2012 Impact Evaluation of Pacific Gas & Electric Company's PeakChoice Program for Commercial and Industrial Customers

Ex Post Report

CALMAC Study ID PGE0325

Daniel G. Hansen and David A. Armstrong

Christensen Associates Energy Consulting, LLC

800 University Bay Drive, Suite 400
Madison, WI 53705
(608) 231-2266

April 1, 2013

Table of Contents

Tables

Figures

Abstract

This report documents the results of a load impact evaluation of the PeakChoice Program offered by Pacific Gas and Electric Company ("PG&E") in 2012. Ex post hourly load impacts were estimated for the three event days called during the 2012 program year.

First offered in 2009, PeakChoice was a flexible bidding-based demand response program that provided enrolled customers with the opportunity to receive financial credits in payment for load reductions on event days. This program was available to bundled service customers who are able to provide at least 10 kW of load reductions and are served on a commercial, industrial, or agricultural time-of-use rate. The program season ran from May 1 through October 31. A number of program options were available to participating customers. First, they were able to choose to participate on a Committed Load or Best Efforts basis. Under the Committed Load version, customers received a monthly capacity credit, plus an energy payment for measured load reductions if events were called, but were penalized for non-compliance during program events. Under the Best Efforts option, customers were paid only for performance during program events and were *not* penalized for non-compliance. The program was terminated on December 31, 2012.

Program year 2012 enrollment in PeakChoice was 256 service accounts. The majority of the service accounts were located in the Greater Bay Area. The Manufacturing and Offices, Hotels, Health, Services groups account for the largest shares of demand.

We estimated ex post load impacts on the basis of individual-customer regression equations estimated using customer-level hourly load data from May through October. The equations represented hourly load as a function of variables designed to control for factors affecting consumers' hourly demand levels. The customer-specific regressions allowed the development of ex post load impacts at the program level, by program type, by industry type, and by local capacity area. Load impacts were estimated for all participating customers (which includes all called Committed Load customers and the Best Efforts customers who were called and submitted a bid). The total load level (i.e., reference load) includes all called customers (i.e., including Best Efforts customers who were called but did not submit a bid). The total hourly PeakChoice program load impact averaged 3.9 MW (or 3.6 percent) over the event hours.

Executive Summary

This report documents a load impact evaluation of Pacific Gas and Electric Company's ("PG&E") PeakChoice Program for 2012. Ex-post hourly load impacts were estimated for the three events called during the 2012 program year. Load impacts were estimated using separate regression equations for each called customer account. This approach provides a flexible method for reporting estimated load impacts by a number of factors, such as industry type and location, and for investigating the effects of participation in PG&E's Automated Demand Response (AutoDR) program.

The primary research questions addressed by this study are:

1. What were the PeakChoice load impacts in 2012?
2. How were the load impacts distributed across industry groups?
3. How were the load impacts distributed across local capacity areas?
4. What were the effects of AutoDR on customer-level load impacts?

ES.1 Resources Covered

PeakChoice Program Description

First offered in 2009, PeakChoice was a flexible bidding-based demand response program that provided enrolled customers with the opportunity to receive financial credits in payment for load reductions on event days. This program was available to bundled service customers who are able to provide at least 10 kW of load reductions and are served on a commercial, industrial, or agricultural time-of-use rate. The program season ran from May 1 through October 31. A number of program options were available to participating customers. First, they were able to choose to participate on a Committed Load or Best Efforts basis.[1] Under the Committed Load version, customers received a monthly capacity credit, plus an energy payment for measured load reductions if events were called, but were penalized for non-compliance during program events. Under the Best Efforts option, customers were paid only for performance during program events and were *not* penalized for non-compliance. The program was terminated on December 31, 2012.

Three PeakChoice events were called in 2012, on July 11, August 9, and August 10. Because of the range of options available to program participants, the event hours varied by service account. In addition, a subset of the PeakChoice customers also participated in the California Independent System Operator's Market Award Proxy Demand Resource (PDR) program, which had five additional event days: August 13-15, September 12, and October 17.

[1] The tariff allowed customers participating under the Committed Load option to also participate under the Best Efforts option. There were no PeakChoice customers participating under both the Committed and Best Efforts options.

Enrollment

Program year 2012 enrollment in PeakChoice was 256 service accounts. The majority of the service accounts were located in the Greater Bay Area. The Manufacturing and Offices, Hotels, Health, Services groups account for the largest shares of demand.

ES.2 Evaluation Methodology

We estimated ex post load impacts using customer-level hourly load data from May through September. Individual-customer regression equations represented hourly load as a function of several variables designed to control for factors affecting consumers' hourly demand levels, including:

- Seasonal and hourly time patterns (*e.g.*, year, month, day-of-week, and hour, plus various hour/day-type interactions);
- Weather (*e.g.*, cooling degree hours, including hour-specific weather coefficients);
- Event indicator (dummy) variables. A series of variables was included to account for each hour of the event days, allowing us to estimate the load impacts for each hour of the event days.

PeakChoice program-level load impacts were obtained by summing the estimated hourly event coefficients for all participating customers. The individual customer models allow the development of information on the distribution of load impacts across industry types and geographical regions by aggregating customer load impacts for the relevant industry group or local capacity area.

ES.3 Ex Post Load Impacts

The total hourly PeakChoice program load impact averaged 3.9 MW (or 3.6 percent) over the event hours.

The average per-customer event-hour load impact by program type was as follows:

1. Committed load, day-of notice = 59.1 kW
2. Committed load, day-ahead notice = 15.1 kW
3. Committed load, two-day-ahead notice = 49.9 kW
4. Best efforts, day-of notice = 2.9 kW
5. Best efforts, day-ahead notice = 15.9 kW
6. Best efforts, two-day-ahead notice = 0 kW

ES.4 AutoDR and TA/TI Load Impacts

An average of two TA/TI service accounts participated in each PeakChoice event. They provided an average of 121 kW in load impacts, or 3.3 percent of their reference load. For AutoDR, an average of 3 service accounts participated in each PeakChoice event. They provided 76 kW of load impacts, or 4.8 percent of their reference load.

1. Introduction and Purpose of the Study

This report documents a load impact evaluation of Pacific Gas and Electric Company's ("PG&E") PeakChoice Program for 2012. Ex-post hourly load impacts were estimated for the three events called during the 2012 program year. Load impacts were estimated using separate regression equations for each called customer account. This approach provides a flexible method for reporting estimated load impacts by a number of factors, such as industry type and location, and for investigating the effects of participation in PG&E's Automated Demand Response (AutoDR) program.

During 2012, the PeakChoice Program was available to bundled service customers who are able to provide at least 10 kW of load reductions and are served on a commercial, industrial, or agricultural time-of-use rate. PeakChoice provided a wide range of DR program options, including variations in the level of customer commitment to respond, the amount of notice provided for events, and the allowed event duration. The program was terminated on December 31, 2012.

The primary research questions addressed by this study are:

1. What were the PeakChoice load impacts in 2012?
2. How were the load impacts distributed across industry groups?
3. How were the load impacts distributed across local capacity areas?
4. What were the effects of AutoDR on customer-level load impacts?

The report is organized as follows. Section 2 describes the PeakChoice program, the enrolled customers, and the events called; Section 3 describes the methods used in the study; Section 4 contains the detailed ex post load impact results, including estimates of AutoDR load impacts; Section 5 contains an assessment of the validity of the study; and Section 6 provides conclusions and recommendations. The appendix contain detailed tables of event-specific load impacts for each program, as well as load impacts by industry group and local capacity area.

2. Description of Resources Covered in the Study

2.1 Program Description

First offered in 2009, PeakChoice was a flexible bidding-based demand response program that provided enrolled customers with the opportunity to receive financial credits in payment for load reductions on event days. This program was available to bundled service customers who are able to provide at least 10 kW of load reductions and are served on a commercial, industrial, or agricultural time-of-use rate. The program season ran from May 1 through October 31. A number of program options were available to participating customers. First, they were able to choose to participate

on a Committed Load or Best Efforts basis.[2] Under the Committed Load version, customers received a monthly capacity credit, plus an energy payment for measured load reductions if events ware called, but were penalized for non-compliance during program events. Under the Best Efforts option, customers were paid only for performance during program events and were *not* penalized for non-compliance.

Customers had a variety of additional options within PeakChoice, including the following:

- Four different levels of *event notification* time (two days, one day, 4.5 hours, and 30 minutes prior to initiation of an event);
- Three different *event durations* (two to three, three to five, and four to six hours);
- Three different numbers of *consecutive event days allowed* (one, two and three);
- The *maximum number of events* per summer season (three to twenty-five); and
- Two different *event windows* (1 p.m. to 7 p.m. on non-holiday weekdays, or all hours of non-holidays).

The combination of options produced a wide range of program options in which a given customer could have enrolled.

For analysis purposes, we categorize enrolled customers into one of six groups:

1. Committed load, day-ahead (DA) notice;
2. Committed load, day-of (DO) notice;
3. Commited load, two-day-ahead (2DA) notice;
4. Best efforts, day-ahead notice;
5. Best efforts, day-of notice; and
6. Best efforts, two-day-ahead notice.

Credits were paid based on the difference between the customers' actual metered load during an event to a reference load, or baseline, calculated from that customer's usage data prior to the event (*e.g.*, using the 10-in-10 day method). Thus, credits were paid based on the difference between a customer's baseline for a particular hour and their actual energy usage during that hour. Notice for events could have been sent to the customer two days before, the day before, or the day of the event.

[2] The tariff allowed customers participating under the Committed Load option to also participate under the Best Efforts option. There were no PeakChoice customers participating under both the Committed and Best Efforts options.

2.2 Characteristics of Enrolled and Participating Customers

2.2.1 Development of Customer Groups

In order to assess differences in load impacts across customer types, the enrolled customers[3] were categorized according to eight industry types. The industry groups are defined according to their applicable two-digit North American Industry Classification System (NAICS) codes:

1. Agriculture, Mining and Oil and Gas, Construction: 11, 21, 23
2. Manufacturing: 31-33
3. Wholesale, Transport, other Utilities: 22, 42, 48-49
4. Retail stores: 44-45
5. Offices, Hotels, Health, Services: 51-56, 62, 72
6. Schools: 61
7. Entertainment, Other Services, and Government: 71, 81, 92
8. Other or unknown

In addition, customers were classified by the CAISO Local Capacity Area (LCA) in which the customer service account is located (if any).

2.2.2 Enrolled Customers by Program Type

The following sets of tables summarize the characteristics of the enrolled customer accounts, including industry type, LCA, and program type. Table 2.1 shows enrollment by industry group of the 256 participants, including usage statistics. The Manufacturing and Offices, Hotels, Health, Services groups accounted for the largest shares of demand.

A notable difference between enrollments in PY2012 versus the previous program year is that a very large (over 100 MW) and highly demand responsive customer left the program following the 2011 program year.

[3] In this report, the terms "customer" and "service account" are used interchangeably. In both instances, the term refers to a single service account, or SAID.

Table 2.1: PeakChoice Enrollees by Industry group – *2012*

Industry Type	Number of SAIDs	Sum of Max MW[4]	Sum of Avg. MWh[5]	% of Max MW	Avg. Max MW[6]
1. Agriculture, Mining & Construction	4	2.5	0.8	1.6%	0.61
2. Manufacturing	61	40.3	26.9	26.5%	0.66
3. Wholesale, Transport, Other Utilities	6	1.5	1.0	1.0%	0.25
4. Retail Stores	2	0.5	0.2	0.3%	0.23
5. Offices, Hotels, Health, Services	139	86.2	52.1	56.7%	0.62
6. Schools	32	16.1	6.6	10.6%	0.50
7. Entertainment, Other Services, Gov't	10	4.0	2.1	2.7%	0.40
8. Other/Unknown	2	1.0	0.5	0.6%	0.48
TOTAL	**256**	**152.1**	**90.3**		**0.59**

Table 2.2 shows enrollment by local capacity area. The majority of the customers and load were in the Greater Bay Area LCA.

Table 2.2: PeakChoice Enrollees by Local Capacity Area – *2012*

Local Capacity Area	Number of SAIDs	Sum of Max MW	Sum of Avg. MWh	% of Max MW	Avg. Max MW
Greater Bay Area	207	125.3	77.9	82.4%	0.61
Greater Fresno	1	0.4	0.2	0.3%	0.41
Humboldt	1	0.1	0.0	0.0%	0.05
Kern	17	11.7	5.1	7.7%	0.69
Northern Coast	9	2.8	1.4	1.8%	0.31
Not in any LCA	19	10.5	5.3	6.9%	0.55
Stockton	2	1.4	0.3	0.9%	0.70
TOTAL	**256**	**152.1**	**90.3**		**0.59**

Table 2.3 shows enrollment by program type. The Committed Load and Best Efforts day-ahead programs contained the largest shares of customers and load.

[4] "Sum of Max MW" is defined as the sum of the non-coincident peak demands across service accounts, where each service account's peak demand is calculated as the average of the six monthly peak demand values for the program months (May through October).

[5] "Sum of Avg. MWh" is defined as the sum of the average hourly usage values across service accounts. Each service account's average usage is calculated across all hours of the program months (May through October).

[6] "Avg. Size" is calculated as "Sum of Max MW" divided by "Number of SAIDs."

Table 2.3: PeakChoice Enrollees by Program Type – *2012*

Program Type	Number of SAIDs	Sum of Max MW	Sum of Avg. MWh	% of Max MW	Avg. Max MW
Best Efforts, 2-Day Ahead	16	9.3	5.9	6.1%	0.58
Best Efforts, Day Ahead	92	51.9	28.4	34.1%	0.56
Best Efforts, Day Of	39	19.5	10.7	12.8%	0.50
Committed Load, 2-Day Ahead	2	1.0	0.7	0.7%	0.52
Committed Load, Day Ahead	95	60.6	40.0	39.9%	0.64
Committed Load, Day Of	12	9.7	4.7	6.4%	0.81
TOTAL	**256**	**152.1**	**90.3**		**0.59**

2.3 Event Days

Three PeakChoice events were called in 2012, on July 11, August 9, and August 10. Because of the range of options available to program participants, the event hours varied by service account. Tables 2.4 through 2.6 show the number and size of service accounts by event type, with variations shown by level of commitment (Best Efforts versus Committed Load), notice amount, and the event window. The tables include only event "participants," which includes all called Committed Load customers but only Best Efforts customers who submitted a bid.

Table 2.4: PeakChoice Participants by Program Type – *July 11, 2012 Event*

Commitment	Notice	Event Hours	Count	Sum of Max MW	% of Max MW
Best efforts	2 day ahead	3:00 to 5:00 p.m.	7	2.5	2.4%
Best efforts	Day ahead	2:00 to 4:00 p.m.	3	1.7	1.6%
Best efforts	Day ahead	2:00 to 6:00 p.m.	30	24.3	23.8%
Best efforts	Day of	2:00 to 4:00 p.m.	1	0.6	0.6%
Best efforts	Day of	2:00 to 5:00 p.m.	1	0.2	0.2%
Best efforts	Day of	2:00 to 6:00 p.m.	3	1.4	1.4%
Committed load	2 day ahead	3:00 to 6:00 p.m.	2	1.0	1.0%
Committed load	Day ahead	2:00 to 4:00 p.m.	65	41.9	41.1%
Committed load	Day ahead	2:00 to 5:00 p.m.	3	1.0	1.0%
Committed load	Day ahead	2:00 to 6:00 p.m.	27	17.7	17.4%
Committed load	Day of	2:00 to 4:00 p.m.	4	4.9	4.8%
Committed load	Day of	2:00 to 5:00 p.m.	6	3.9	3.8%
Committed load	Day of	2:00 to 6:00 p.m.	2	0.9	0.9%
TOTAL			**154**	**102.0**	**100.0%**

Table 2.5: PeakChoice Participants by Program Type – *August 9, 2012 Event*

Commitment	Notice	Event Hours	Count	Sum of Max MW	% of Max MW
Best efforts	2 day ahead	1:00 to 4:00 p.m.	6	2.3	2.2%
Best efforts	2 day ahead	1:00 to 5:00 p.m.	7	4.8	4.6%
Best efforts	Day ahead	1:00 to 4:00 p.m.	4	2.1	2.0%
Best efforts	Day ahead	1:00 to 5:00 p.m.	28	17.8	17.0%
Best efforts	Day ahead	1:00 to 6:00 p.m.	5	3.5	3.4%
Best efforts	Day ahead	1:00 to 7:00 p.m.	1	3.0	2.8%
Best efforts	Day of	1:00 to 5:00 p.m.	1	0.2	0.2%
Best efforts	Day of	1:00 to 6:00 p.m.	3	1.2	1.2%
Committed load	2 day ahead	3:00 to 6:00 p.m.	2	1.0	1.0%
Committed load	Day ahead	1:00 to 4:00 p.m.	63	41.2	39.3%
Committed load	Day ahead	1:00 to 5:00 p.m.	14	7.4	7.1%
Committed load	Day ahead	1:00 to 6:00 p.m.	16	11.3	10.8%
Committed load	Day of	1:00 to 4:00 p.m.	5	5.5	5.2%
Committed load	Day of	1:00 to 5:00 p.m.	4	2.4	2.2%
Committed load	Day of	1:00 to 6:00 p.m.	2	0.9	0.9%
TOTAL			**161**	**104.7**	**100.0%**

Table 2.6: PeakChoice Participants by Program Type – *August 10, 2012 Event*

Commitment	Notice	Event Hours	Count	Sum of Max MW	% of Max MW
Best efforts	2 day ahead	1:00 to 5:00 p.m.	7	4.8	8.7%
Best efforts	Day ahead	1:00 to 4:00 p.m.	9	3.0	5.5%
Best efforts	Day ahead	1:00 to 5:00 p.m.	24	16.0	28.8%
Best efforts	Day ahead	1:00 to 6:00 p.m.	6	3.8	6.8%
Best efforts	Day of	1:00 to 4:00 p.m.	1	0.8	1.4%
Best efforts	Day of	1:00 to 5:00 p.m.	1	0.2	0.4%
Best efforts	Day of	1:00 to 6:00 p.m.	2	0.9	1.6%
Committed load	2 day ahead	1:00 to 4:00 p.m.	2	1.0	1.8%
Committed load	Day ahead	1:00 to 4:00 p.m.	10	7.3	13.2%
Committed load	Day ahead	1:00 to 5:00 p.m.	12	6.4	11.5%
Committed load	Day ahead	1:00 to 6:00 p.m.	12	7.2	12.9%
Committed load	Day of	1:00 to 4:00 p.m.	3	1.5	2.7%
Committed load	Day of	1:00 to 5:00 p.m.	4	2.4	4.2%
Committed load	Day of	1:00 to 6:00 p.m.	1	0.2	0.4%
TOTAL			**94**	**55.7**	**100.0%**

A subset of the PeakChoice customers also participated in the California Independent System Operator's Market Award Proxy Demand Resource (PDR) program, which had five additional event days: August 13-15, September 12, and October 17. The report summarizes the load impacts for those customers and event days in addition to the PeakChoice event days.

3. Study Methodology

3.1 Overview

The ex post load impact evaluation includes three activities:

1) Develop estimates of hourly load impacts for the event days in 2012, where the evaluation conforms to the requirements of the Protocols;
2) Report the percentage of those load impacts that are accounted for by each industry type and each LCA; and
3) Estimate hourly load impacts for program enrollees who participated in the AutoDR program.

The first study activity consists of estimating the hourly load impacts and average daily load impacts for each event day during the 2012 program year. The results are summarized at the program level and various sub-program levels, using methods that conform to the Protocols. These include estimating the load impacts at both the program-level and per-enrolled-customer basis. The second study activity involves estimating load impacts for each industry type and each of the CAISO local capacity areas. In addition, uncertainty-adjusted ranges of load impact estimates are to be provided.

We estimated *individual customer regressions* that include event-specific variables, allowing the direct estimation of hourly load impacts for each called customer. Program-level load impacts may then be obtained directly as the sum of the estimated individual customer load impacts for participating customers.[7] In addition, load impacts by LCA (or other relevant sub-groups, such as Committed Load and Best Efforts, and day-ahead and day-of program types) may be obtained similarly as the sum of participating customer load impacts within each category. The availability of individual customer load impacts also provides the information needed to examine *distributions* of load impacts across customers of different types.

3.2 Description of Methods

3.2.1 Regression Model

The model shown below was separately estimated for each enrolled customer. Table 3.1 describes the terms included in the equation.

[7] That is, we only add up load impacts for *participating* customers (all called Committed Load customers plus Best Efforts customers who submitted a bid). The reference and observed loads include all *called* customers (i.e., it includes Best Efforts customers who were called for the event but did not submit a bid).

$$Q_t = a + \sum_{Evt=1}^{E} \sum_{i=1}^{24} (b_{i,Evt}^{PeakChoice} \times h_{i,t} \times PeakChoice_t) + \sum_{i=1}^{24} (b_i^{MornLoad} \times h_{i,t} \times MornLoad_{i,t})$$
$$+ \sum_{i=1}^{24} (b_i^{Weather} \times h_{i,t} \times Weather_t) + \sum_{i=2}^{24} (b_i^{MON} \times h_{i,t} \times MON_t) + \sum_{i=2}^{24} (b_i^{FRI} \times h_{i,t} \times FRI_t)$$
$$+ \sum_{i=2}^{24} (b_i^{h} \times h_{i,t}) + \sum_{i=2}^{5} (b_i^{DTYPE} \times DTYPE_{i,t}) + \sum_{i=6}^{10} (b_i^{MONTH} \times MONTH_{i,t}) + e_t$$

Table 3.1: Descriptions of Terms included in the Ex Post Regression Equation

Variable Name / Term	Variable / Term Description
Q_t	the demand in hour *t* for a customer enrolled in PeakChoice prior to the last event date
The various *b*'s	the estimated parameters
$h_{i,t}$	a dummy variable for hour *i*
$PeakChoice_t$	an indicator variable for program event days
$Weather_t$	the weather variables selected using our model screening process
E	the number of event days that occurred during the program year
$MornLoad_t$	a variable equal to the average of the day's load in hours 1 through 10
MON_t	a dummy variable for Monday
FRI_t	a dummy variable for Friday
$DTYPE_{i,t}$	a series of dummy variables for each day of the week
$MONTH_{i,t}$	a series of dummy variables for each month
e_t	the error term.

The "morning load" variables are included in the same spirit as the day-of adjustment to the 10-in-10 baseline settlement method. That is, those variables help adjust the reference loads (or the loads that would have been observed in the absence of an event) for factors that affect pre-event usage, but are not accounted for by the other included variables. The model allows for the hourly load profile to differ by day of week, with separate profiles for Monday, Tuesday through Thursday, and Friday.

The model specification shown above has the *level* of load in a particular hour as the dependent variable. As part of our model validation process (explained in Section 5), we tested models in which the dependent variable is the *difference* between the current hour's load and the load during the same hour on the previous day. We refer to these as models of "differences," in which these differences are calculated for all of the variables included in the model. Therefore, instead of estimating the equation using Q_t as the dependent variable (as in the levels model), the model is estimated using dQ_t, which is calculated from hourly data as follows:

$$dQ_t = Q_t - Q_{t-24}$$

Every explanatory variable in the estimating equation is transformed in the same fashion and the model is estimated using the differenced data.

We estimated customer-level equations for all called customers. These equations produced estimates of hourly load impacts and the implied average daily load impacts for the event for each customer. Load impacts by industry type, CAISO local capacity area, program type, and presence of enabling technology were calculated by adding the load impacts from the customer-level regression models of participating customers. The following six major categories of PeakChoice program variations were used in this evaluation:

- Committed Load, Day-ahead notice;
- Committed Load, Day-of notice;
- Committed Load, Two-day-ahead notice;
- Best Efforts, Day-ahead notice;
- Best Efforts, Day-of notice; and
- Best Efforts, Two-day-ahead notice.

3.2.2 Development of Uncertainty-Adjusted Load Impacts

The Load Impact Protocols require the estimation of uncertainty-adjusted load impacts. In the case of ex post load impacts, the parameters that constitute the load impact estimates are not estimated with certainty. Therefore, we base the uncertainty-adjusted load impacts on the variances associated with the estimated load impacts.

Specifically, we add the variances of the estimated load impacts across the customers participating in the event in question. The uncertainty-adjusted scenarios were simulated under the assumption that each hour's load impact is normally distributed with the mean equal to the sum of the estimated load impacts and the standard deviation equal to the square root of the sum of the variances of the errors around the estimates of the load impacts. Results for the 10^{th}, 30^{th}, 70^{th}, and 90^{th} percentile scenarios are generated from these distributions.

4. Detailed Study Findings

The primary objective of the ex post evaluation is to estimate the aggregate and per-customer PeakChoice event-day load impacts.[8] This section begins with a summary of estimated *hourly* and *average hourly load impacts*, with separate tables summarizing load impacts by event, industry type, local capacity area, and program type. Tables of hourly load impacts are then presented in the format required by the Load Impact Protocols adopted by the California Public Utilities Commission (CPUC) in Decision (D.) 08-04-050 ("the Protocols"), including uncertainty-adjusted load impacts at different probability levels, and figures that illustrate the PeakChoice event-day loads and load impacts.

[8] The main body of the report focuses on aggregate program impacts. The full set of tables required by the Protocols, including load impacts by event day and local capacity area, are provided separately in an Excel file.

4.1 Average Hourly Load Impacts by Industry Group, LCA, and Program

Aggregate PeakChoice program load impacts were estimated on the basis of individual customer regression equations using data for all participants. Table 4.1 summarizes the estimated hourly load impacts, along with the estimated reference load and observed load) for the three PeakChoice event days, reflecting an aggregation across program types.[9] Note that fewer customers were called for the August 10th event day, which is why the levels of the aggregate reference load and load impact are lower than they are on the preceding event days.

Total PeakChoice load impacts averaged 3.9 MW across the three event days. This is substantially lower than the 20.9 MW average during PY2011, primarily due to the departure of the program's largest customer.

Table 4.1: Average Hourly Load Impacts by Event, *PeakChoice*

Event	Date	Day of Week	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% LI
1	7/11/2012	Wednesday	128.2	123.8	4.4	3.5%
2	8/9/2012	Thursday	129.2	124.8	4.4	3.4%
3	8/10/2012	Friday	69.3	66.5	2.8	4.0%
		Average	**108.9**	**105.0**	**3.9**	**3.6%**
		Std. Dev.			**0.9**	**0.9%**

Table 4.2 summarizes the estimated load impacts for the five PDR event days during the 1:00 to 7:00 p.m. event window. The events are quite different from one another due to changes in the participating customers.

Table 4.2: Average Hourly Load Impacts by Event, *PDR*

Event	Date	Day of Week	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% LI
1	8/13/2012	Monday	4.59	4.35	0.25	5.3%
2	8/14/2012	Tuesday	0.70	0.28	0.42	59.4%
3	8/15/2012	Wednesday	5.23	4.51	0.73	13.9%
4	9/12/2012	Wednesday	2.27	2.26	0.01	0.3%
5	10/17/2012	Wednesday	1.29	1.08	0.21	16.3%
		Average	**2.82**	**2.50**	**0.32**	**11.4%**
		Std. Dev.			**0.27**	**9.6%**

Tables 4.3, 4.4 and 4.5 show the distribution of estimated average hourly load impacts by industry group, LCA and program type, respectively, for the average PeakChoice event (i.e., not considering the five PDR events). The reference loads, observed loads, and load impacts are averaged across 2:00 to 6:00 p.m. to produce the tables.

[9] The load impacts are summed over only participating customers, while the observed and reference loads include all called customers. The July 11th event is summarized across 2:00 to 6:00 p.m., while the latter two events are summarized across 1:00 to 6:00 p.m.

Table 4.3: Average Hourly PeakChoice Load Impacts (MW) – *by Industry Type*

Industry Type	# of SAIDs	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% Load Impact
1. Agriculture, Mining & Construction	4	1.1	0.6	0.46	44.0%
2. Manufacturing	61	27.6	26.8	0.81	2.9%
3. Wholesale, Transport, Other Utilities	6	0.9	0.9	0.03	3.0%
4. Retail Stores	2	0.3	0.3	0.02	6.2%
5. Offices, Hotels, Health, Services	137	64.4	63.1	1.26	2.0%
6. Schools	32	9.9	9.0	0.87	8.9%
7. Entertainment, Other Services, Gov't	10	3.4	3.2	0.22	6.4%
8. Other/Unknown	2	0.9	0.8	0.08	8.9%
TOTAL	**254**	**108.4**	**104.6**	**3.75**	**3.5%**

Table 4.4 shows average hourly load impacts by LCA.

Table 4.4: Average Hourly PeakChoice Load Impacts (MW) – *by LCA*

Local Capacity Area	# of SAIDs	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% Load Impact
Greater Bay Area	205	91.6	89.8	1.81	2.0%
Greater Fresno	1	0.4	0.4	0.00	0.0%
Humboldt	1	0.0	0.0	0.00	0.0%
Kern	17	7.7	6.9	0.77	10.0%
Northern Coast	9	1.6	1.5	0.09	5.4%
Not in any LCA	19	6.8	5.8	1.00	14.6%
Stockton	2	0.3	0.2	0.09	28.2%
TOTAL	**254**	**108.4**	**104.6**	**3.75**	**3.5%**

Table 4.5 shows the average hourly loads and load impact across all PeakChoice event days (from 2:00 to 6:00 p.m.) by program type. The majority of the load impacts were in the Best Efforts and Committed Load day-ahead notice groups

Table 4.5: Average Hourly PeakChoice Load Impacts (MW) – *by Program Type*

Program Type	# of SAIDs	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% Load Impact
Best Efforts, Day Ahead	92	38.0	36.5	1.46	3.9%
Best Efforts, Day Of	39	15.0	14.9	0.11	0.8%
Best Efforts, 2-Day Ahead	16	5.5	5.5	-0.01	-0.2%
Committed Load, Day Ahead	94	43.4	42.0	1.42	3.3%
Committed Load, Day Of	11	5.5	4.8	0.67	12.3%
Committed Load, 2-Day Ahead	2	1.0	0.9	0.10	10.2%
TOTAL	**254**	**108.4**	**104.6**	**3.75**	**3.5%**

The average per-customer event-hour load impact by program type was as follows:

1. Committed load, day-of notice = 59.1 kW
2. Committed load, day-ahead notice = 15.1 kW
3. Committed load, two-day-ahead notice = 49.9 kW
4. Best efforts, day-of notice = 2.9 kW
5. Best efforts, day-ahead notice = 15.9 kW

6. Best efforts, two-day-ahead notice = 0 kW

4.2 Hourly Load Impacts

Table 4.6 presents hourly load impacts for all PeakChoice customers and events (excluding the PDR events) in the manner required by the Protocols. Load impacts were estimated from the individual customer regressions for customers who participated in each event. Note that the overall level of the reference loads and load impacts is reduced somewhat by the inclusion of the third event, during which fewer customers participated.

Table 4.6: Hourly PeakChoice Loads and Load Impacts (MW) – *Typical Event Day*

Hour Ending	Estimated Reference Load (MWh/hr)	Observed Event-Day Load (MWh/hr)	Estimated Load Impact (MWh/hr)	Weighted Average Temperature (^{o}F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th%ile	30th%ile	50th%ile	70th%ile	90th%ile
1	64.2	64.0	0.1	63	-0.4	-0.1	0.1	0.4	0.7
2	63.2	63.0	0.1	62	-0.5	-0.1	0.1	0.4	0.7
3	62.2	61.9	0.2	62	-0.3	0.0	0.2	0.5	0.8
4	62.3	62.2	0.1	61	-0.5	-0.2	0.1	0.3	0.7
5	63.7	63.7	0.1	60	-0.5	-0.2	0.1	0.3	0.6
6	70.5	70.6	0.0	60	-0.6	-0.3	0.0	0.2	0.6
7	80.0	80.1	-0.1	60	-0.7	-0.3	-0.1	0.2	0.5
8	87.1	87.1	-0.1	62	-0.6	-0.3	-0.1	0.2	0.5
9	93.6	93.9	-0.2	65	-0.8	-0.5	-0.2	0.0	0.3
10	100.3	100.1	0.1	68	-0.5	-0.1	0.1	0.4	0.7
11	105.0	104.8	0.2	72	-0.4	0.0	0.2	0.4	0.8
12	108.3	108.0	0.3	76	-0.3	0.1	0.3	0.5	0.9
13	109.8	109.1	0.7	79	0.1	0.4	0.7	0.9	1.2
14	112.1	108.4	3.8	82	3.2	3.5	3.8	4.0	4.4
15	113.2	108.0	5.2	84	4.6	5.0	5.2	5.5	5.8
16	111.8	107.5	4.3	85	3.7	4.1	4.3	4.5	4.9
17	107.4	104.5	2.9	84	2.3	2.7	2.9	3.1	3.5
18	101.1	98.5	2.6	83	2.0	2.3	2.6	2.8	3.2
19	87.8	86.1	1.7	81	1.1	1.5	1.7	2.0	2.3
20	80.3	79.2	1.1	76	0.5	0.9	1.1	1.4	1.7
21	75.6	74.8	0.8	71	0.2	0.6	0.8	1.0	1.4
22	72.0	71.7	0.3	68	-0.3	0.1	0.3	0.6	0.9
23	68.5	68.7	-0.3	66	-0.9	-0.5	-0.3	0.0	0.3
24	65.8	66.2	-0.4	64	-1.0	-0.6	-0.4	-0.1	0.2

	Reference Energy Use (MWh)	Observed Event-Day Energy Use (MWh)	Change in Energy Use (MWh)	Cooling Degree Hours (Base 75^{o} F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th	30th	50th	70th	90th
Daily	2,066	2,042	24	54.3	n/a	n/a	n/a	n/a	n/a

Figure 4.1 shows the estimated hourly load impacts for each program type, which allows for a comparison of the load impacts across program types. Three of the programs (Committed Load Day Of and Day Ahead; and Best Efforts Day Ahead) provided the majority of the total load impact. Figure 4.2 shows the hourly load impacts by event day.

Figure 4.1: PeakChoice Hourly Load Impacts by Program Type[10]

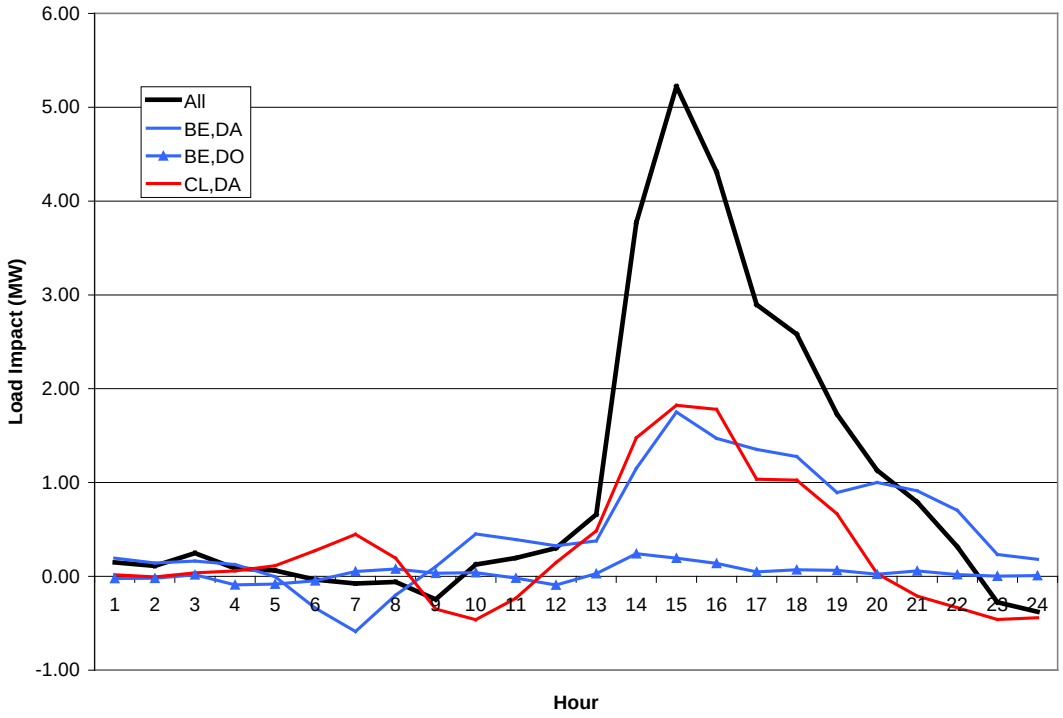
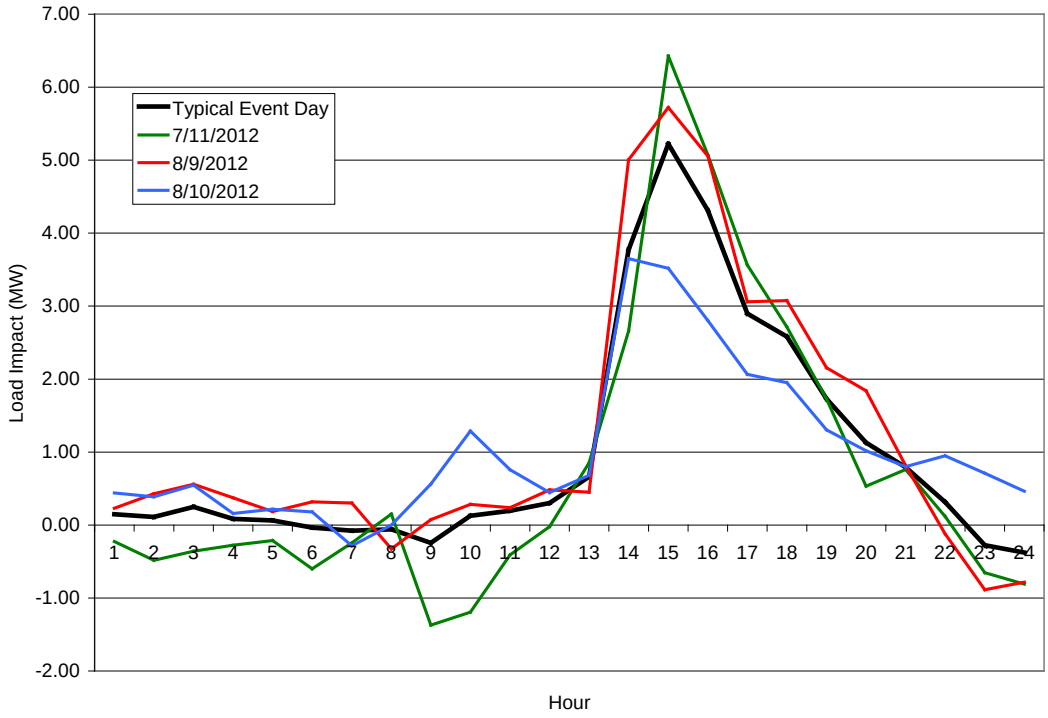


Figure 4.2: PeakChoice Hourly Load Impacts by Event Day



[10] Due to confidentiality concerns, load impacts have been removed for Best Efforts, Two-Day Ahead; Committed Load, Two-Day Ahead; and Committed Load, Day Of customers.

4.3 Protocol Tables by Program

Tables 4.7 through 4.12 present hourly PeakChoice estimated reference loads, observed loads, and load impacts for each program type, averaged across the three PeakChoice event days. As with the results presented above, the load impacts are estimated only for participating customers, while the reference and observed loads include all called customers (i.e., including Best Efforts customers who were called but did not submit a bid).

The full set of tables required by the Protocols, including tables for each local capacity area, is contained in an Excel file attached as an Appendix.

Table 4.7: Hourly Loads and Load Impacts for the Typical Event Day –
PG&E PeakChoice Committed Load, Day-Of Notice

Table removed due to confidentiality concerns.

Table 4.8: Hourly Loads and Load Impacts for the Typical Event Day –
PG&E PeakChoice Committed Load, Day-Ahead Notice

Hour Ending	Estimated Reference Load (MWh/hr)	Observed Event-Day Load (MWh/hr)	Estimated Load Impact (MWh/hr)	Weighted Average Temperature (°F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th%ile	30th%ile	50th%ile	70th%ile	90th%ile
1	27.52	27.50	0.02	63	-0.28	-0.10	0.02	0.14	0.31
2	27.16	27.17	-0.01	62	-0.30	-0.13	-0.01	0.12	0.29
3	26.76	26.72	0.04	61	-0.26	-0.08	0.04	0.16	0.33
4	26.61	26.55	0.06	60	-0.24	-0.06	0.06	0.18	0.36
5	26.95	26.84	0.11	59	-0.18	-0.01	0.11	0.24	0.41
6	28.08	27.80	0.27	59	-0.02	0.15	0.27	0.40	0.57
7	30.65	30.20	0.45	59	0.15	0.33	0.45	0.57	0.75
8	32.53	32.33	0.19	61	-0.10	0.07	0.19	0.31	0.49
9	34.61	34.96	-0.35	64	-0.64	-0.47	-0.35	-0.23	-0.05
10	37.07	37.53	-0.46	67	-0.76	-0.58	-0.46	-0.34	-0.16
11	39.12	39.36	-0.23	70	-0.53	-0.36	-0.23	-0.11	0.06
12	40.94	40.79	0.15	74	-0.15	0.02	0.15	0.27	0.44
13	41.90	41.42	0.49	78	0.19	0.36	0.49	0.61	0.78
14	43.03	41.55	1.48	81	1.18	1.35	1.48	1.60	1.77
15	43.78	41.96	1.82	84	1.52	1.70	1.82	1.94	2.12
16	44.13	42.35	1.78	85	1.48	1.66	1.78	1.90	2.08
17	43.80	42.77	1.03	85	0.74	0.91	1.03	1.16	1.33
18	42.02	40.99	1.03	84	0.73	0.90	1.03	1.15	1.33
19	37.10	36.43	0.67	82	0.37	0.54	0.67	0.79	0.97
20	33.60	33.58	0.03	76	-0.27	-0.10	0.03	0.15	0.33
21	31.11	31.32	-0.21	71	-0.51	-0.33	-0.21	-0.09	0.09
22	29.71	30.05	-0.33	68	-0.63	-0.46	-0.33	-0.21	-0.03
23	28.39	28.84	-0.46	66	-0.76	-0.58	-0.46	-0.34	-0.16
24	27.70	28.14	-0.44	65	-0.74	-0.56	-0.44	-0.32	-0.14
	Reference Energy Use (MWh)	Observed Event-Day Energy Use (MWh)	Change in Energy Use (MWh)	Cooling Degree Hours (Base 75° F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th	30th	50th	70th	90th
Daily	824	817	7	55.2	n/a	n/a	n/a	n/a	n/a

Table 4.9: Hourly Loads and Load Impacts for the Typical Event Day –
PG&E PeakChoice Committed Load Two-Day-Ahead Notice

Table removed due to confidentiality concerns.

Table 4.10: Hourly Loads and Load Impacts for the Typical Event Day – *PG&E PeakChoice Best Efforts, Day-Of Notice*

Hour Ending	Estimated Reference Load (MWh/hr)	Observed Event-Day Load (MWh/hr)	Estimated Load Impact (MWh/hr)	Weighted Average Temperature (^{o}F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th%ile	30th%ile	50th%ile	70th%ile	90th%ile
1	8.79	8.81	-0.02	61	-0.16	-0.08	-0.02	0.03	0.12
2	8.51	8.53	-0.02	61	-0.16	-0.08	-0.02	0.04	0.12
3	8.41	8.40	0.02	60	-0.12	-0.04	0.02	0.07	0.15
4	8.74	8.83	-0.09	60	-0.23	-0.15	-0.09	-0.03	0.05
5	9.03	9.11	-0.08	59	-0.22	-0.14	-0.08	-0.03	0.05
6	10.29	10.34	-0.05	59	-0.18	-0.10	-0.05	0.01	0.09
7	11.44	11.39	0.05	59	-0.09	-0.01	0.05	0.11	0.19
8	12.70	12.62	0.08	60	-0.06	0.02	0.08	0.14	0.22
9	13.64	13.61	0.03	63	-0.10	-0.02	0.03	0.09	0.17
10	14.80	14.76	0.04	67	-0.10	-0.02	0.04	0.09	0.18
11	15.53	15.55	-0.02	70	-0.16	-0.08	-0.02	0.04	0.12
12	15.86	15.95	-0.09	73	-0.23	-0.15	-0.09	-0.04	0.05
13	15.70	15.67	0.03	76	-0.11	-0.03	0.03	0.08	0.17
14	15.91	15.67	0.24	78	0.11	0.19	0.24	0.30	0.38
15	15.77	15.58	0.19	80	0.06	0.14	0.19	0.25	0.33
16	15.63	15.50	0.14	81	0.00	0.08	0.14	0.19	0.28
17	14.90	14.85	0.05	80	-0.09	-0.01	0.05	0.10	0.18
18	13.67	13.60	0.07	79	-0.07	0.02	0.07	0.13	0.21
19	11.93	11.86	0.06	76	-0.07	0.01	0.06	0.12	0.20
20	10.64	10.61	0.02	72	-0.11	-0.03	0.02	0.08	0.16
21	10.30	10.24	0.06	68	-0.08	0.00	0.06	0.12	0.20
22	10.00	9.99	0.02	65	-0.12	-0.04	0.02	0.07	0.16
23	9.61	9.61	0.00	63	-0.13	-0.05	0.00	0.06	0.14
24	9.23	9.22	0.01	62	-0.13	-0.05	0.01	0.06	0.15

	Reference Energy Use (MWh)	Observed Event-Day Energy Use (MWh)	Change in Energy Use (MWh)	Cooling Degree Hours (Base 75^{o} F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th	30th	50th	70th	90th
Daily	291	290	1	24.1	n/a	n/a	n/a	n/a	n/a

Table 4.11: Hourly Loads and Load Impacts for the Typical Event Day – *PG&E PeakChoice Best Efforts, Day-Ahead Notice*

Hour Ending	Estimated Reference Load (MWh/hr)	Observed Event-Day Load (MWh/hr)	Estimated Load Impact (MWh/hr)	Weighted Average Temperature (°F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th%ile	30th%ile	50th%ile	70th%ile	90th%ile
1	21.36	21.16	0.20	66	-0.22	0.03	0.20	0.36	0.61
2	21.09	20.95	0.14	65	-0.27	-0.03	0.14	0.31	0.55
3	20.72	20.56	0.16	64	-0.25	-0.01	0.16	0.33	0.58
4	20.65	20.53	0.13	63	-0.29	-0.04	0.13	0.30	0.54
5	21.27	21.27	0.00	62	-0.42	-0.17	0.00	0.16	0.41
6	25.15	25.49	-0.34	63	-0.75	-0.51	-0.34	-0.17	0.08
7	29.65	30.24	-0.59	63	-1.00	-0.76	-0.59	-0.42	-0.18
8	31.98	32.18	-0.20	65	-0.61	-0.37	-0.20	-0.03	0.21
9	34.43	34.32	0.10	68	-0.31	-0.06	0.10	0.27	0.52
10	36.64	36.19	0.45	72	0.04	0.28	0.45	0.62	0.86
11	38.16	37.76	0.39	76	-0.02	0.22	0.39	0.56	0.80
12	39.39	39.07	0.33	79	-0.09	0.16	0.33	0.49	0.74
13	39.93	39.56	0.38	82	-0.03	0.21	0.38	0.55	0.79
14	40.47	39.32	1.15	85	0.74	0.98	1.15	1.32	1.56
15	40.74	38.98	1.75	86	1.34	1.58	1.75	1.92	2.16
16	39.77	38.30	1.47	88	1.06	1.30	1.47	1.64	1.88
17	36.97	35.62	1.35	87	0.94	1.18	1.35	1.52	1.77
18	34.55	33.27	1.28	85	0.87	1.11	1.28	1.45	1.69
19	29.94	29.05	0.89	84	0.48	0.72	0.89	1.06	1.30
20	27.93	26.93	1.00	79	0.59	0.83	1.00	1.17	1.41
21	26.46	25.55	0.91	75	0.50	0.74	0.91	1.08	1.32
22	24.90	24.20	0.70	71	0.29	0.54	0.70	0.87	1.12
23	23.44	23.21	0.23	68	-0.18	0.06	0.23	0.40	0.65
24	22.14	21.96	0.18	67	-0.23	0.01	0.18	0.35	0.59

	Reference Energy Use (MWh)	Observed Event-Day Energy Use (MWh)	Change in Energy Use (MWh)	Cooling Degree Hours (Base 75° F)	Uncertainty Adjusted Impact (MWh/hr) - Percentiles				
					10th	30th	50th	70th	90th
Daily	728	716	12	79.9	n/a	n/a	n/a	n/a	n/a

Table 4.12: Hourly Loads and Load Impacts for the Typical Event Day –
PG&E PeakChoice Best Efforts Two-Day-Ahead Notice

Table removed due to confidentiality concerns.

Figures 4.3 through 4.8 display the corresponding estimated reference load, observed load, and load impacts for the typical event day by program type. The scale for the reference and observed loads is contained on the left axis, while the scale for the load impacts is shown on the right axis.

Figure 4.3: PeakChoice Loads and Load Impacts,
Committed Load, Day-Of Notice

Figure removed due to confidentiality concerns.

Figure 4.4: PeakChoice Loads and Load Impacts,
Committed Load, Day-Ahead Notice

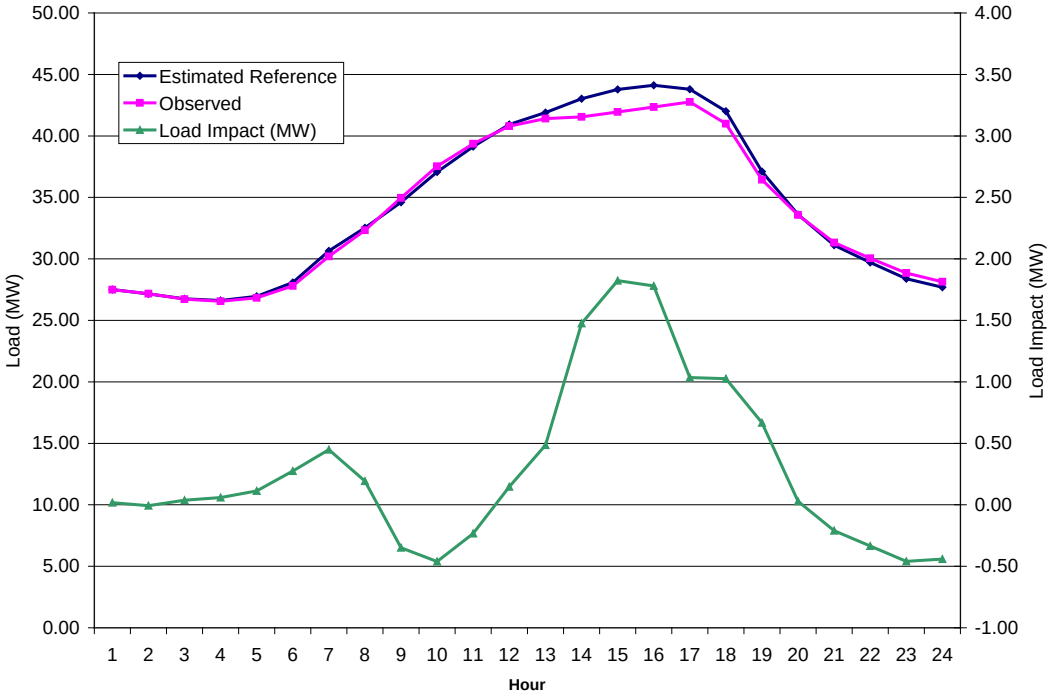


Figure 4.5: PeakChoice Loads and Load Impacts,
Committed Load, Two-Day-Ahead Notice

Figure removed due to confidentiality concerns.

Figure 4.6: PeakChoice Loads and Load Impacts,
Best Efforts, Day-Of Notice

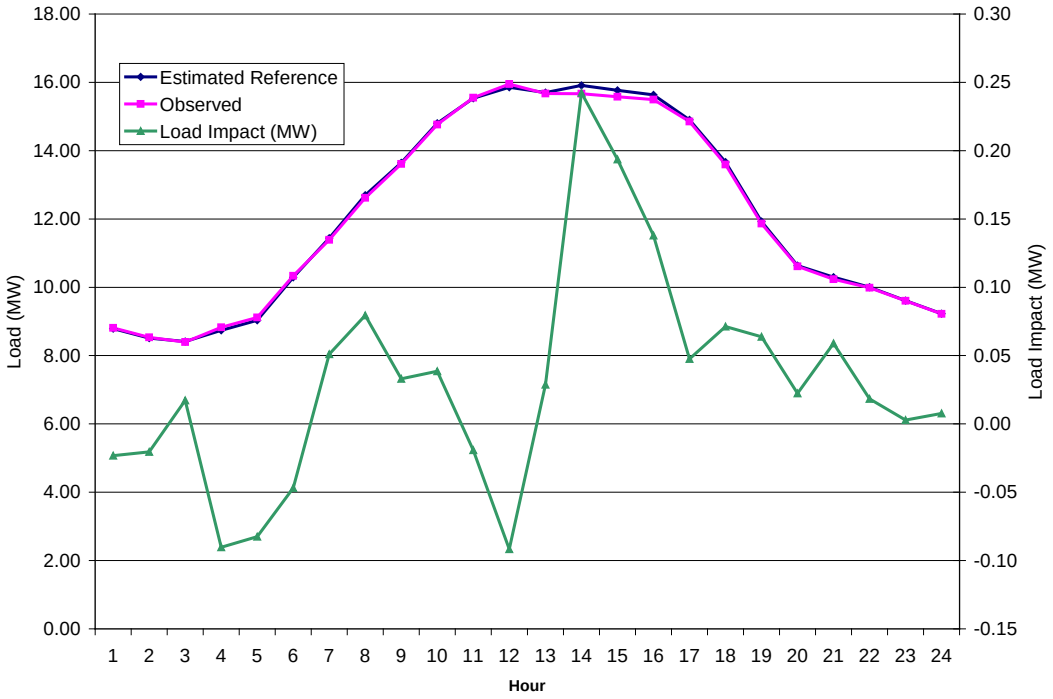


Figure 4.7: PeakChoice Loads and Load Impacts,
Best Efforts, Day-Ahead Notice

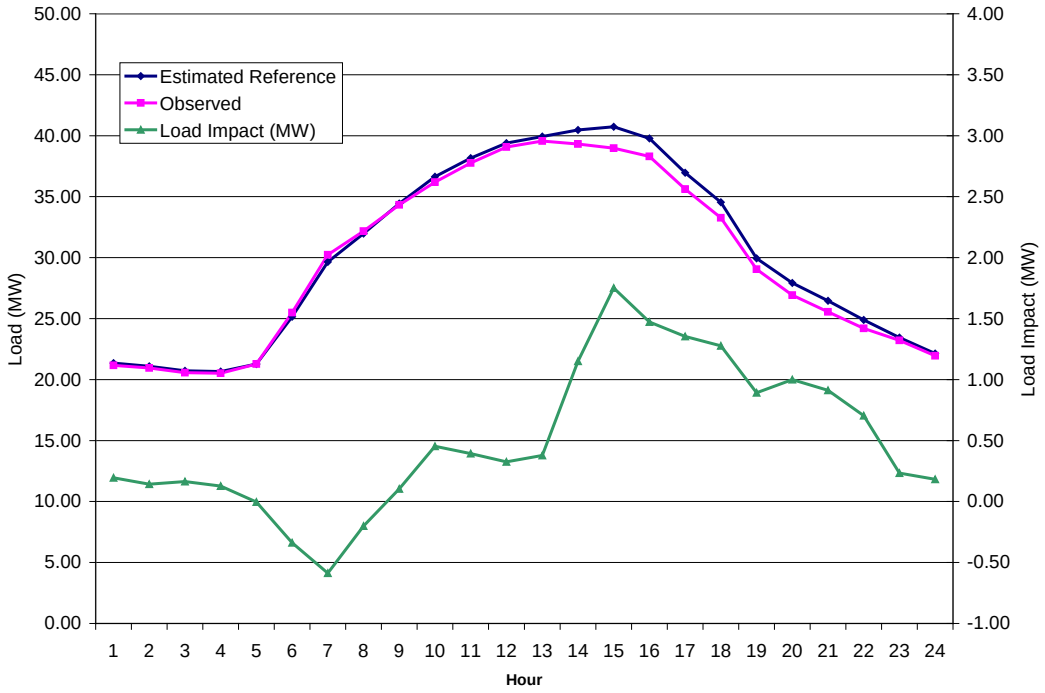


Figure 4.8: PeakChoice Loads and Load Impacts,
Best Efforts, Two-Day-Ahead Notice

Figure removed due to confidentiality concerns.

4.4 Distribution of Load Impacts

The estimation of customer-level load impacts allows us to examine how the program-level load impacts were distributed across customers. We found that the top 5 percent of participating service accounts were responsible for 50.5 percent of the total PeakChoice load impacts. This contrasts with the distribution of load impacts in the previous two program years, in which a single large and very responsive customer accounted for approximately two-thirds of the PeakChoice load impacts.

4.5 AutoDR and TA/TI Load Impacts

This section describes the ex post load impacts achieved by PeakChoice customer accounts that participated in two demand response incentive programs: TA/TI and AutoDR.

The Technical Assistance and Technology Incentives (TA/TI) program has two parts: technical assistance in the form of energy audits, and technology incentives. The objective of the TA portion of the program is to subsidize customer energy audits that have the objective of identifying ways in which customers can reduce load during demand response events. The TI portion of the program then provides incentive payments for the installation of equipment or control software supporting DR.

The Automated Demand Response (AutoDR) program helps customers activate DR strategies, such as managing lighting or heating, ventilation and air conditioning (HVAC) systems, whereby electrical usage can be automatically reduced or eliminated during times of high electricity prices or electricity system emergencies.

In the sub-sections below, we summarize *total* load impacts for TA/TI and AutoDR. These are simply the sum of the estimated load impacts for customers in each program, as estimated using the methods described in Section 3.2.1.

TA/TI

According to data provided by PG&E, two PeakChoice service accounts participated in both the TA/TI program and at least one PY2012 event.

Table 4.13 shows the event-specific load impact for the TA/TI participants. These customers averaged a 3.3 percent load impact across the first two event days (they did not participate in the third event). The rightmost column (“Approved MW for bidders”) shows the total MW approved following the TA/TI DR test.

Table 4.13: Average Hourly Load Impacts by Event, *TA/TI*

Event Date	Number of Participating SAIDs	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% Load Impact	Approved MW for Bidders
7/11/2012	2	3.63	3.50	0.13	3.7%	0.41
8/9/2012	2	3.64	3.53	0.11	3.0%	0.41
8/10/2012	0	n/a	n/a	n/a	n/a	n/a
Average	**2**	**3.63**	**3.51**	**0.12**	**3.3%**	**0.41**

AutoDR

According to data provided by PG&E, an average of 3 PeakChoice service accounts participated in both the AutoDR program and a PeakChoice event day. During any one event, a maximum of 5 service accounts participated. Table 4.14 shows the average hourly load impact for the AutoDR participants, which was 0.08 MW, or 4.8 percent of the reference load.

Table 4.14: Average Hourly Load Impacts by Event, *AutoDR*

Event Date	Number of Participating SAIDs	Estimated Reference Load (MW)	Observed Load (MW)	Estimated Load Impact (MW)	% Load Impact	Approved MW for Bidders
7/11/2012	2	1.12	1.13	-0.01	-0.9%	0.24
8/9/2012	3	1.73	1.63	0.11	6.2%	0.31
8/10/2012	5	1.91	1.78	0.13	6.9%	0.36
Average	**3**	**1.59**	**1.51**	**0.08**	**4.8%**	**0.30**

5. Validity Assessment

5.1 Model Specification Tests

A range of model specifications were tested before arriving at the model used in the ex post load impact analysis. The basic structure of the model is shown in Section 3.2.1. The tests are conducted using average-customer data rather than at the individual customer level. The Committed Load and Best Efforts programs are separately tested (combining all notice levels). Model variations include:

1. *Weather variables*. We tested 18 different combinations of weather variables. The weather variables include: temperature-humidity index (THI)[11]; the 24-hour moving average of THI; heat index (HI)[12]; the 24-hour moving average of HI;

[11] THI = $T - 0.55 \times (1 - HUM) \times (T - 58)$ if T>=58 or THI = T if T<58, where T = ambient dry-bulb temperature in degrees Fahrenheit and *HUM* = relative humidity (where 10 percent is expressed as "0.10").

[12] HI = $c_1 + c_2T + c_3R + c_4TR + c_5T^2 + c_6R^2 + c_7T^2R + c_8TR^2 + c_9T^2R^2 + c_{10}T^3 + c_{11}R^3 + c_{12}T^3R + c_{13}TR^3 + c_{14}T^3R^2 + c_{15}T^2R^3 + c_{16}T^3R^3$, where T = ambient dry-bulb temperature in degrees Fahrenheit and R = relative humidity (where 10 percent is expressed as "10"). The values for the various c's may be found here: http://en.wikipedia.org/wiki/Heat_index.

cooling degree hours (CDH)[13], including both a 60 and 65 degree Fahrenheit threshold; the 3-hour moving average of CDH; the 24-hour moving average of CDH; the one-day lag of cooling degree days (CDD)[14]. A list of the 18 combinations of these variables that we tested in provided in Table 5.1.

2. *Level models versus difference models*. The dependent variable in the model presented in Section 3.2.1 is the level of customer usage in a particular hour. This has been the most common way of estimating load impact models in our previous evaluations. In our specification tests, we include models of *differences* in usage across days that attempt to explain day-to-day load changes, including those on event days. These models explain the difference in load for each hour relative to the same hour on the previous day as a function of the corresponding differences in weather conditions and day-types. The potential advantage of this approach is that each hour's load is evaluated relative only to loads on neighboring days, which may remove spurious effects across time (for which we are unable to control due to incomplete information).

Table 5.1: Weather Variables Included in the Tested Specifications

Model Number	Included Weather Variables
1	THI
2	HI
3	CDH60
4	CDH65
5	CDH60_MA3
6	CDH65_MA3
7	THI THI_MA24
8	HI HI_MA24
9	CDH60 CDH60_MA24
10	CDH65 CDH65_MA24
11	CDH60_MA3 CDH60_MA24
12	CDH65_MA3 CDH65_MA24
13	THI LagCDD60
14	HI LagCDD60
15	CDH60 LagCDD60
16	CDH65 LagCDD60
17	CDH60_MA3 LagCDD60
18	CDH65_MA3 LagCDD60

The model variations are evaluated according to two primary validation tests:

1. Ability to predict usage on event-like *non-event days*. Specifically, we identified a set of days that were similar to event days, but were not called as event days (i.e., "test days"). The use of non-event test days allows us to evaluate model

[13] Cooling degree hours (CDH) was defined as MAX[0, Temperature – Threshold], where Temperature is the hourly temperature in degrees Fahrenheit and Threshold is either 60 or 65 degrees Fahrenheit. Customer-specific CDH values are calculated using data from the most appropriate weather station.

[14] Cooling degree days (CDD) are defined as MAX[0, (Max Temp + Min Temp) / 2 – 60], where Max Temp is the daily maximum temperature in degrees Fahrenheit and Min Temp is the daily minimum temperature. Customer-specific CDD values are calculated using data from the most appropriate weather station.

performance against known "reference loads," or customer usage in the absence of an event. We estimate the model excluding one of the test days and use the estimates to make out-of-sample predictions of customer loads on that day. The process is repeated for all of the test days. The model fit (i.e., the difference between the actual and predicted loads on the test days, during afternoon hours in which events are typically called) is evaluated using mean absolute percentage error (MAPE) as a measure of accuracy and mean percentage error (MPE) as a measure of bias.

2. Performance on *synthetic* event days (e.g., event-like non-event days that are treated as event days in estimation), to test for "event" coefficients that demonstrate statistically significant bias, as opposed to expected non-significance, since customers have no reason to modify usage on days that are not actual events. This is an extension of the previous test. The same test days are used, with a set of hourly "synthetic" event variables included in addition to the rest of the specification to test whether non-zero load impacts are estimated for these days. A successful test involves synthetic event load impact coefficients that are not statistically significantly different from zero.

5.1.1 Selection of Event-Like Non-Event Days

In order to select event-like non-event days, we created an average weather profile using the load-weighted average across customers, each of which is associated with a weather station. We "scored" each non-holiday weekday by comparing the dry-bulb temperature and relative humidity to the values for each event day. For example, we calculated the following statistic for each day relative to the first day: abs($Temp_t$ – $Temp_{Evt}$) / StdDev(*Temp*). A similar score was calculated for the relative humidity, and the sum of the temperature and humidity scores was used to rank the days. We selected the five lowest-scoring days (low scores indicate greater similarity to the event day) for each event day.

Table 5.1: List of Event-Like Non-Event Days

Event-Like Days	Day of Week
7/10/2012	Tuesday
7/20/2012	Friday
7/30/2012	Monday
7/31/2012	Tuesday
8/8/2012	Wednesday
8/27/2012	Monday

5.1.2 Results from Tests of Alternative Weather Specifications

For each program, we tested 36 specifications (i.e., 18 different sets of weather variables, each estimated in levels and differences). The aggregate load used in conducting these tests was constructed separately for Committed Load and Best Efforts customers.

The tests are conducted by estimating one model for each program (2), specification (36), and event-like day (6). Each model excludes one event-like day from the estimation model and uses the estimated parameters to predict the usage for that day. The MPE and MAPE are calculated across the event windows of the withheld days.

Tables 5.2 and 5.3 show the adjusted R-squared, mean percentage error (MPE), and mean absolute percentage error (MAPE) for each specification, by program. As a general rule, the level models perform better than the models of differences. For the preferred specifications (number 4 for Committed Load, which is CDH65; and number 5 for Best Efforts, which is the 3-hour moving average of CDH60), there is essentially no bias (as evidenced by the near-zero MPE values). The mean absolute percentage error is less than 1 percent for Committed Load and less than 2 percent for Best Efforts.

Table 5.2: Specification Test Results, *Committed Load*

Specification Number	Level or Differences	Adjusted R^2	MPE	MAPE
1	Level	0.996	-0.5%	0.8%
2		0.993	-1.8%	1.8%
3		0.994	-0.4%	0.7%
4		**0.991**	**-0.1%**	**0.8%**
5		0.992	-1.6%	1.6%
6		0.988	-1.4%	1.4%
7		0.997	-0.8%	0.9%
8		0.995	-2.1%	2.1%
9		0.995	-0.8%	0.9%
10		0.993	-0.5%	0.7%
11		0.993	-1.8%	1.8%
12		0.990	-1.5%	1.5%
13		0.997	-0.7%	0.8%
14		0.994	-2.0%	2.0%
15		0.995	-0.7%	0.8%
16		0.993	-0.4%	0.7%
17		0.993	-1.8%	1.8%
18		0.990	-1.7%	1.7%
1	Differences	0.659	-0.5%	1.1%
2		0.614	-1.7%	2.2%
3		0.639	-0.4%	1.5%
4		0.591	-0.3%	1.6%
5		0.613	-1.4%	2.1%
6		0.564	-1.3%	2.1%
7		0.662	-0.5%	1.3%
8		0.623	-1.7%	2.6%
9		0.650	-0.5%	1.8%
10		0.614	-0.4%	1.9%
11		0.619	-1.3%	2.1%
12		0.578	-1.2%	2.3%
13		0.662	-0.4%	1.2%
14		0.617	-1.7%	2.4%
15		0.648	-0.3%	1.7%
16		0.604	-0.2%	1.8%
17		0.617	-1.3%	2.2%
18		0.574	-1.2%	2.2%

Table 5.3: Specification Test Results, *Best Efforts*

Specification Number	Level or Differences	Adjusted R^2	MPE	MAPE
1	Level	0.986	1.1%	1.9%
2		0.983	-0.1%	1.5%
3		0.984	1.3%	2.2%
4		0.982	1.5%	2.3%
5		**0.983**	**0.0%**	**1.7%**
6		0.981	0.2%	1.8%
7		0.986	0.8%	1.9%
8		0.984	-0.6%	1.8%
9		0.985	0.8%	2.1%
10		0.984	0.9%	2.1%
11		0.984	-0.2%	1.8%
12		0.983	-0.1%	1.8%
13		0.986	0.6%	1.8%
14		0.984	-0.8%	1.7%
15		0.985	0.6%	2.0%
16		0.985	0.8%	2.1%
17		0.984	-0.5%	1.7%
18		0.983	-0.4%	1.7%
1	Differences	0.390	0.3%	2.3%
2		0.378	-0.6%	2.7%
3		0.369	0.2%	2.6%
4		0.352	0.2%	2.7%
5		0.362	-0.5%	3.1%
6		0.337	-0.5%	3.1%
7		0.406	0.3%	2.6%
8		0.401	-0.5%	3.1%
9		0.390	0.2%	3.1%
10		0.376	0.2%	3.1%
11		0.377	-0.4%	3.4%
12		0.360	-0.5%	3.4%
13		0.402	0.4%	2.6%
14		0.394	-0.5%	2.9%
15		0.390	0.4%	3.0%
16		0.380	0.4%	3.0%
17		0.376	-0.5%	3.5%
18		0.362	-0.4%	3.5%

For each specification, we estimated a single model that included all of the days (i.e., not withholding any event-like days), but using a single set of actual event variables (i.e., a 24-hour profile of the average event-day load impacts).

Figures 5.1 and 5.2 show the estimated hourly load impacts for each of the 18 level models by program. The models that used the differenced load as the dependent variable had somewhat different load impacts, but given the inferior performance of those models we show only the results for the levels models here. The load impacts for the selected specifications are highlighted in bold in each of the figures.

As the figures show, the estimated load impacts vary somewhat considerably across specifications. For Committed Load customers, the selected specification produces some of the largest load impacts. For the Best Efforts customers, the selected specification produces average load impacts.

Figure 5.1: Average Event-Hour Load Impacts by Specification, *Committed Load Level Models*

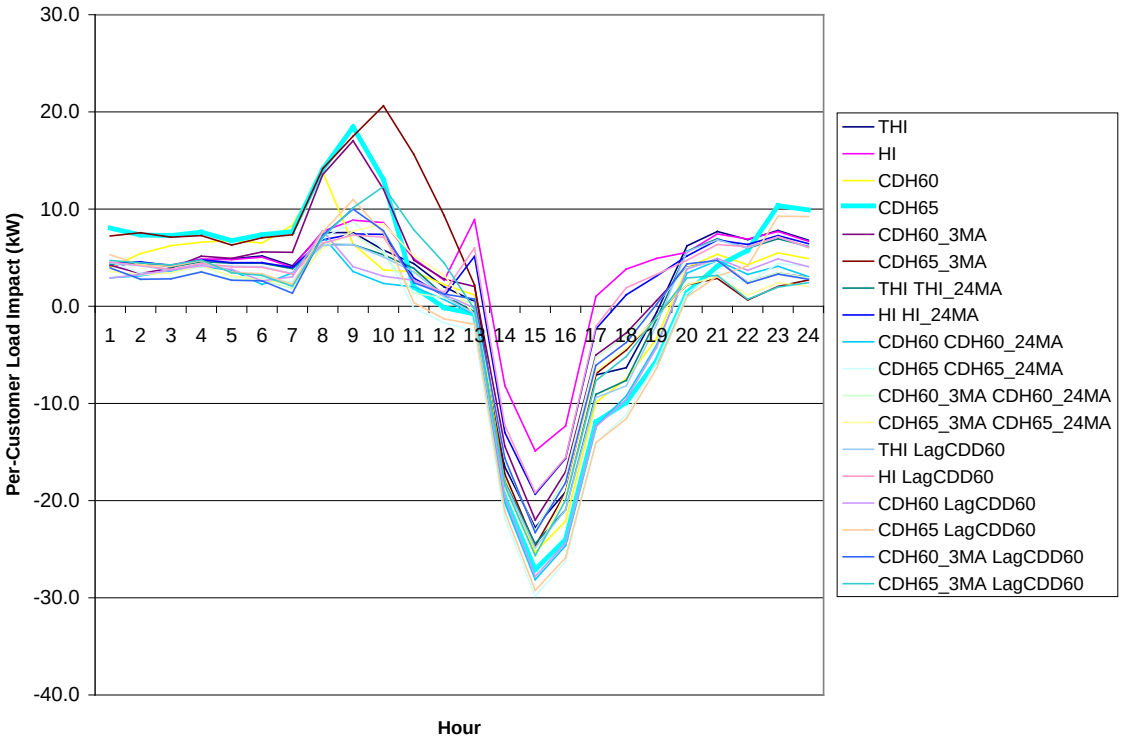
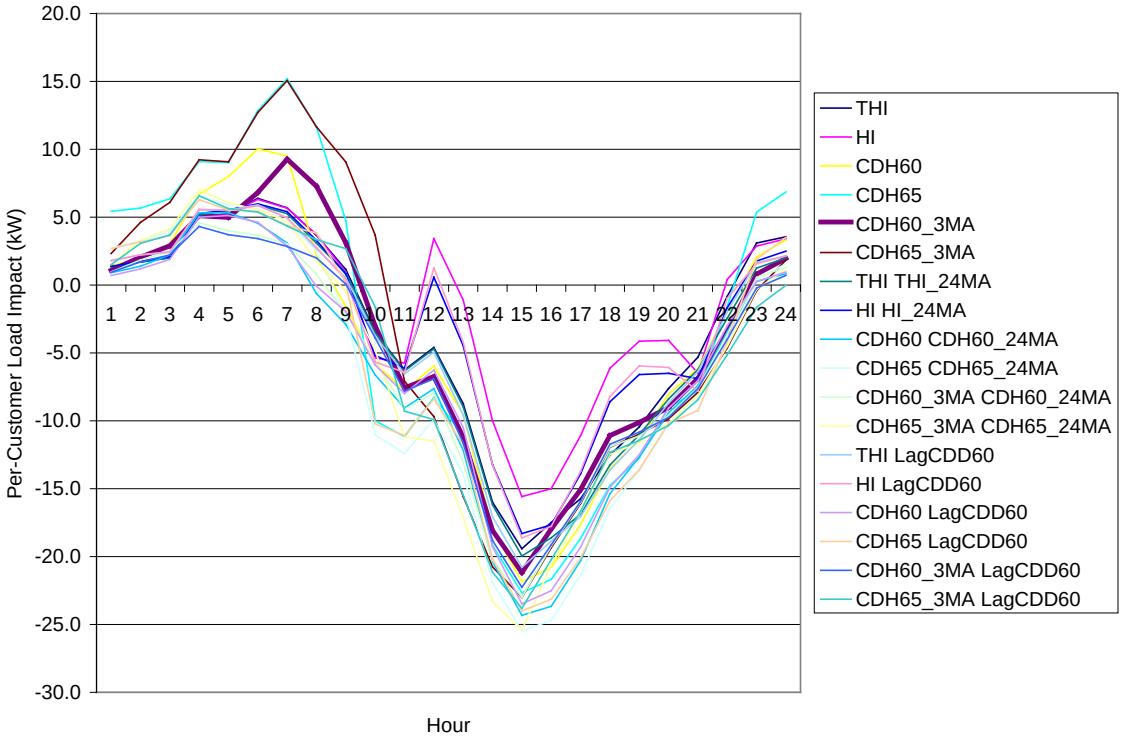


Figure 5.2: Average Event-Hour Load Impacts by Specification,
Best Efforts Level Models



5.1.3 Synthetic Event Day Tests

For the specifications selected from the testing described in Section 5.1.2, we conducted an additional test. The selected specifications were estimated on the aggregate customer data, including a set of 24 hourly "synthetic" event-day variables. These variables equaled one on the days listed in Table 5.1, with a separate estimate for each hour of the day.

If the model produces synthetic event-day coefficients that are not statistically significantly different from zero, the test provides some added confidence that our actual event-day coefficients are not biased. That is, the absence of statistically significant results for the synthetic event days indicates that the remainder of the model is capable of explaining the loads on those days.

Table 5.4 presents the results of this test for each program, showing only the coefficients during the core event window (hours-ending 14 through 18). The values in parentheses are p-values, or measures of statistical significance. A p-value less than 0.05 indicates that the estimated coefficient is statistically significantly different from zero with 90 percent confidence. The p-values in Table 5.4 are uniformly higher than this standard, indicating that each model "passes" this test.

Table 5.4: Synthetic Event-Day Tests by Program

Hour	Committed Load	Best Efforts
14	2.01 (0.55)	-4.12 (0.34)
15	0.76 (0.82)	-2.60 (0.55)
16	0.61 (0.86)	0.65 (0.88)
17	0.50 (0.89)	4.17 (0.35)
18	-1.44 (0.68)	2.88 (0.52)

5.2 Comparison of Load Impacts to Program Year 2011

It may be instructive to compare the ex post load impacts estimated for PY 2012 to those of the previous program year. Table 5.5 separates the load impacts for each year into three categories: customers who participated in a PeakChoice event during both program years; those that participated during PY 2012 only; and those that participated during PY 2011 only.

Load impacts went down dramatically between program years, primarily because of the departure of a single service account that accounted for 13.6 MW of load impacts. An additional 2.7 MW of load impacts from PY2011 did not appear in PY2012. A small amount of load impacts (1.4 MW) is associated with service accounts that participated in PY2012, but not in PY2011 (however, they were *enrolled* in PY2011).

Table 5.5: Comparison of Load Impacts (in MW) in PY 2011 and PY 2012

Program Year	LI in PY 2012	LI in PY 2011	Change
In both years	3.2	4.6	-1.4
In PY 2012 only	1.4	n/a	1.4
In PY 2011 only	n/a	16.3	-16.3
TOTAL	**4.6**	**20.9**	**-16.3**

6. Recommendations

Because PeakChoice is a canceled program, we do not provide any recommendations for future analyses of the program.

Appendix

The following Appendix accompanies this report. It is an Excel file that can produce the ex post tables required by the Protocols.

Appendix A: Ex Post Load Impact Tables