



LOAD IMPACT EVALUATION OF NON-RESIDENTIAL CRITICAL PEAK AND PEAK DAY PRICING

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- Program Descriptions
- Methodology
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- Key Findings



Kelly Marrin

- Managing Director, Applied Energy Group
- Lead our Research and Analytics Practice
- Educational Background in Economics
- 15+ year's in the industry



Program Description

PROGRAM DESCRIPTION

Critical Peak Pricing / Peak Day Pricing

Program Basics:

- Non-Residential customers only
- Statewide price responsive DR program
- Customers experience an increase in price (above existing on-peak price) during events
- Operates year-round

Events:

- Event hours are 2-6 PM (PG&E and SDG&E) and 4-9 PM (SCE)
- Number of events per year varies
 - PG&E 9 to 15
 - SCE 12
 - SDG&E maximum of 18
- Customers are notified on a day ahead basis

PROGRAM DESCRIPTION

Program changes

PG&E:

- Defaults are on hold until TOU period transition change is implemented in November 2020.
- Enrollment dropped by 19% as a result of CCA transitions
- Discontinued their in-season support program.

SCE:

- Defaulted approximately 235,000 small, 35,000 medium customer, and large Ag & Pump customers
- Event window changed to 4-9 PM effective March 1, 2019
- Capacity Reservation Level (CRL) and CPP-lite options are no longer available

SDG&E:

- No new changes to the CPP rate in PY2019.

PROGRAM DESCRIPTION

2019 Participation, Typical Event Day

Participation by Size	PG&E	SCE	SDG&E*
Small < 20 kW	91,156	235,219	-
Medium $20 \leq x < 200$ kW	24,994	34,963	13,402
Large ≥ 200 kW	1,246	2,201	1,525
Total	117,397	272,383	14,927

Participation by Industry	PG&E	SCE	SDG&E*
1. Agriculture, Mining & Construction	6,455	11,730	394
2. Manufacturing	4,744	13,247	1,123
3. Wholesale, Transport, Other Util	17,646	18,626	969
4. Retail Stores	10,801	23,829	1,899
5. Offices, Hotels, Finance, Services	39,677	124,974	7,279
6. Schools	2,653	4,469	817
7. Institutional/Government	21,742	45,848	1,999
8. Other/Unknown	13,678	29,660	447
Total	117,397	272,383	14,927

*Since SDG&E did not call any events, the counts represent PY2019 enrollment instead of a typical event day.

PROGRAM DESCRIPTION

Communication Around Events



Not all the participants were aware of events

- All IOUs provide day ahead notification to customers with contact information
- PG&E discontinued their in-season support program, which is an enhanced level of support that includes post event feedback



Methodology

SUBGROUP LEVEL MODELING APPROACH

Each utility and size group is at a different stage in the default schedule

Design was selected based on eligible non-participants favoring the development of a control group when feasible

Utility	Size Group	Analysis Method
PG&E	Small	Within Subjects
	Medium	Within Subjects
	Large	Matched Control
SCE	Small	Within Subjects
	Medium	Within Subjects
	Large	Matched Control
SDG&E	Medium	Within Subjects
	Large	Within Subjects

For all subgroups, regardless of design, we developed hourly fixed effect regression models

- Subgroups include utility, size, and industry
- Each model was optimized and validated using our optimization approach

Regression analysis is about identifying and estimating statistical relationships between variables.

Regression analysis studies the dependence of one variable, *the dependent variable*, on one or more other variables, *the explanatory variables*, with a goal of estimating and/or predicting the mean of the former in terms of the known values of the latter.¹

$$Y_{it} = \beta_0 + \beta_1 x_{it} + \dots + \beta_n x_{it} + \varepsilon_i$$

- We use regression models to estimate the counter-factual – what would have happened in absence of an event
- The model uses information from non-event days to predict how much energy customers would have used in absence of an event

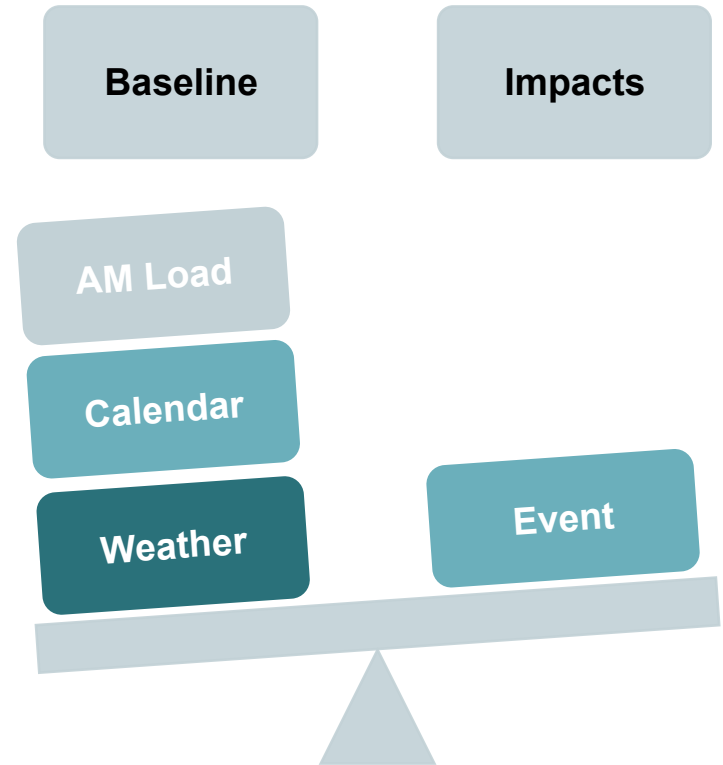
¹ Gujarati, D., Basic Econometrics, p.18, McGraw-Hill, 2003.

SUBGROUP LEVEL REGRESSION APPROACH

1

Develop a set of candidate models using building blocks set up in logical groups

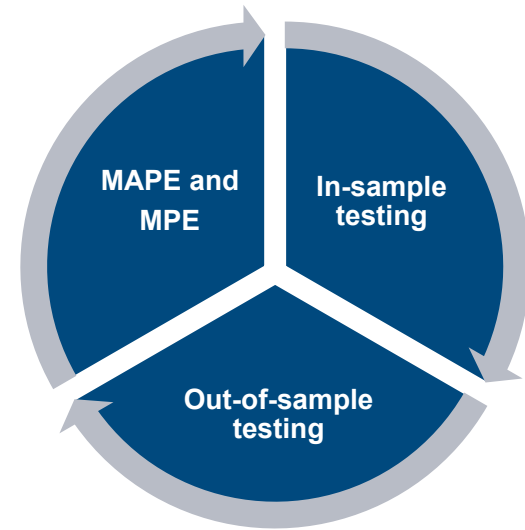
- ~16-20 Candidate Models



SUBGROUP LEVEL REGRESSION APPROACH

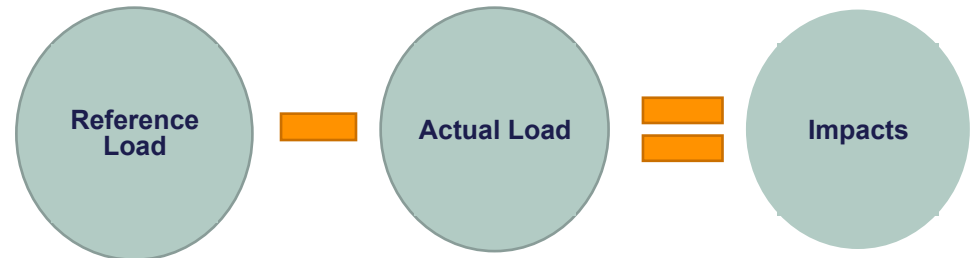
2

Testing and optimization process that minimizes error and bias to select the best model for each subgroup



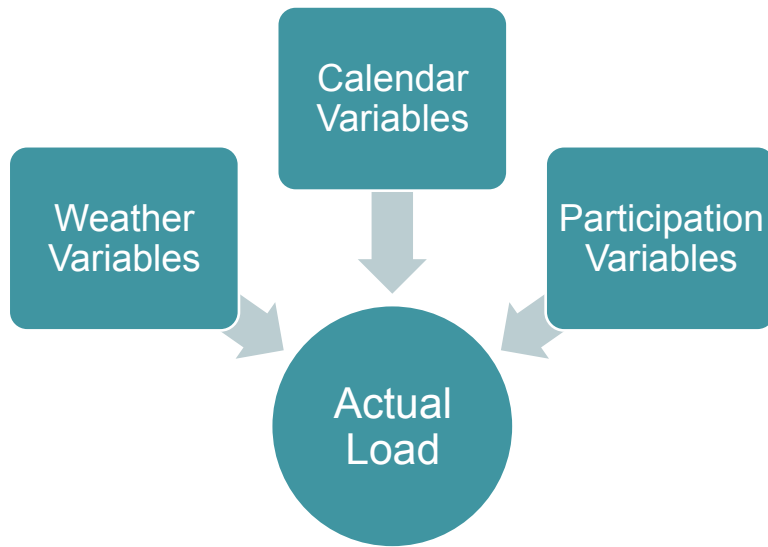
3

Model the actual load
 Model the reference load
 Calculate the impacts

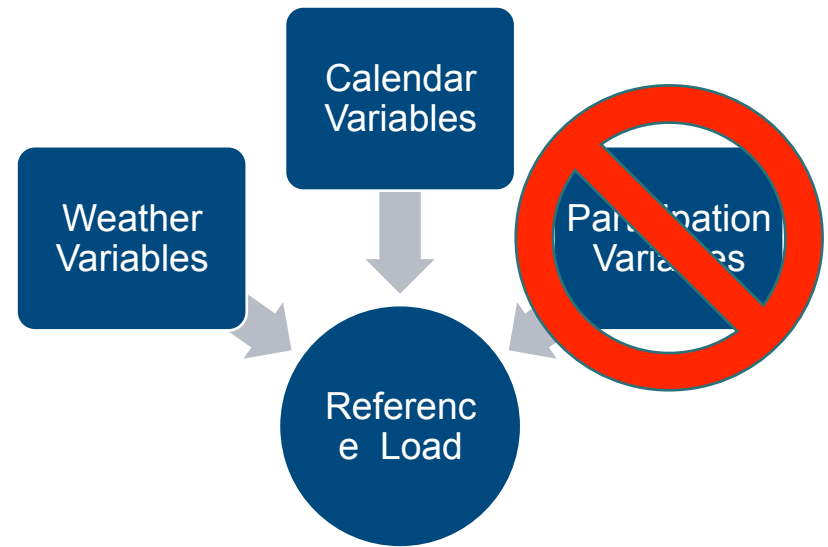


ESTIMATING IMPACTS

Actual consumption on an event day



Consumption on the same day but in absence of an event



$$\text{Reference Load} - \text{Actual Load} = \text{Impacts}$$



Ex-Post Impacts

EX-POST IMPACTS

Event Summary

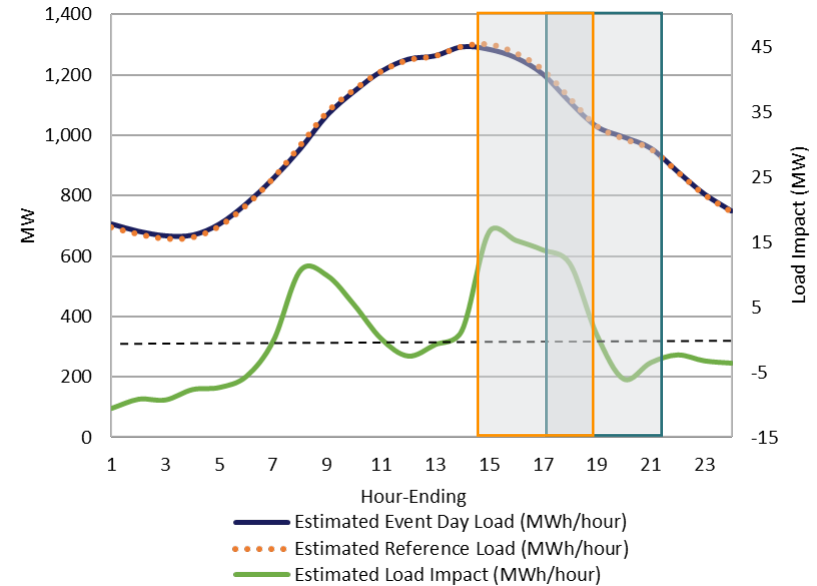


Date	Day of Week	PG&E	SCE	SDG&E
6/11/2019	Tuesday	X		
7/12/2019	Friday		X	
7/15/2019	Monday		X	
7/16/2019	Tuesday		X	
7/24/2019	Wednesday	X		
7/26/2019	Friday	X		
8/13/2019	Tuesday	X		
8/14/2019	Wednesday	X	X	
8/15/2019	Thursday		X	
8/16/2019	Friday	X		
8/22/2019	Thursday		X	
8/23/2019	Friday		X	
8/26/2019	Monday	X		
8/27/2019	Tuesday	X	X	
9/5/2019	Thursday		X	
9/6/2019	Friday		X	
9/12/2019	Thursday		X	
9/13/2019	Friday	X	X	
Total		9	12	0

EX-POST IMPACTS – PG&E

Average Summer Event, Average Event Hour

Utility	Size Group	# Enrolled	Ref. Load (MW)	Load Impact (MW)	% Load Impact	Event Temp
	Large	1,246	472.1	13.7	2.9%	97.5
PG&E	Medium	24,994	571.5	-0.1	-0.0%	96.1
	Small	91,156	182.4	0.6	0.4%	95.2
ALL PG&E		117,397	1,226.0	14.3	1.2%	96.2

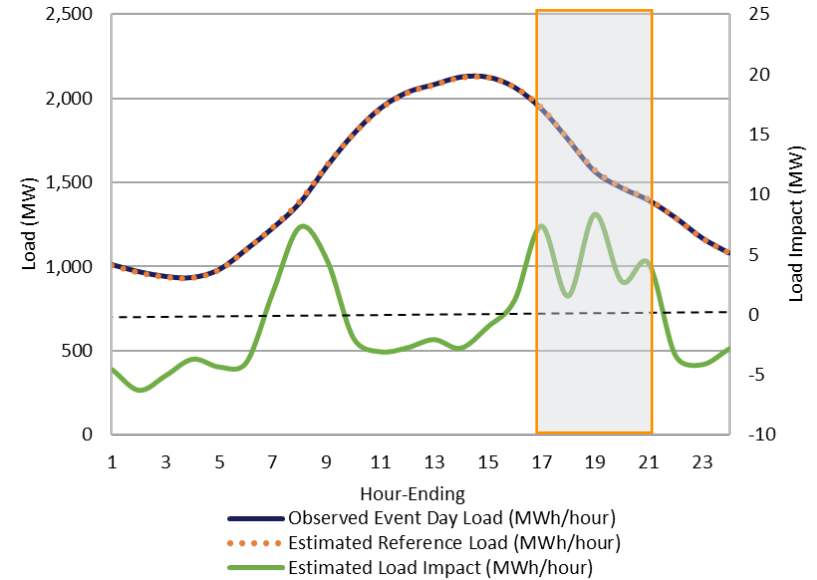


- Large customers provide the majority of the impact
- Medium customer impacts are statistically insignificant, i.e. essentially zero
- Hottest overall weather of the three IOUs

EX-POST IMPACTS – SCE

Average Summer Event, Average Event Hour

Utility	Size Group	# Enrolled	Ref. Load (MW)	Load Impact (MW)	% Load Impact	Event Temp
SCE	Large	2,201	426.9	7.0	1.6%	88.7
	Medium	34,963	861.8	-1.4	-0.2%	88.0
	Small	253,219	340.4	-0.7	-0.2%	87.1
ALL SCE		272,383	1629.1	4.9	0.3%	87.9



- Again large customers provide the majority of the impact
- Small customer impacts are statistically insignificant, i.e. essentially zero
- Medium customer impacts are negative as a result from modeling noise or bias, less than -0.01 kW per-customer

EX-POST IMPACTS

Notification – Percent Notified

PG&E

Size Group	PG&E % Notified
Small < 20 kW	92%
Medium 20 kW ≤ x < 200 kW	95%
Large ≥ 200 kW	94%
Total	92%

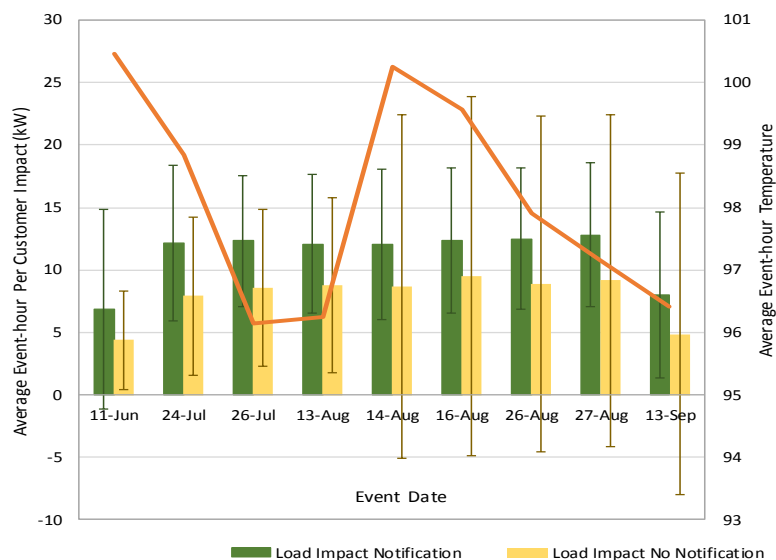
SCE

Size Group	SCE % Notified
Small < 20 kW	54%
Medium 20 kW ≤ x < 200 kW	61%
Large ≥ 200 kW	89%
Total	55%

EX-POST IMPACTS

Notification – Impacts

PG&E



SCE



Notification	No			Yes		
	Small	Med.	Large	Small	Med.	Large
# Customers	7,255	1,245	77	83,902	23,749	1,169
Per-Customer Impact (kW)	0.0	0.0	7.8	0.0	0.0	11.2
Aggregate Impact (MW)	0.2	0.0	0.6	0.4	-0.1	13.1

Notification	No			Yes		
	Small	Med.	Large	Small	Med.	Large
# Customers	107,218	13,300	226	128,004	21,663	1,974
Per-Customer Impact (kW)	0.0	(0.1)	(0.4)	(0.0)	(0.0)	3.6
Aggregate Impact (MW)	0.4	(0.8)	(0.1)	(1.2)	(0.7)	7.1

EX POST IMPACTS

Statewide System Peak Hour, 8/15/2019 - HE18

Utility	# Enrolled	Ref. Load (MW)	Load Impact (MW)	% Load Impact	Event Temp
PG&E - PDP	-	-	-	-	-
SCE - CPP	272,565	1,779.0	1.2	0.1%	92
SDG&E - CPP	-	-	-	-	-
Statewide	272,565	1,779.0	1.2	0.1%	92

- Only SCE called an event on the statewide peak day.
- The total load reduction across all three programs on the statewide system peak was 1.2 MW.
- Note: the IOUs did not call CPP events during the IOU system peak days



Ex-Ante Impacts

EX-ANTE IMPACTS

Methodology

- Use subgroup level regression models from ex-post analysis
 - Predict per-customer weather-adjusted impacts for all subgroups
 - Apply Utility and CAISO weather scenarios
 - Use enrollment forecasts from IOUs to forecast aggregate impacts
 - Enrollment was derived based on
 - Default schedules
 - Population growth
 - Historical trends
-
- **IMPORTANT** - RA Window 4-9 PM
 - SCE operating hours coincident with RA window
 - SDG&E and PG&E operating hours **NOT** coincident with RA window

EX-POST IMPACTS – PG&E

2019 vs. 2018

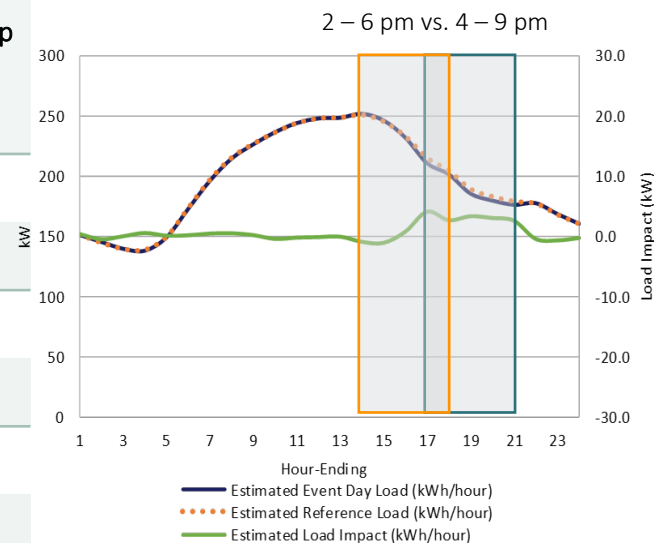
	Ex-Post Year	# of Accts	Aggregate (MW)		Per-Customer (kW)		% Impact	Event Temp (°F)
			Ref. Load	Load Impact	Ref. Load	Load Impact		
Large	2018	1,712	445.5	23.9	260.2	14.0	5.4%	93.1
	2019	1,246	472.1	13.7	378.9	11.0	2.9%	97.5
Medium	2018	34,014	750.0	4.9	22.0	0.1	0.3%	93.2
	2019	24,994	571.5	-0.1	22.9	0.0	0.0%	96.1
Small	2018	119,004	243.7	-0.1	2.0	0.0	0.0%	93.0
	2019	91,156	182.4	0.6	2.0	0.0	0.4%	95.2

- Decrease in enrollment across all three groups
- Large: Decrease in impacts but increase in reference load
- Medium: Similar to Large but on a smaller scale
- Small: Similar to last year

EX-POST IMPACTS- SCE

2018 vs. 2019

	Ex-Post Year	# of Accts	Aggregate (MW)		Per-Customer (kW)		% Impact	Event Temp (°F)
			Ref. Load	Load Impact	Ref. Load	Load Impact		
Large	2018	2,251	583.7	14.2	259.3	6.3	2.4%	89.9
	2019	2,201	426.9	7.0	194.0	3.2	1.6%	88.7
Medium	2018	659	45.9	0.2	69.7	0.4	0.5%	89.4
	2019	34,963	861.8	(1.4)	24.6	0.0	(0.2%)	88.0
Small	2018	106	0.2	<0.1	1.9	<0.1	2.3%	88.9
	2019	235,219	340.4	(0.7)	1.4	0.0	(0.2%)	87.1



- Slight decrease in enrollment in large, but dramatic increase in other groups
- Large: Decrease in impacts and decrease in reference load in event window
- Medium: New population similar to PG&E results
- Small: New population similar to PG&E results

EX-ANTE IMPACTS

Comparison of current and previous ex-ante forecast

Utility	Previous Forecast, 2018		Current Forecast, 2019	
	Accounts	Aggregate Impact (MW)	Accounts	Aggregate Impact (MW)
PG&E	238,238	46.6	137,077	9.6
SCE	103,300	59.6	300,243	26.7
SDG&E	13,282	15.3	14,074	3.7
Statewide	354,820	121.5	451,394	40.0

Results are average event-hour impacts for August peak day; Utility Peak 1-in-2 weather conditions.

- PG&E
 - Decrease in enrollment due to change in default schedule
 - Changes in RA window mean that only 2 of the 5 RA hours are program hours, with three of those hours occurring directly after the event when some customers might be increasing load.
- SCE
 - Increase in enrollment due to change in default schedule.
 - Decrease in impacts due to more realistic assumptions about impacts for small and medium customers and reduction in impacts for large under new event window
- SDG&E
 - Decrease in impacts almost entirely due to changes in the RA window – similar to PG&E above

EX-ANTE IMPACTS

Enrollment and Impacts, Typical Event Day, Utility 1-in-2

Utility	PY 2020 Enrollment	PY 2020 Load Impact (MW)	PY 2030 Enrollment	PY 2030 Load Impact (MW)
PG&E- PDP	113,154	1.8	183,765	4.6
SCE - CPP	252,481	8.0	397,481	12.6
SDG&E - CPP	14,160	2.5	13,302	3.1
Statewide	379,795	12.2	594,548	20.3

Drivers

- PG&E forecasts increased participation and impacts as default schedule resumes in 2020.
- SCE enrollments and impacts grow steadily over time with population, after initial jump due to 2019 defaulting
- SDG&E enrollments decrease over time as medium customers opt out of the program. Impacts, on the other hand, increase slightly as large customers join the program.



Key Findings

STATEWIDE KEY FINDINGS

Ex-Post Analysis – Typical Event Day

Impacts by Utility

Utility	# Enrolled	Ref. Load (MW)	Load Impact (MW)	% Load Impact	Event Temp
PG&E	117,396	1,226	14.3	1.2%	97.5
SCE	272,383	1,629	4.9	0.3%	87.9
SDG&E	-	-	-	-	-
Statewide	389,779	2,855	19.2	0.7%	92.7

Impacts by Size

Size	# Enrolled	Ref. Load (MW)	Load Impact (MW)	% Load Impact	Event Temp
Large	3,447	899	20.7	2.3%	93.1
Medium	59,957	1,433	-1.5	-0.1%	92.1
Small	326,375	522.8	-0.1	-0.0%	95.2
Statewide	389,779	2,855	19.1	0.7%	93.5

- Overall state level reduction of 19.2 MW
- PG&E contributes 74% of impacts
- Per participant percentage impacts are low across all three utilities 0-2%
- Large customers account for all of the impacts but make up less than 1% of the participants
- Small and medium customers essentially contribute zero

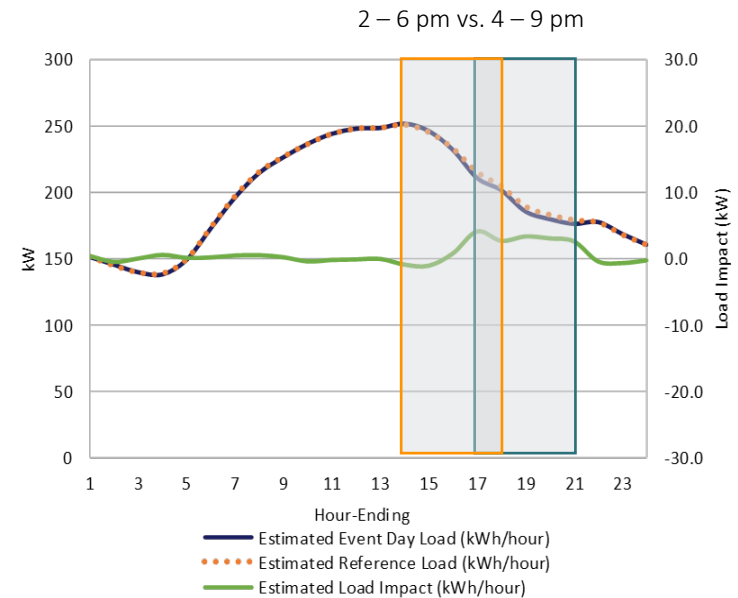
KEY FINDINGS

Ex-Post Analysis

It is unclear how notification affects event response

- PG&E notified 92% of their customers
 - Small and medium customers did not respond
 - Large customers seem to respond even when not notified
- SCE notified 55% of their customers
 - Small and medium customers did not respond
 - Large customers seem more sensitive to notification, but do show some response even without it

Shifting the event window to match the RA window may further decrease impacts



KEY FINDINGS

Ex-Ante Analysis



Despite increased enrollment from additional defaults forecasted impacts dropped dramatically from 121 MW to 40 MW

- The RA window only includes 2 program operating hours (PG&E and SDG&E) while the other three hours are post event hours
- PG&E's customer makeup seems to be changing as participants migrate to CCAs
- SCE's large customers reduced impacts by about 50% under new event window
- Actual performance of SCE's small and medium default customers was lower than expected (essentially zero)

PROJECT CONTRIBUTORS



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