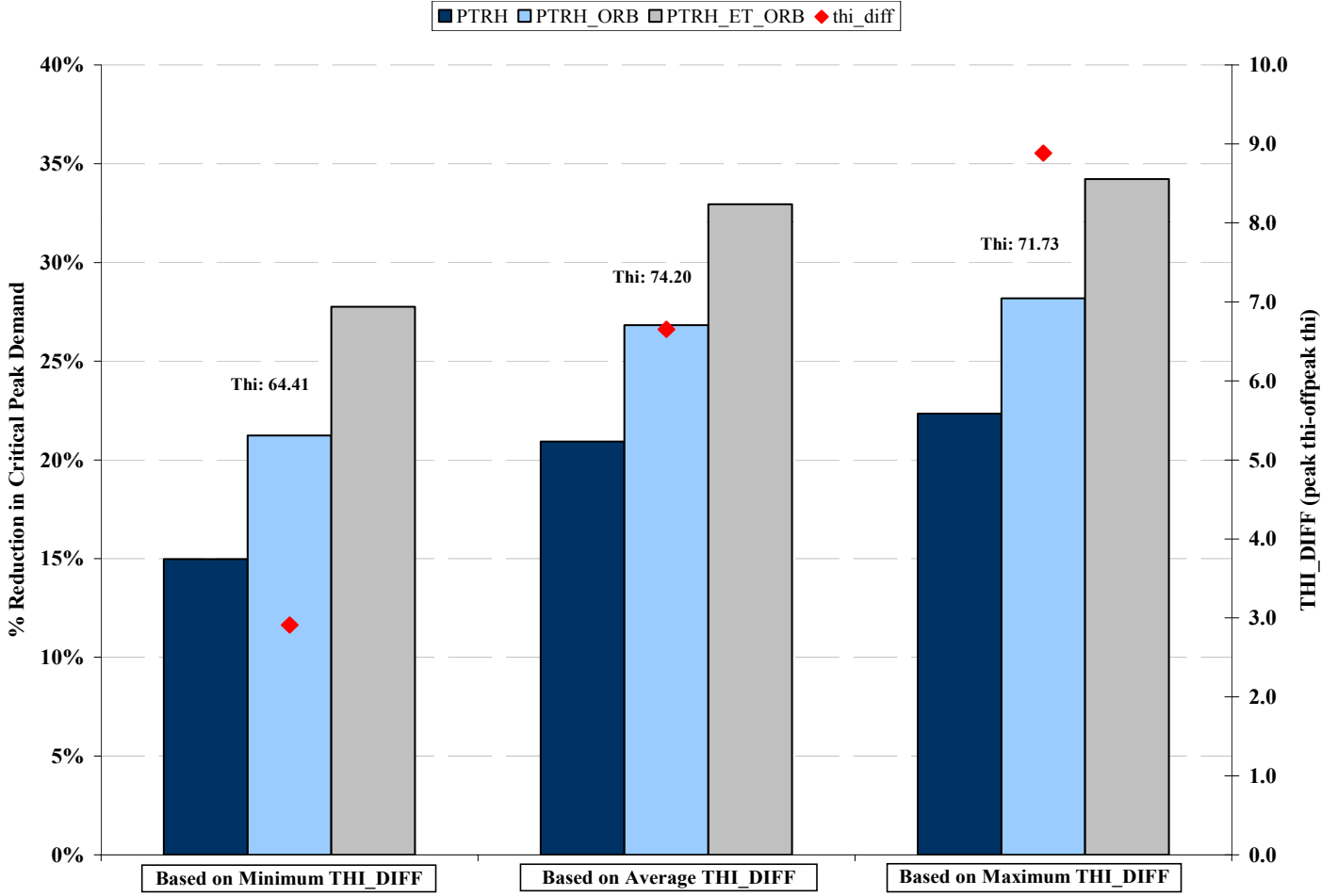
DPP Program- Critical Peak Demand Impacts



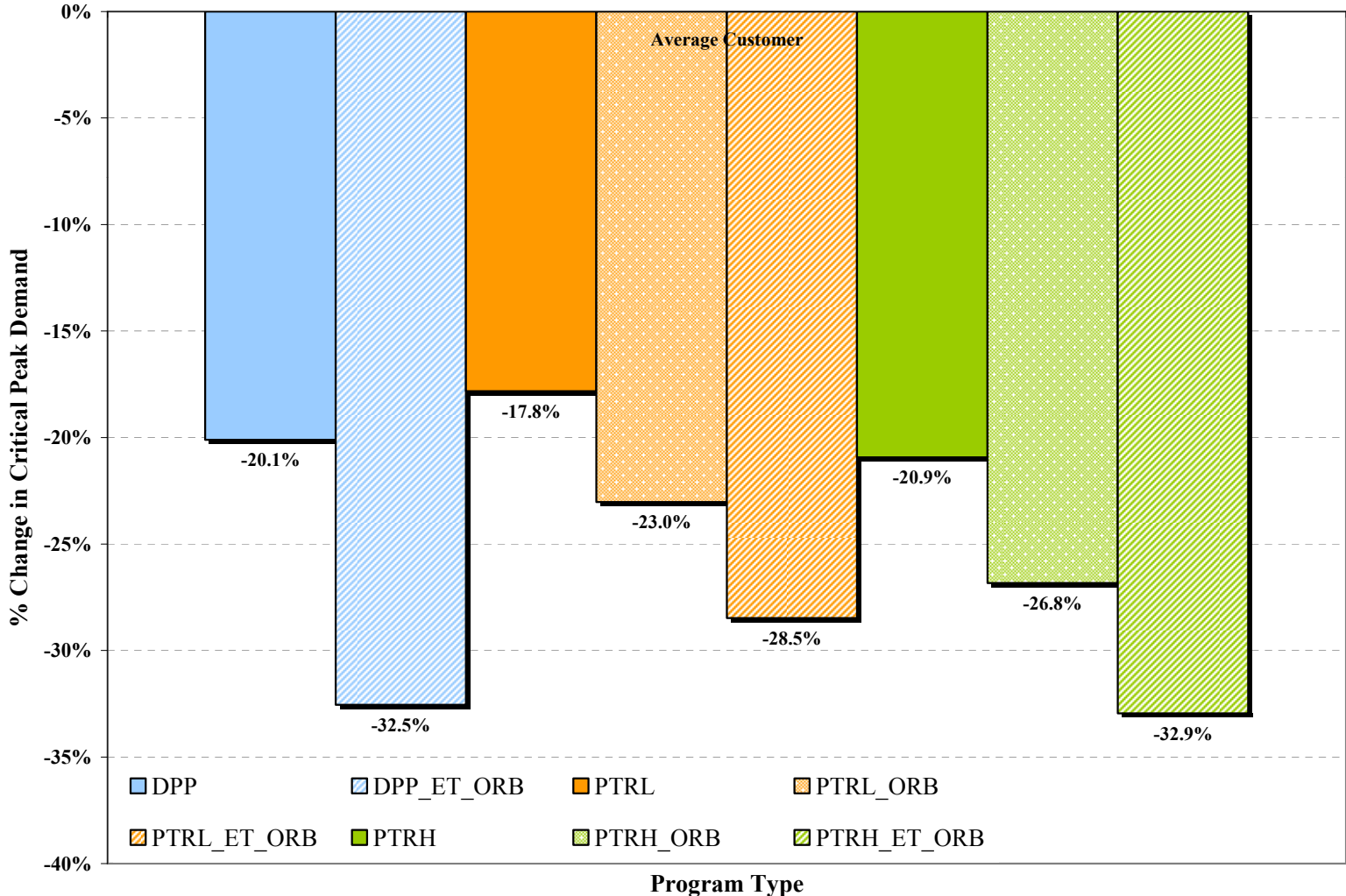
PTRL Program- Critical Peak Demand Impacts



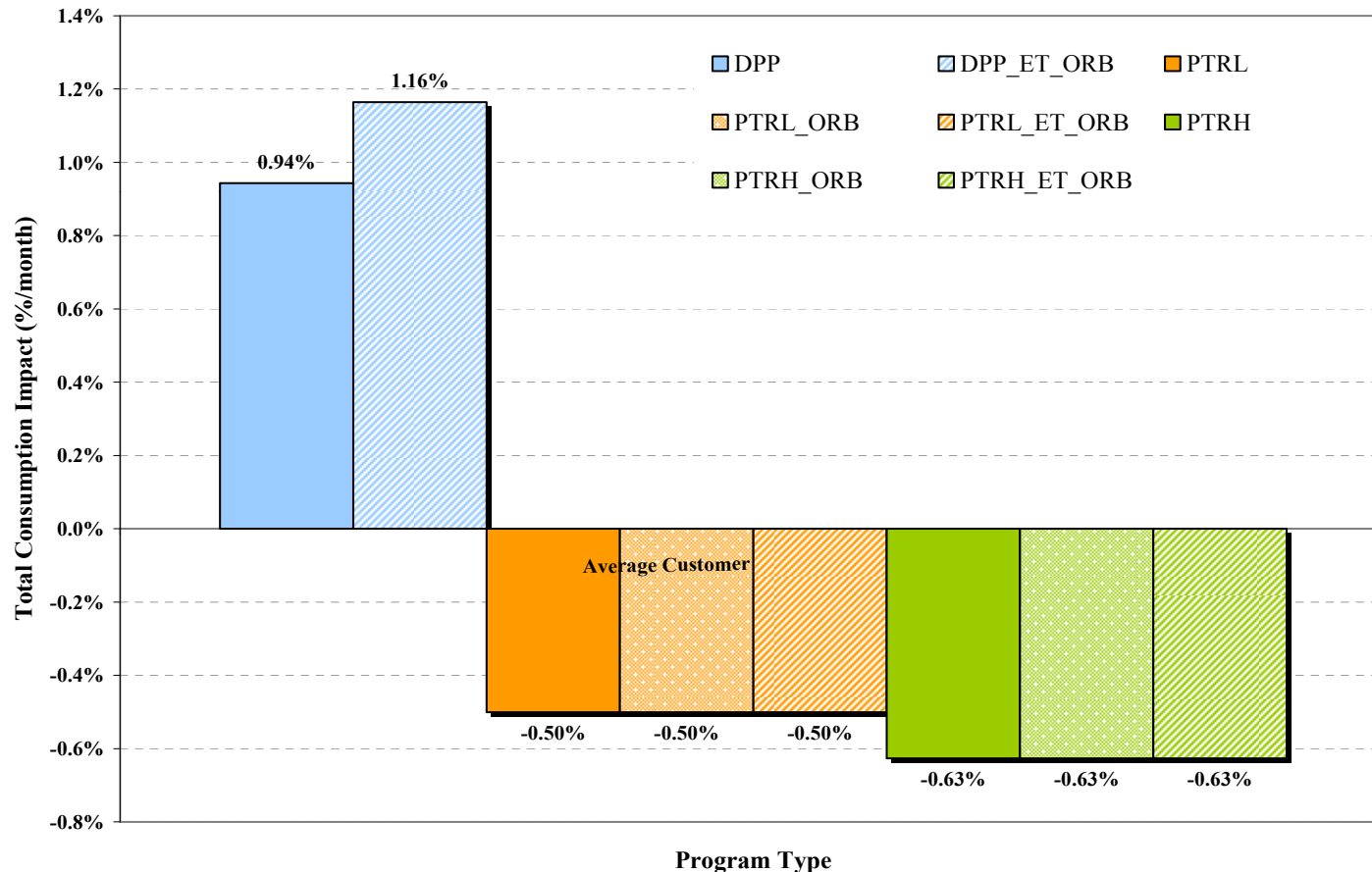
PTRH Program- Critical Peak Demand Impacts



Demand Response Impact Summary (Based on Average Critical Peak Day Weather)



Total Monthly Consumption Impact Summary (Based on Average Critical Peak Day Weather)



Summary of SEP Impacts

- 1- Customers show the same price responsiveness to dynamic pricing, whether it is expressed as a price increase during the critical hours or a rebate
- 2- Average reduction in critical peak period usage ranges from 18 to 33 percent
 - DPP, PTRL, and PTRH programs without enhancing technologies yields impacts in the range of 18 to 21 percent
 - Presence of both A/C switch and orb almost doubles the impacts that are obtained from the rates alone
 - Existence of the Orb conclusively increases the extent of demand response
- 3- As a result of the programs, total monthly consumption increases by at about one percent for DPP and decreases by about half percent for PTRL and 0.6 percent for PTRH

Conclusion: The SPP and SEP Pilot results are comparable

1- The results from the SEP and SPP are qualitatively similar:

- Customers respond to dynamic prices by reducing their peak period usage
- Automating technologies increase the extent of the demand response (PCTs in SPP and A/C switch in the case of BGE)

2- The range of the impact estimates from the two pilots is also comparable:

- The SEP yielded impacts in the range of 18 to 33 percent
- The SPP yielded impacts in the range of 13 to 27 percent
- In fact, the simulation of California SPP prices using the BGE PRISM model overstates the SPP impacts by only couple of percentage points— customer responses converge

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