



2008 Impact Evaluation of Pacific Gas and Electric Co. SmartRate Tariff

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Overview

- Tariff/Program Overview and Design
- SmartRate Marketing and Enrollment
- Impact Analysis Methodology and Model Validity Assessment
- Load Impact Results
 - Summary of impacts
 - Load impact variation across event days
 - Load impact variation by customer type
 - Distribution of impacts among customers
- Enrollment Decisions and Load Impacts of Structural Winners and Losers
- Questions and Feedback

The impact evaluation of the SmartRate dynamic pricing tariff was conducted by the consulting firm Freeman, Sullivan & Co.

Pacific Gas & Electric Co.

- ❑ 70,000 square miles in northern and central California
- ❑ 142,000 circuit miles of electric lines.
- ❑ 23,000 employees
- ❑ 5.2M Electric service accounts and 4.2M Gas accounts;
- ❑ 15 million people served. ~ 1 in 20 Americans take utility service from PG&E
- ❑ System peak: 20,385 MW on 07/08/08 @ 16:00
- ❑ Over 3 Million SmartMeters installed as of August 1, 2009. Approximately 1.3 Million electric meters



What is SmartRate?

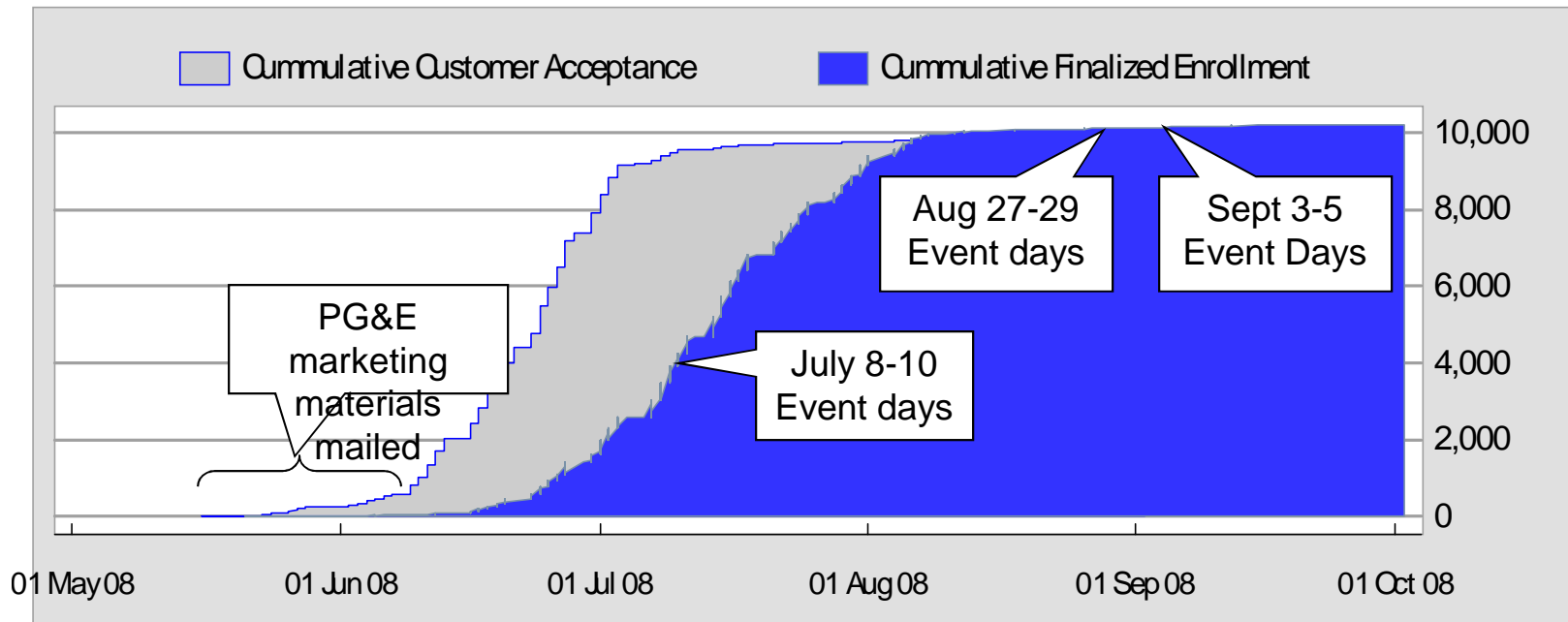
- SmartRate is an overlay on existing tariffs that prices electricity during peak periods significantly higher than the otherwise applicable price on up to 15 days, known as SmartDays
- Event days can be called from May 1st through October 31st and notification is provided by 3 pm the day prior to an event
- During non-event days from June 1st to September 30th, customers get a rate discount
- In 2008, SmartRate was only offered to customers on non-time varying tariffs, so prices varied by time of day only on Smart Days, not on other days
- The event window is fixed from 2-7 pm for residential customers
- In 2008, load response was entirely driven by customer behavior, not by automation
- Customers had several options for receiving notification (e.g., phone, email), including not being notified

SmartRate - Tariff Design

- During critical peak periods, residential customers pay an incremental 60 ¢/kWh
- SmartRate is an overlay on top of PG&E's other tariff offerings and provides different price signals to different customers due to California's tiered, increasing block rates
- Customers with low income are eligible to receive lower rates for electricity use (CARE)
- There are two components to the SmartRate credit, both of which apply only in the months of June through September
 - A credit of ~3 ¢/kWh applies to all usage other than peak-period usage on SmartDays
 - An additional credit of ~1 ¢/kWh, applies to all usage 200% or more above the baseline kWh

Customer Type	% of Baseline Usage	Approximate Maximum Monthly Usage in Tier (kWh)	E-1 Price (¢/kWh)	SmartRate Rate Discount (¢/kWh)	Average E-1 Price Based on Mid-Tier Usage (¢/kWh)	Average Smart Rate Price for non-event periods (¢/kWh)	SmartRate Price during Event Periods (¢/kWh)	Peak to Off-Peak Price Ratio (¢/kWh)
non-CARE customers	100%	582	11.5	3	11.6	8.6	68.6	8.0
	130%	757	13.1	3	11.8	8.8	68.8	7.8
	200%	1,164	24.7	3	14.7	11.7	71.7	6.1
	300%	1,746	35.4	4	20.2	16.2	76.2	4.7
	>300%	>1,746	41.0	4	25.1	21.1	81.1	3.8
CARE customers	100%	582	8.3	3	8.3	5.3	65.3	12.3
	200%	1,164	9.6	3	8.7	5.7	65.7	11.5
	>200%	>1,164	9.6	4	9.1	5.1	65.1	12.8

SmartRate Marketing and Enrollment



- Enrollment grew significantly over the summer, from roughly 4,000 in early July to almost 10,000 in early September
- The primary marketing channel for SmartRate was direct mail
 - A \$50 Visa gift card was offered to residential customers who signed up early
 - Customers were offered first-year bill protection

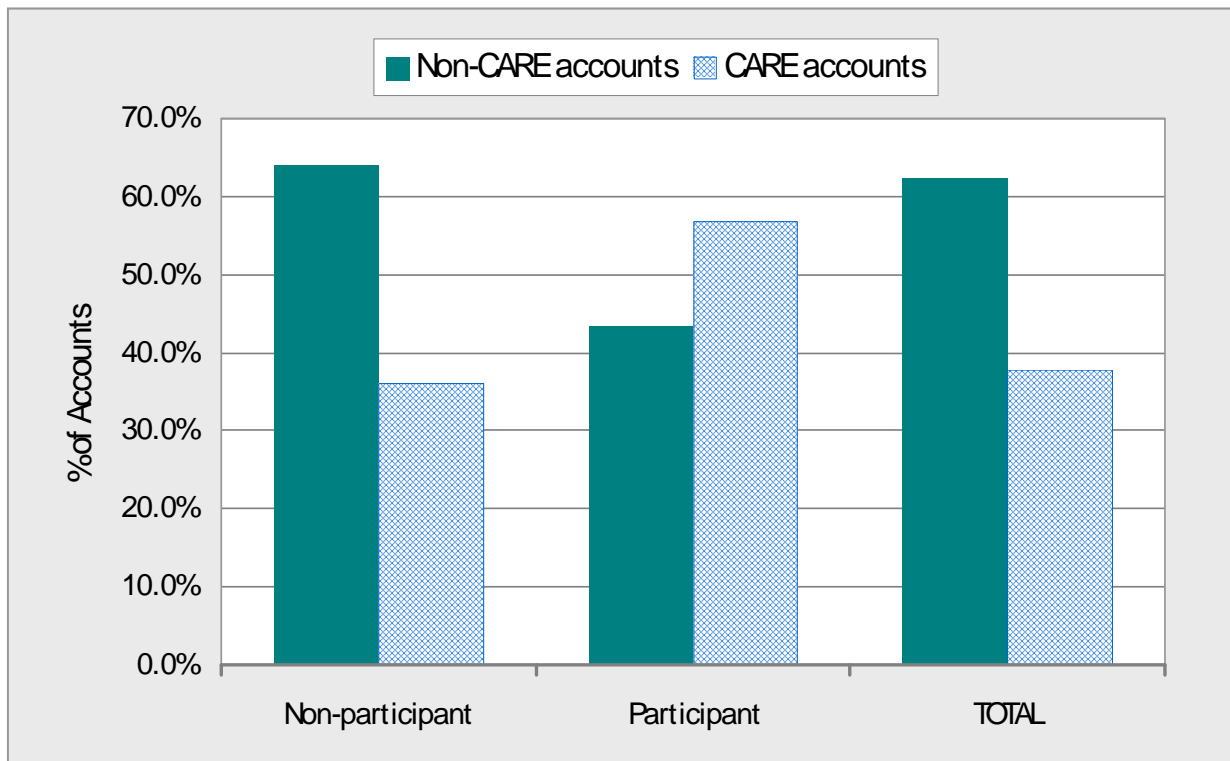
Participant Characteristics

SmartRate Marketing and Enrollment

- The program was marketed to approximately 129,000 households
- Over 10,000 households (~8%) accepted the offer, most of whom received a single direct mail promotional piece
- Customer enrollment exceeded expectations (initial goal was to enroll 6,000)
- There were small differences in the annual usage of the participants and non-participants
 - 56% of participants had usage below 7,500 kWh, compared with 50% of non-participants
- There were almost no differences in the ratio of their summer to non-summer usage
- Data on air conditioner ownership and type of air conditioner were not available for the population or for the analysis, but 80% of participants had central air conditioning
 - Approximately 71 percent of CARE customers had central air conditioning
 - In contrast, 92 percent of non-CARE customers had central air conditioning

Participant Characteristics

The SmartRate Offering Disproportionately Appealed to Lower Income Customers

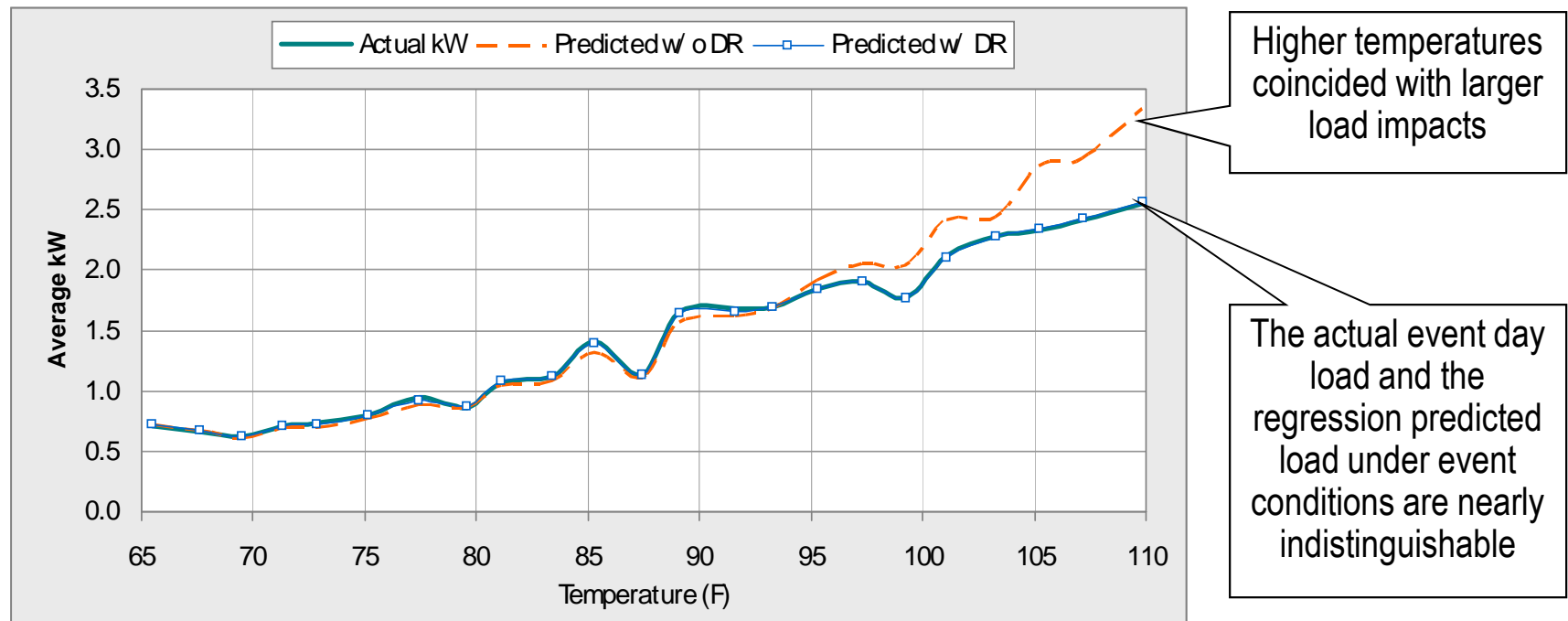


- A disproportionate number of CARE customers enrolled in SmartRate
- Approximately 35 percent of Bakersfield residential customers who were sent marketing materials were CARE customers
- 56 percent of customers who enrolled in SmartRate in 2008 were CARE customers

Analysis Methodology

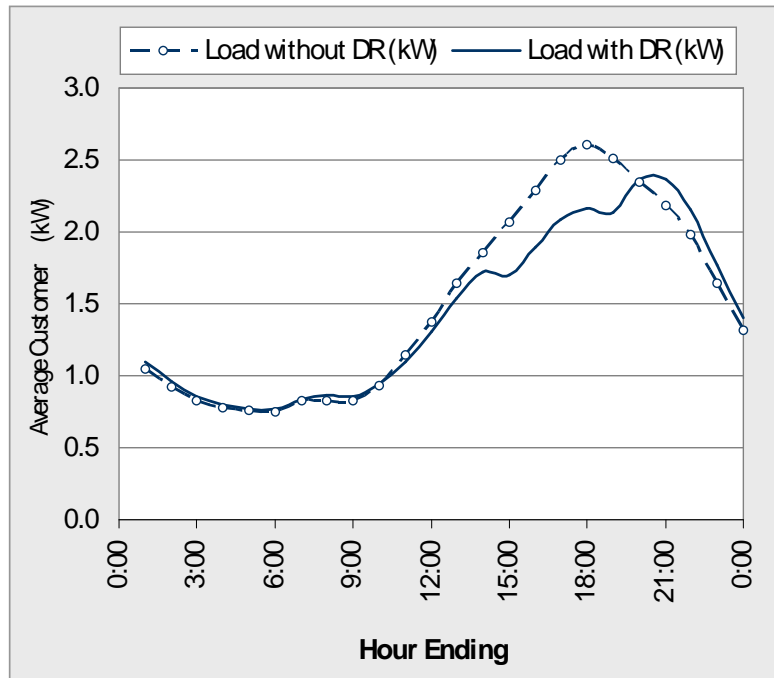
- The impact estimates were based on time-series regressions for individual customers for a sample of roughly 2,000 households
- The dependent variable in each regression was average hourly demand (kW). The explanatory variables can be grouped into three main categories:
 - Variables that reflect the average load shape of customers, absent the need for cooling;
 - Variables that explain deviations in hourly usage from the average load shape; and
 - Variables that estimate the change in energy use during event days and the factors that influence the load reductions.
- In the aggregate, the regressions explain over 92% of the variation in energy usage
- Extensive comparisons of actual usage to regression predicted usage were conducted to assess the accuracy and validity of the regression models

The Regression Predicted Values Mirror Actual Usage Across All Temperatures and Hours



- The most important feature of load impact analysis is the ability to predict accurately under the extreme conditions for which demand response is designed to provide insurance
- Multiple comparisons, by customer segment and for individual event days, were conducted to assess the ability of the regression model to accurately predict customer behavior

Hourly Load Impacts for Average Event



Hour Ending	Load without DR (kW)	Load with DR (kW)	Load Impact (kW)	%Load Reduction	Weighted Temp (F)
10:00	0.93	0.94	-0.01	-1.13%	85.2
11:00	1.14	1.10	0.04	3.59%	89.9
12:00	1.38	1.30	0.08	5.51%	93.6
13:00	1.65	1.54	0.11	6.70%	96.6
14:00	1.86	1.72	0.14	7.37%	98.5
15:00	2.07	1.70	0.37	17.78%	100.3
16:00	2.29	1.89	0.40	17.35%	101.3
17:00	2.50	2.08	0.42	16.64%	101.9
18:00	2.60	2.17	0.44	16.72%	101.6
19:00	2.51	2.13	0.37	14.94%	100.1
20:00	2.35	2.37	-0.02	-0.81%	97.1
21:00	2.19	2.37	-0.18	-8.33%	93.4
22:00	1.98	2.15	-0.17	-8.71%	89.7
23:00	1.65	1.77	-0.12	-7.11%	86.6
0:00	1.32	1.40	-0.08	-6.44%	83.7

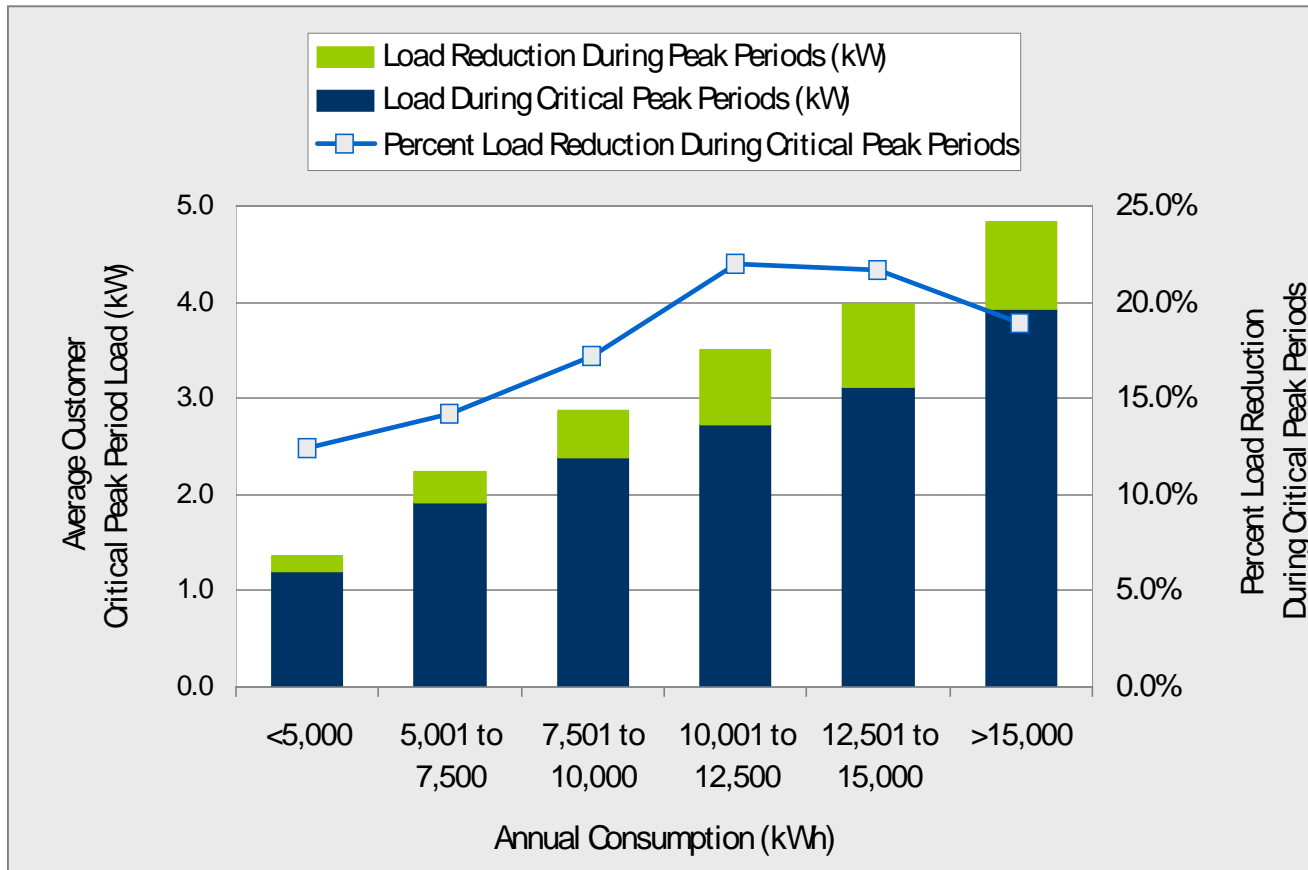
- The average residential customer reduced load by 16.6% during the average event, but impacts vary by hour
- Load reductions were generally followed by a snapback period
- Load reductions were affected by the amount of successful event notifications. On average, customers who were successfully notified reduced load by 20.3% during the critical peak periods.

Load Impacts and Conditions Varied by Event

Date	Day of Week	# of Enrolled Accts	% Notified	Max Temp (°F)	Min Temp (°F)	Average Hourly Load (kW) 2 to 7 pm	Average Load Reduction (kW) 2 to 7 pm	Average % Load Reduction 2 to 7 pm
7/8	T	3,279	64.7	108	79	2.70	0.56	19.2
7/9	W	3,688	70.8	108	84	3.01	0.57	19.1
7/10	Th	3,977	75.3	111	84	3.19	0.72	22.5
8/27	W	9,581	83.7	98	72	2.16	0.27	12.4
8/28	Th	9,561	85.0	102	74	2.50	0.42	17.0
8/29	F	9,544	84.3	106	77	2.82	0.56	19.7
9/3	W	9,924	80.2	98	66	1.91	0.24	12.7
9/4	Th	9,913	80.2	100	67	2.07	0.30	14.7
9/5	F	9,913	80.2	101	71	2.16	0.34	15.7
Avg	n/a	8,758	80.4	102	73	2.39	0.40	16.6

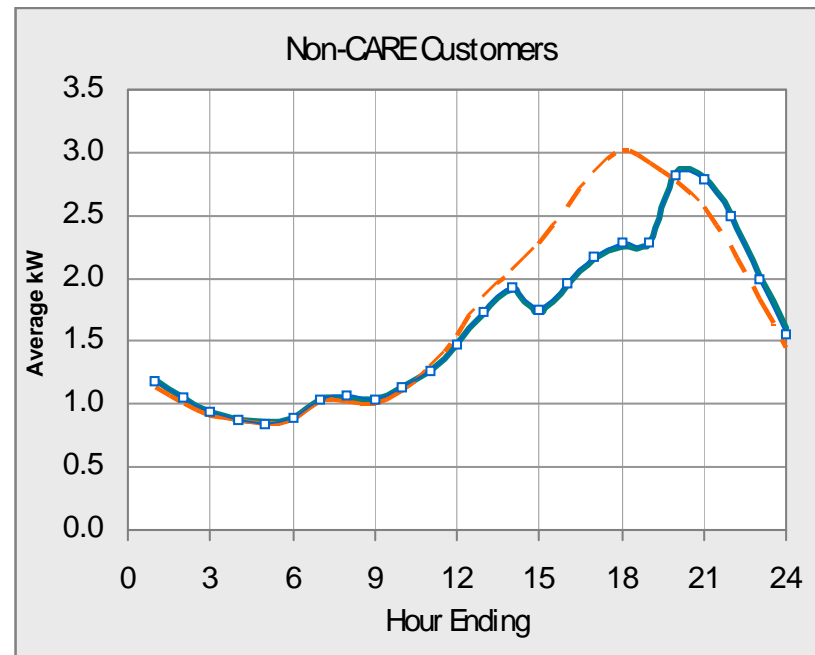
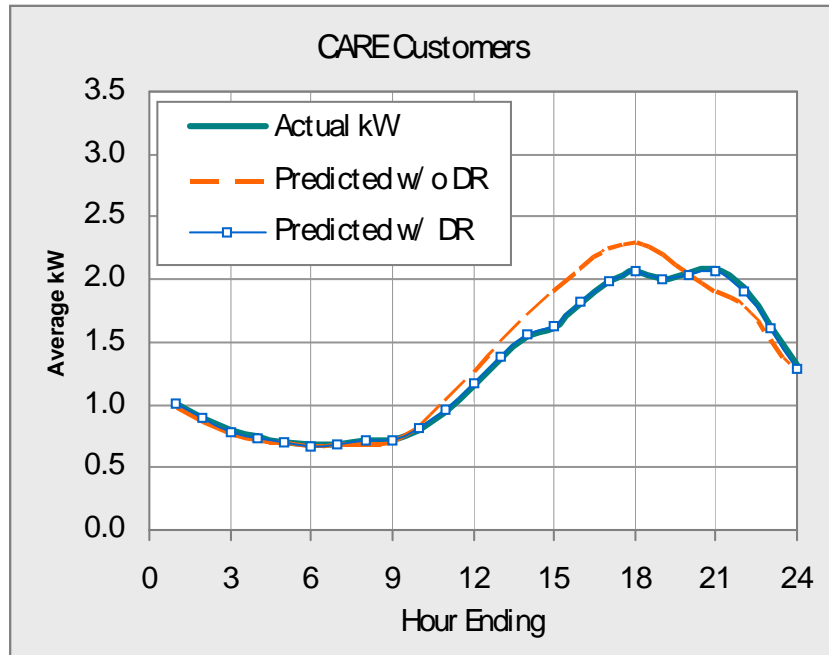
- Absolute and percent load reductions were higher on hotter days
- Load reductions did not drop on the third day of consecutive-day events
- For the first three events, a smaller share of customers were notified due to the rapid enrollment ramp up

Load Impacts Varied by Customer Size



- Mid-sized customers provided the largest percent load reductions
- Customers with the least consumption provided the least percent load reductions

Customers on the Low Income Tariff (CARE) Provided Load Response, But In Smaller Quantities



- The average CARE customer provided load reduction of 0.24 kW (11.0%)
- The average non-CARE customer provided load reduction of 0.62 kW (22.6%)
- CARE customers have flatter loads and get bigger percent rate discounts

Distribution of Percent Load Reductions Among Customers Who Were Notified

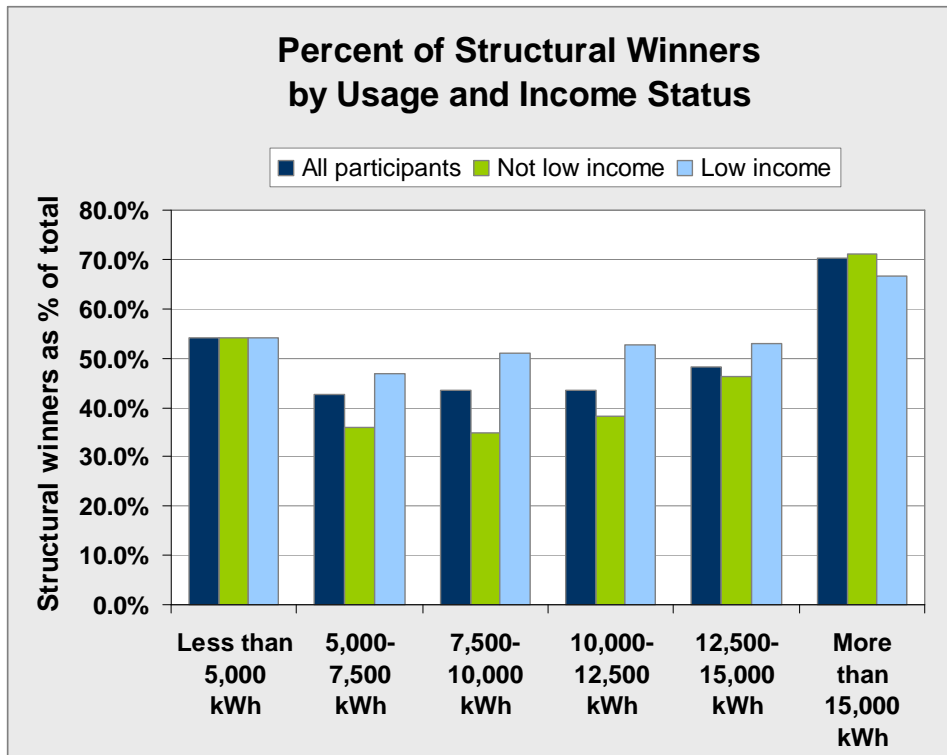
DATE	Share of accounts providing load reductions greater than...					
	0%	10%	20%	30%	40%	50%
7/8/2008	74.7%	61.7%	49.4%	38.5%	31.9%	26.0%
7/9/2008	74.1%	62.5%	46.8%	35.4%	28.9%	24.0%
7/10/2008	76.5%	63.6%	50.2%	38.2%	30.1%	25.0%
8/27/2008	65.3%	47.2%	34.4%	27.9%	21.5%	16.6%
8/28/2008	74.1%	55.5%	38.1%	27.6%	22.4%	17.5%
8/29/2008	75.7%	60.9%	42.4%	31.3%	23.7%	18.8%
9/3/2008	65.7%	50.8%	38.1%	30.5%	23.8%	18.6%
9/4/2008	69.2%	52.8%	37.8%	28.7%	21.7%	17.1%
9/5/2008	70.1%	53.1%	39.3%	28.9%	22.0%	17.2%
Average Event	70.8%	54.7%	39.8%	30.3%	23.6%	18.7%

- The majority of customers who were sent notification provided load response
- Over half reduced load by more than 10% and more than 20% of customers reduced load by more than 40%
- Customers who were sent notification did not necessarily receive the e-mail or voice message on time

Winners, Losers, Enrollment, and Impacts

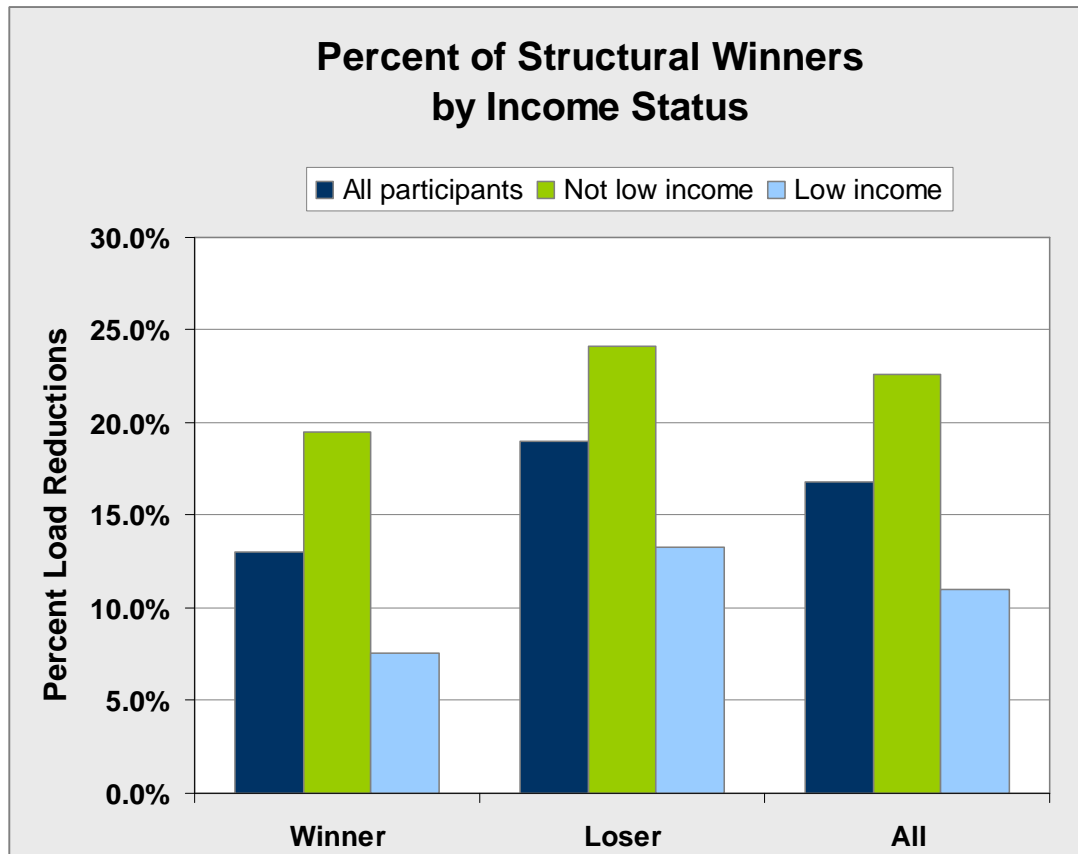
- Who wins or losses as a result of dynamic rates is a controversial issue with little research until now
 - While new rates are revenue neutral on the average, roughly half the customers are automatic winners and half are automatic losers.
 - With new rates, customer bills change without any change in behavior, **primarily a function of** the rate design and load shape creating structural winners and losers.
 - Actual wins and losses are also tied to customer behavior. Structural losers can come out ahead if they respond to prices.
- There are several key questions associated with structural wins and losses, including:
 - Do customers who automatically lose by enrolling in the rate do so anyhow?
 - Once we factor in changes in behavior, **do they come out** ahead?
 - Are low income customers more likely to be structural winners or losers?
 - Do structural winners provide load response since they come out ahead event if they do not provide price response?

Who Were the Winners and Losers?



- 48.5% of all customers who enrolled in SmartRate were structural winners – structural loser do enroll
- 51.5% of customer on the low income tariff were structural winners
- Customer with very low usage and high usage were more likely to be winners, partly due to the rate design
- More than 90% of customers came out ahead after factoring behavior
 - 9 events were called, though the tariff was designed for 15 events

Did structural winners provide load response?



- YES
- Structural winners and losers provided load response regardless of whether they were signed onto the low income tariff
- The net results indicate lower percent load regression
- The preliminary regression results indicate that wins and losses do not affect the percent load reduction.

Summary

- SmartRate enrollment rates exceeded expectations, reaching nearly 8% of the target population based largely on a single direct mail marketing piece
- An average reduction of almost 17% was obtained without any enabling technology such as Programmable Communicating Thermostats (PCTs)
 - Based on evidence from elsewhere, larger reductions are likely with PCTs
 - In 2009, PG&E will be offering SmartRate customers participation in the Company's A/C cycling/PCT program (SmartAC), and will also offer SmartRate to current SmartAC participants
- Almost 1/3 of enrolled customers provided average load reductions exceeding 30%
- CARE customers were less price responsive than non-CARE customers, although the average reduction for CARE customers (11%) was still significant
- Both percent and absolute load reductions increased as temperature increased
- Demand response did not drop off on the third day of consecutive, three day events



For any questions or for copies of the reports, feel free to contact

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