REPORT

San Diego Gas and Electric Company Summer Saver 2015 Program Evaluation

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Prepared for
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1 Executive Summary

San Diego Gas and Electric Company's (SDG&E) Summer Saver program is a demand response resource based on central air conditioner (CAC) load control. It is implemented through an agreement between SDG&E and Comverge, Inc. and is currently scheduled to continue through 2016. This report provides ex post load impact estimates for the 2015 Summer Saver program and ex ante load impact forecasts for 2016–2026.

The Summer Saver program is available to residential and nonresidential customers with average monthly peak demand up to a maximum of 100 kW over a 12 month period. The Summer Saver season runs from May 1 through October 31. A Summer Saver event may be triggered by temperature or system load conditions and customers are not automatically notified when an event occurs; however, customers can sign up to receive event notification.

There are two enrollment options each for both residential and nonresidential customers. Residential customers can choose between 50% or 100% cycling and nonresidential customers can choose between 30% and 50% cycling. The incentive paid for each option varies and is based on the number of CAC tons being controlled at each site.

At the end of 2015 there were 26,386 customers enrolled in the program with a total cooling capacity of 135,252 tons; representing a 5% decrease over 2014 enrolled customers and tons. About 82% of participants were residential customers, who accounted for 69% of the total tons of cooling in the program. Roughly 42% of residential participants were on the 100% cycling option and 70% of nonresidential customers selected the 50% cycling option over the 30% option. Summer Saver enrollment is projected to stay constant over the forecast horizon.

Fifteen Summer Saver events were called in 2015, and each one lasted for four hours, except for the event called on September 20. This event was called for an emergency and only lasted two hours, from 1:35 to 3:35 PM. For the remaining 14 events, 9 were called from 3 to 7 PM, with the others going from 2 to 6 PM and 4 to 8 PM, respectively. For the nine events with the same event hours, the average aggregate demand reduction for residential customers from 3 to 7 PM equaled 13 MW. The aggregate load reduction for nonresidential customers equaled roughly 1.4 MW, or 0.3 kW per premise. In aggregate, the average reduction for the entire Summer Saver program across the nine event days with common hours of 3 to 7 PM equaled 14.6 MW.

Ex ante load impacts are intended to represent weather conditions under normal (1-in-2 year) and extreme (1-in-10 year) conditions, defined for two scenarios: one representing weather conditions expected when the SDG&E system peaks and another representing weather conditions when the CAISO system peaks. The event window for ex ante impacts is 1 to 6 PM, which differs from the typical 2015 ex post event window from 3 to 7 PM. On a typical event day under 1-in-2 year SDG&E-specific peaking conditions, aggregate load impacts are projected to equal 9.4 MW for residential customers and 2.9 MW for nonresidential customers, for a total program load reduction equal to 12.3 MW. Summer Saver load impacts increase with temperature, and load impacts for the hotter 1-in-2 year SDG&E-specific September monthly system peak day are estimated to be 11.1 MW for residential customers and 3.0 MW for nonresidential customers, for a total load reduction potential of 14.1 MW.

Under 1-in-10 year SDG&E-specific peaking conditions, estimated impacts on the typical event day are forecasted to equal 12.6 MW and 3.1 MW for residential and nonresidential customers, respectively, or 15.7 MW in total. This is about 30% greater than on a typical event day under 1-in-2 year weather conditions. On the much hotter September SDG&E monthly system peak day for a 1-in-10 weather year, estimated impacts equal 14.6 MW and 3.2 MW respectively, for a total load reduction of 17.8 MW for the entire program.

As Summer Saver enters its final year of contracted operation with Comverge as an important demand resource in the San Diego region, Nexant recommends that SDG&E consider the following change to the program's operational activities as SDG&E moves forward to repower Summer Saver for 2017 and beyond or prepare for a successor load control program.

- Load impacts for 2015 continue in a trend since 2014 of lower load impacts than those that were observed in prior program years, 2010 through 2013. The program should consider implementing an enrollment screen to only bring or retain residential customers to the program that show the presence of cooling load available for load shed during program event hours.

2 Introduction and Program Summary

The Summer Saver program is a San Diego Gas and Electric Co. (SDG&E) demand response resource based on central air conditioning (CAC) load control. It is implemented through an agreement between SDG&E and Alternative Energy Resources (AER), a subsidiary of Comverge, Inc.,[1] and is expected to continue to be implemented at SDG&E through 2016. This report provides 2015 ex post load impact estimates and ex ante load impact estimates for an 11-year forecast horizon (2016–2026) as required by the California Public Utilities Commission (CPUC) Load Impact Protocols,[2] even though the program may not continue in its current form beyond 2016.

The Summer Saver program is classified as a day-of demand response program and is available to both residential and nonresidential customers, where eligible nonresidential customers are subject to a demand limit; only those nonresidential customers with average monthly peak demand up to a maximum of 100 kW over a 12 month period may participate. Summer Saver events may only be called during the months of May through October. Load control events must run for at least two hours but may also not run for more than four hours. Participants' air conditioners cannot be cycled for more than four hours in any event day and events cannot be triggered for more than 40 hours per month or 120 hours per year. Load control events can occur on weekends but not on holidays and cannot be called more than three days in any calendar week. These program rules apply to both residential and nonresidential customers alike.

There are two enrollment options for both residential and nonresidential participants. Residential customers can choose to have their CAC units cycled 50% or 100% of the time during an event. The incentive paid for each option varies; the 50% cycling option pays $11.50 per ton per year of CAC capacity and the 100% cycling option pays $30 per ton per year. A residential customer with a four-ton CAC unit would be paid the following in the form of an annual credit on their SDG&E bill:

- $46 for 50% cycling; or
- $120 for 100% cycling.

Nonresidential customers have the option of choosing 30% or 50% cycling. The incentive payment for 30% cycling is $9 per ton per year and $15 per ton per year for the 50% cycling option. A nonresidential customer with five tons of air conditioning would be paid the following in the form of an annual credit on their SDG&E bill:

- $45 for 30% cycling; or
- $75 for 50% cycling.

1 SDG&E's contract with Comverge, Inc. was amended in 2007 to reflect that the agreement is thereafter recognized to be between a subsidiary of Comverge, Inc., AER, and SDG&E. In the remainder of this document, the company is referred to as Comverge.

2 See CPUC Rulemaking 07-01-041 Decision (D.) 08-04-050, "Adopting Protocols for Estimating Demand Response Load Impacts" and Attachment A, "Protocols."

Prior to 2013, Summer Saver offered two additional options regarding the days of the week when an event can be called—only weekdays or both on weekdays and weekends. In 2013, all participants taking the five-day option were converted to the seven-day option.

Enrollment in the Summer Saver program as of September 2015 is summarized in Table 2-1. Total enrollment—as measured by number of customers, number of devices, and air conditioning capacity (measured in tons)—has decreased since fall 2014, continuing a decline in enrollment that was seen in 2014 over 2013 enrollments. As of September 2015, there were 26,386 customers enrolled in the program, which in aggregate represents 135,252 tons of CAC capacity. This is a 5.1% decrease in enrolled customers and a 5.1% decrease in enrolled tons relative to 2014. About 82% of participants were residential customers who accounted for 69% of the total tons of cooling subject to control under the program. About 57% of residential participants chose 50% cycling and 24% of nonresidential customers chose 30% cycling, which was the lowest cycling strategies offered to those customer segments. After holding steady around 50% for many years, the percentage of residential customers taking the 100% cycling option has begun to decline—from 46% in 2014 to 43% in 2015. However, the percentage of nonresidential customers taking the 50% cycling option has consistently increased from 60% in 2010 to 72% in 2014, and to 76% in 2015. Overall, Summer Saver enrollment is expected to remain roughly constant for the remaining life of the program.

In 2013, SDG&E began offering Summer Saver participants the option of receiving notification of load control events by telephone. A letter announcing the availability of telephone notification was sent to program participants in 2013. Subsequently, Summer Saver participants are able to elect to receive event notifications through a link on SDG&E's Summer Saver website. As of March 2016, 3,151 Summer Saver participants have signed up for event notification; nearly all of them are residential customers (less than 1% can be identified as nonresidential program participants).

Table 2-1: Summer Saver Enrollment, September 2015

Customer Type	Cycling Option	Enrolled Customers	Enrolled Control Devices	Enrolled Tons
Commercial	30%	1,137	3,324	12,871
	50%	3,515	7,750	29,704
	Total	4,652	11,074	42,575
Residential	50%	12,474	14,540	51,053
	100%	9,260	11,432	41,623
	Total	21,734	25,972	92,677
Grand Total		**26,386**	**37,046**	**135,252**

2.1 Report Structure

The remainder of this report is organized as follows. Section 3 summarizes the data and methods that were used to develop ex post and ex ante load impact estimates and the validation tests that were applied to assess their accuracy. Section 4 contains the ex post load impact estimates and Section 5 presents the ex ante estimates. Section 5 also provides details concerning differences between 2014 ex ante load impacts and 2015 load impacts—in addition to differences between ex post and ex ante load impacts.

3 Data and Methodology

This section describes the datasets and analysis methods used to estimate load impacts for each event in 2015 and for ex ante weather and event conditions. Ex post results were calculated using control and treatment groups. In the case of the residential segment within a randomized control trial framework, whereby with random assignment to treatment and control status and reasonably large sample sizes (2,000 residential participants), any differences in the average hourly electric loads of the treatment and control group may be reliably assumed to be due to Summer Saver load control and free of estimation bias. In the case of the nonresidential segment, most of the nonresidential program participants were all statistically matched to a control group of nonparticipants. The ex post load impact estimates from 2010 through 2015 were used to estimate models relating temperature to load reductions that were then used in conjunction with ex ante weather data to estimate ex ante load impacts.

3.1 Data

Fifteen Summer Saver events were called in 2015. Table 3-1 shows the date, day of week, and the start and stop time for each event. All residential and nonresidential participants were called for each event, except for the control group customers that were held back for measurement and evaluation purposes. Three weekend events were called in 2015. All Summer Saver events lasted four hours in 2015, with some events starting as early as 2 PM and others as late as 4 PM.

Table 3-1: Summary of 2015 Summer Saver Events

Date	Day of Week	Start Time	End Time
8/13/2015	Thursday	3:00 PM	7:00 PM
8/14/2015	Friday	4:00 PM	8:00 PM
8/16/2015	Sunday	3:00 PM	7:00 PM
8/26/2015	Wednesday	4:00 PM	8:00 PM
8/27/2015	Thursday	3:00 PM	7:00 PM
8/28/2015	Friday	3:00 PM	7:00 PM
9/9/2015	Wednesday	3:00 PM	7:00 PM
9/10/2015	Thursday	3:00 PM	7:00 PM
9/11/2015	Friday	3:00 PM	7:00 PM
9/20/2015*	Sunday	2:00 PM	4:00 PM
9/24/2015	Thursday	2:00 PM	6:00 PM
9/25/2015	Friday	2:00 PM	6:00 PM
10/9/2015	Friday	3:00 PM	7:00 PM
10/10/2015	Saturday	3:00 PM	7:00 PM
10/13/2015	Tuesday	4:00 PM	8:00 PM

Table 3-2 shows the distribution of CAC tonnage by cycling option and climate zone for the residential participant population as of September 2015 and for the residential sample used for analysis purposes. The differences between the fraction of residential customer tonnage in the residential sample and population cells are small; there are only small differences across climate zones and cycling options. Sample weights were applied during the analysis so that average load impacts reflect the program's enrollment across climate zones for each cycling strategy.

Table 3-2: Distribution of CAC Tonnage by Program Option and Climate Zone Residential Population

Cycling Option	Group	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Total
50%	Population	5%	1%	0%	49%	55%
	Sample	5%	0%	0%	44%	49%
100%	Population	10%	1%	0%	34%	45%
	Sample	11%	0%	0%	40%	51%
Total	**Population**	**15%**	**2%**	**0%**	**83%**	**100%**
	Sample	**16%**	**0%**	**0%**	**84%**	**100%**

3.2 Methodology

The primary task in developing ex post load impacts is to estimate a reference load for each event. The reference load is a measure of what participant demand would have been in the absence of the CAC cycling during an event. The primary task in estimating ex ante load impacts—which is often of more practical concern—is to make the best use of historical data on loads and load impacts to predict future program performance. The data and models used to estimate ex post impacts are typically the key inputs to the ex ante analysis.

Two separate approaches were used for estimating the reference loads: a randomized controlled trial (RCT) design and a propensity score matching (PSM) design. Residential customer impacts were estimated using a randomized controlled trial. The nonresidential customer impacts were estimated with a PSM study. Under the randomized controlled trial, random samples of residential Summer Saver customers were selected for each cycling strategy. During each event, half of the sample did not have their CAC units cycled so that these customers could be used to provide a reference load for those who did have their units cycled. A matched control group was selected for most of the nonresidential Summer Saver program participants[3].

3.2.1 Ex Post Methodology

An RCT is an experimental research approach where customers are randomly assigned to treatment and control conditions so that the only difference between the two groups, other than random chance, is the existence of the treatment condition. In this context, half of the roughly 2,000 customers in the residential sample had their CAC unit cycled while the remaining customers served as the control group.

[3] A small end-use sample of the nonresidential program population was subject to an RCT (n < 150 in treatment and control) and was excluded from the analysis.

The group that received the event signal alternated from event to event. This design has significant advantages in providing fast, reliable impact estimates if sample sizes are large enough.

A matched control group was selected for the nonresidential program population—whereby one matched nonparticipant was selected for each participant on each event. The entire small commercial customer class was made available for the statistical matching analysis. Each matched customer was chosen because they most closely resembled their matched participant in terms of their propensity score, where the propensity score calculates the likelihood that a customer is a Summer Saver participant given that they have certain characteristics. In this case, those characteristics were typical peak demand on hot nonevent days and demand in the morning and early afternoon prior to the event. This approach minimizes the differences between participants and matched nonparticipants.[4]

Ex post event impacts for each cycling option were estimated for each hour of each event for both RCT and PSM customers by averaging the load of the participants in the group that experienced the event and subtracting it from the average adjusted load of the group that did not receive the event. The adjustment was based on the ratio of usage between the treatment and control groups an hour prior to the event start. For example, if the average usage in the treatment group during the hour preceding an event is 1.2 kW and the average usage in the control group is 1.3 kW, the ratio would equal 0.92 (1.2/1.3=0.92) and the control group load for the entire day would be multiplied by 0.92 to more closely match treatment group load. This adjustment is referred to as a *same-day adjustment* and is an effective way of accounting for small differences in load that can arise between randomly assigned treatment and control groups. A growing number of residential Summer Saver participants receive notification of Summer Saver events; however, since Summer Saver is a day-of demand response program, the notification occurs within hours of the actual event. To the extent that this group of customers engaged in pre-cooling prior to the event, it would be reflected in both the treatment and control groups for the RCT.

Hourly impact estimates for the residential and nonresidential Summer Saver population were calculated by taking a weighted average of the impact estimates for each cycling option, with weights determined by the number of tons enrolled on each cycling option. Similar weighting was done to calculate cycle percentage level impacts. For cycle percentage level impacts, weights were determined by the number of tons enrolled in each climate zone. Impacts for the average event day were calculated from treatment and control group load shapes averaged across the seven events that lasted from 3 to 7 PM.

3.2.2 Ex Post Validation Analysis

Table 3-3 compares the sample size, average CAC tonnage, and cycling option for the randomly chosen test groups for residential participants. As seen, the two groups are very similar along the dimensions of CAC tonnage and cycling option.

[4] Event day, pre-event demand is not typically included in propensity score models for calculating event impacts, but it was included here because less than 15 nonresidential Summer Saver participants were notified of events in advance and so they should have no effect of being treated until the event occurred.

Table 3-3: Residential A and B Group Comparison Sample Size, Tonnage, and Cycling Options

Group	Sample Size	Average CAC Tonnage per Household	% of Customers on 50% Cycling
A	1,178	4.3	52%
B	1,171	4.3	52%
Total/Average	2,349	4.3	52%

Even though random assignment and propensity score matching should produce two groups with similar characteristics, it is still important to compare the two groups based on electricity consumption when Summer Saver events are not in effect since, in the absence of very large samples, differences in energy consumption between them can still occur—due to chance in an RCT and due to a heterogeneous control pool with PSM. In 2015, absolute hourly differences between the residential A and B groups for each cycling strategy on hot nonevent days are within the range of 0 to 9%. For nonresidential customers, a sample of approximately 300 customers was randomly assigned to A and B groups. In addition, matched nonparticipants were selected for the remaining participants. Group A from the RCT and the treated customers from the PSM study combined show absolute hourly differences in the range of 0 to 5% from the combination of Group B from the RCT and the matched controls from the PSM study. Figures 3-1 and 3-2 illustrate these differences on five hot nonevent days in 2015. As the figures show, the two groups are quite similar with respect to load shape and indicate the magnitude of differences alluded to above. Figures 3-3 and 3-4 show the comparison of groups A and B, as well as treatment and matched control, further segmented by cycling option. At the cycling level, residential A and B groups show some difference for both the cycling options—the difference is larger for 50% cycling than for 100%. The nonresidential participant and matched control groups—combined with the A and B groups from the nonresidential RCT—for the 50% and 30% cycling options show small differences in consumption. These differences are considerably smaller than those observed in 2014 and are attributable to the shift toward matching method and the larger sample size that approach affords. Appendix A presents the outcome of out-of-sample testing for seven individual hot non-event days for each cycling strategy.

Figure 3-1: Residential A and B Group Comparison Average Load on the Five Hottest 2015 Nonevent Days[5]

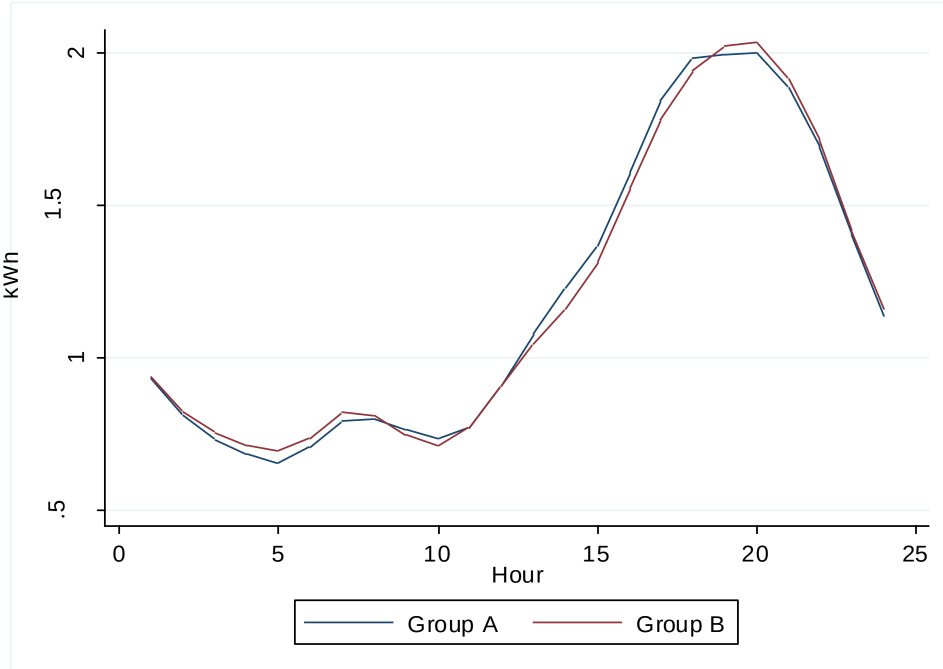
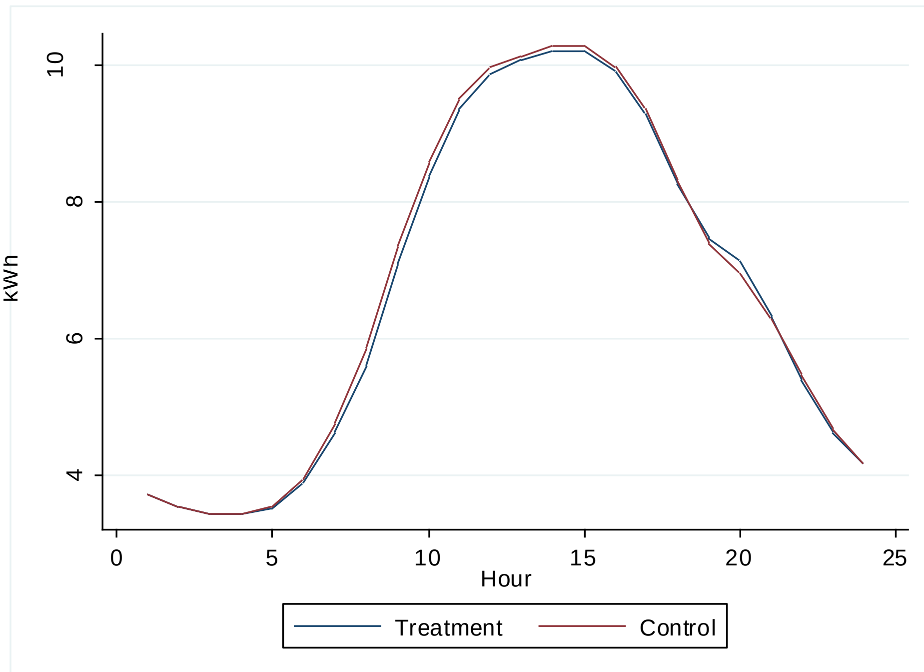


Figure 3-2: Nonresidential Matched Control and Treatment Group Comparison Average Load on the Five Hottest 2015 Nonevent Days



5 The five nonevent days used for this analysis are 9/8, 9/14, 9/28, 10/12, and 10/14/2015.

Figure 3-3: Residential A and B Group Comparison
Average Load on the Five Hottest 2015 Nonevent Days by Cycling Option

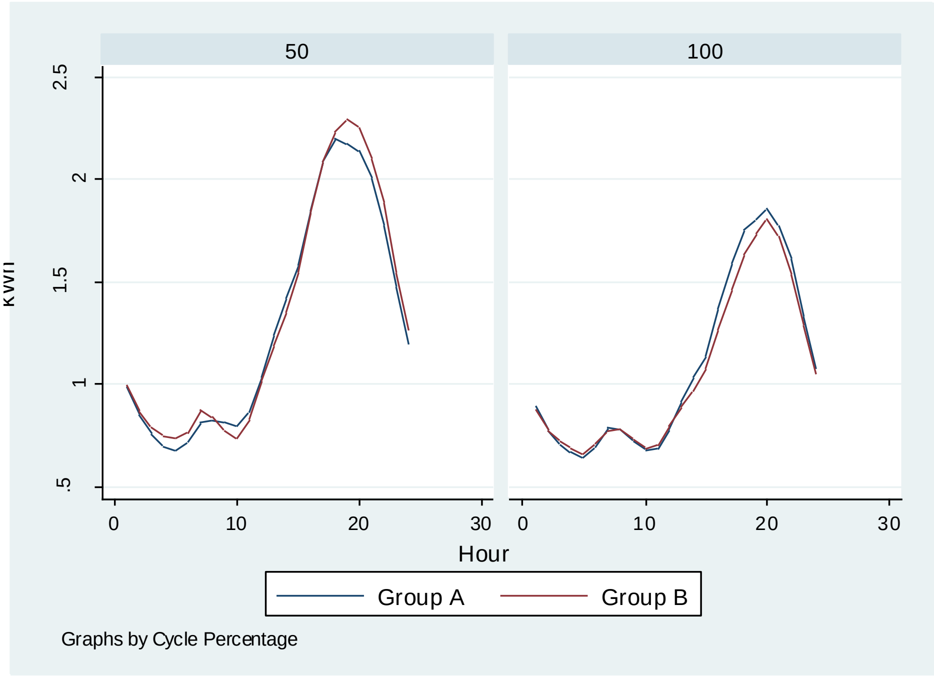
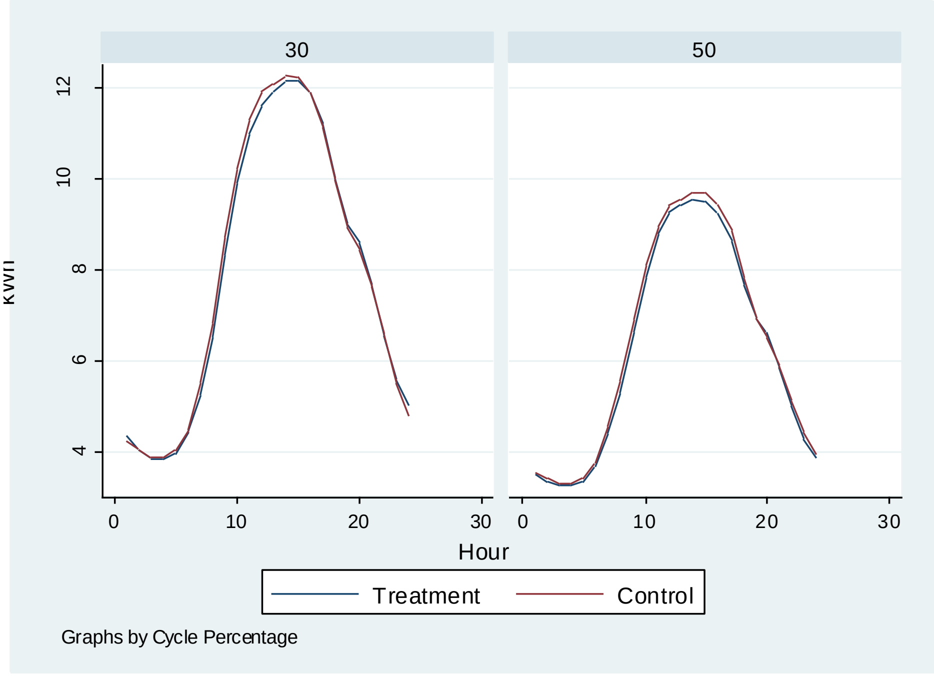


Figure 3-4: Nonresidential Matched Control and Treatment Group Comparison
Average Load on the Five Hottest 2015 Nonevent Days by Cycling Option



3.3 Ex Ante Impact Estimation Methodology

Calculating the ex ante load impacts is a multi-step process, but is driven by a straightforward approach to modeling load impacts as a function of weather. Briefly, load impacts from 2015—plus the previous five years' of Summer Saver events—were modeled as a function of temperature and then applied to ex ante weather conditions to predict ex ante load impacts. This section presents a detailed description of the ex ante methodology.

Ex ante load impacts were developed using the available ex post data. For both residential and nonresidential customers, load impacts for a common set of hours across all ex post events from 2010 through 2015 were used in the estimation database for developing the ex ante model. Only the hours from 3 to 5 PM were used for the analysis because these hours were common across the greatest number of ex post event days. Certain prior Summer Saver event days were not used in the ex ante regression analysis because of atypical circumstances surrounding the event. September 8 and 9, 2011 were excluded as they were associated with a regional system outage. August 10, 2012 and September 20, 2015 were excluded because those events only had one hour during the period 2 to 5 PM. The May 2014 events were excluded because of wildfires in the San Diego region in addition to unusually high temperatures—attributable to Santa Ana wind conditions—that were recorded during those events which were further coupled with unusually low load impacts.

The average load reduction from 3 to 5 PM was modeled as a function of the average temperature for the first 17 hours of each event day—midnight to 5 PM, (mean17). This 17-hour average was used to capture the impact of heat buildup leading up to and including the event hours. Per ton load impacts were used so that the load impacts would be scalable to ex ante scenarios where the tonnage and number of devices per premise may be different. The models were run separately by customer type (residential and nonresidential) and cycling strategy. The estimated parameters from the models were used to predict load impacts under 1-in-2 and 1-in-10 year ex ante weather conditions. The final regressions only included one explanatory variable because more complicated models were not found to perform better in cross-validations done in previous Summer Saver evaluations. The model that was used to predict average ex post impacts was:

$$impact_d = b_0 + b_1 \cdot mean17_{\mathrm{d}} + \varepsilon_d$$

Table 3-6: Ex Ante Regression Variables

Variable	Description
$Impact_d$	Average per ton ex post load impact for each event day from 2 to 5 PM
b_0	Estimated constant
b_1	Estimated parameter coefficient
$mean17_d$	Average temperature over the 17 hours prior to the start of the event for each event day
ε_d	The error term for each day d

Figures 3-5 through 3-8 show the ex post impacts from 2010 through 2015 by customer type and cycling strategy as a function of mean17. The figures also contain the ex ante predictions that were developed based on the regression model of ex post impacts as a function of mean17. The ex ante estimates for residential customers, shown in Figures 3-5 and 3-6, follow from the ex post impacts and are quite plausible. While there is more noise in the nonresidential ex post estimates, shown in Figures 3-7 and 3-8, the linear prediction through these estimates produce ex ante estimates that are conservatively in the middle of the range of ex post estimates. It is also worth noting how the load impacts at a given value of mean17 are quite similar for the two residential cycling options. As discussed in the next section, customers who chose the 100% cycling option have much lower reference loads than those on the 50% cycling option so the average, absolute impacts for the two groups are quite similar in spite of the very different cycling strategies. This is not the case with nonresidential customers, where the difference in load impacts across the two cycling options is much greater. This is logical since residential customers have more discretion in their use of air conditioning (especially those who are not home during the day) and there is much more potential for selection effects to differ across those choosing the two different cycling options. Nonresidential customers have less discretion in how they operate their air conditioning during business hours so selection effects correlated with cycling options are less prevalent for this customer segment.

Figure 3-5: Average Ex Post Load Impacts and Ex Ante Predictions from 3 to 5 PM for Residential 50% Cycling Participants

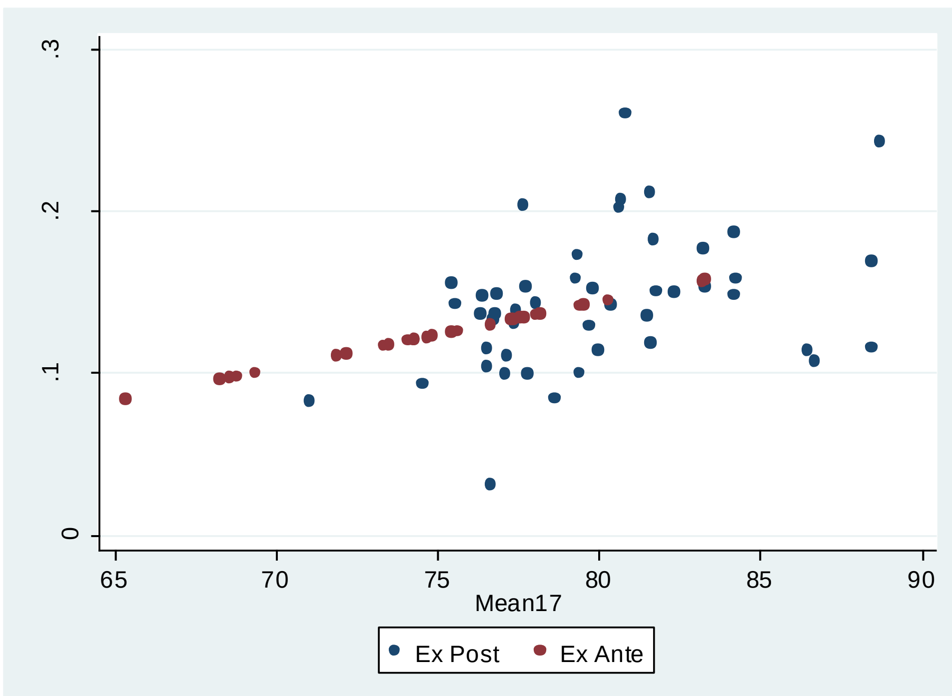


Figure 3-6: Average Ex Post Load Impacts and Ex Ante Predictions from 3 to 5 PM for Residential 100% Cycling Participants

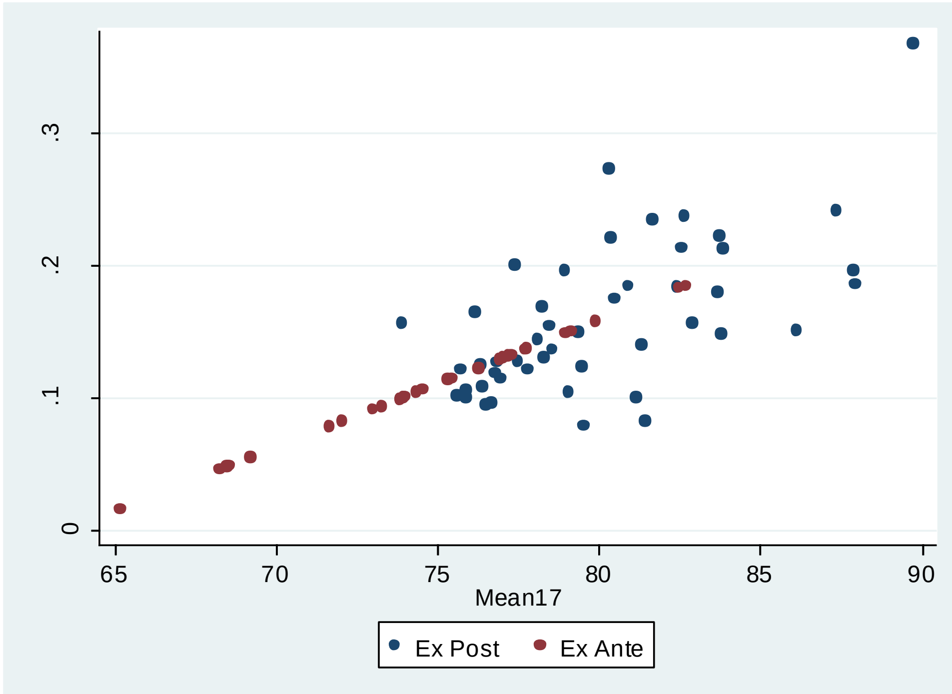


Figure 3-7: Average Ex Post Load Impacts and Ex Ante Predictions from 3 to 5 PM for Nonresidential 30% Cycling Participants

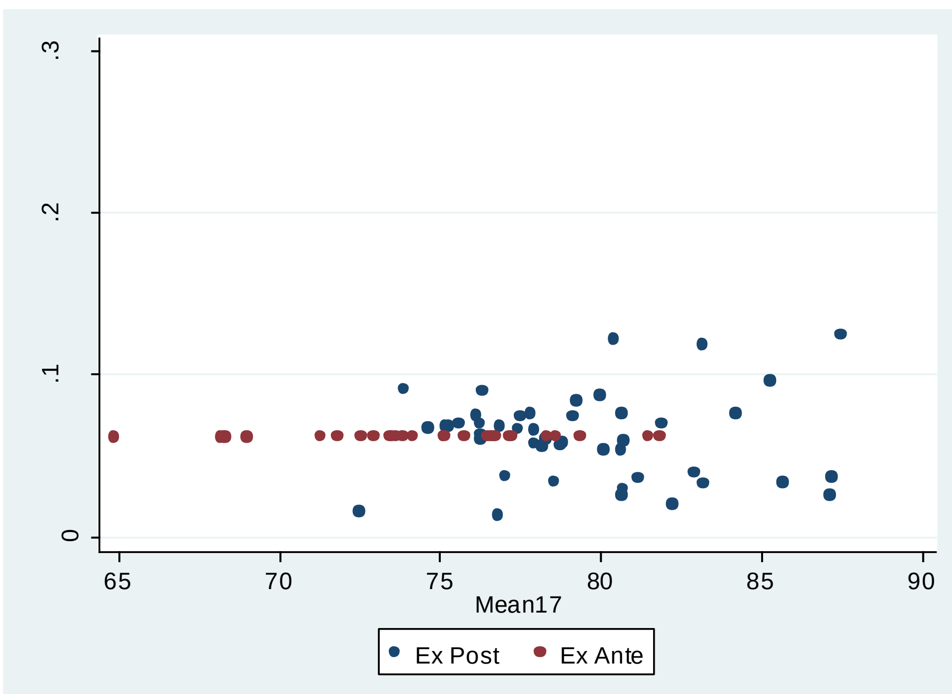
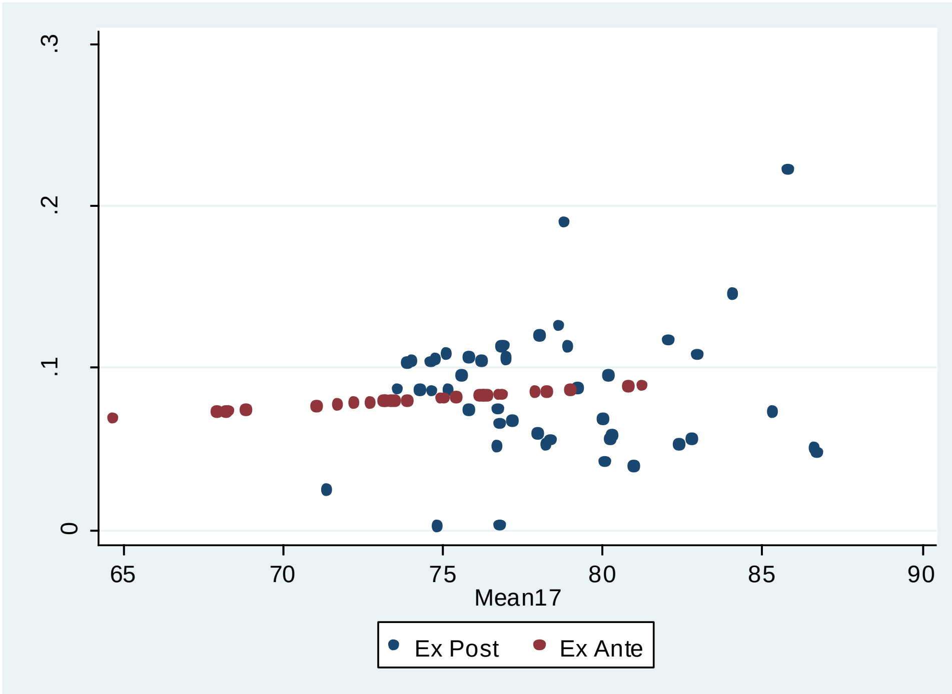


Figure 3-8: Average Ex Post Load Impacts and Ex Ante Predictions from 3 to 5 PM for Nonresidential 50% Cycling Participants



After the ex ante impacts have been estimated for the 3 to 5 PM period, the next step is to predict impacts for the additional hours covered by the CPUC resource adequacy window from 1 to 6 PM. Hourly ex post impact estimates for each event from 2010 to 2015 were expressed as a fraction of the average impact from 3 to 5 PM. Table 3-7 shows the average of these ratios for the hours 1 to 6 PM for the 100% residential cycling group. The first column of Table 3-7 shows how the average event impact for each hour compares with the average impact from 3 to 5 PM. To illustrate further, the second column shows the proportions in the first column multiplied by 0.10 kW/ton, which is the average predicted impact from 3 to 5 PM for residential customers during a typical event day under 1-in-2 year weather conditions. To calculate the estimated impact for 1 to 2 PM, for example, 0.10 kW/ton is multiplied by 0.70 to yield an impact of 0.07 kW/ton. The same strategy was applied for all five hours of the ex ante event window for each cycling option and customer class.

Table 3-7: Hourly Load Impacts Compared to Average Impact from 3 to 5 PM Residential 100% Cycling

Hour of Event	Hourly Impact/ Average 2-5 PM Impact*	Hourly Impact for Typical CAISO Event Day, 1-in-2 Weather (kW/Ton)	Hourly Impact for Typical SDG&E Event Day, 1-in-2 Weather (kW/Ton)
1-2 PM	0.69	0.07	0.06
2-3 PM	0.85	0.09	0.08
3-4 PM	1.00	0.10	0.09
4-5 PM	1.11	0.11	0.10
5-6 PM	1.06	0.11	0.10

*Multiyear Dataset from 2010-2015

This method constrains the relative size of event impacts across different hours to be the same for each event. Event impacts vary with weather, as usual, but in this model the ratio of the impact at 4 PM to the impact at 5 PM, for example, is always the same. A separate ex ante model could be used for each event hour. Such a strategy would have the virtue of independently identifying the effect of weather on event impacts at different times of day. However, when there are only a moderate number of events and, for some hours, many fewer events than for other hours, that strategy risks fitting spurious trends to individual hours or trends across hours that conflict with one another. Given the highly auto-correlated nature of the data, the differential impact of weather on different event hours is likely to be difficult to measure compared with the primary effect of temperature on average event impacts.

As discussed above, average ex ante load impacts were estimated directly based on ex post impacts. However, the CPUC Load Impact Protocols require that ex ante reference loads also be estimated even though they may not always be necessary for load impact estimation, as is true here. To meet this requirement, reference loads were estimated in a manner similar to the approach used for ex ante impact estimation. Models for estimating reference loads were estimated separately by customer type and cycling strategy. The following steps were used:

- Average control group usage during the 3 to 5 PM time period on 2011–2015[6] event days was modeled as a function of mean17;
- The parameters from this regression were used to predict average usage from 3 to 5 PM under ex ante weather conditions;
- A ratio between each ex ante prediction and average 2014 control group usage from 2 to 5 PM across all days was calculated; and

6 Data for the year 2010 was excluded from the reference load estimation process because the evaluation was based on end-use, rather than whole-premise, interval data.

- Average control group load profiles for the entire average event day 2011–2015 were adjusted by the ratio specific to each set of ex ante weather conditions to produce the final ex ante reference loads.

Finally, estimates of the ex ante snapback effect were developed in a similar manner. Snapback refers to the increase in load following termination of a load control event as a result of the increased temperature that occurs in buildings when air conditioning is cycled. Like load impacts and reference loads, snapback for residential customers was calculated by cycling strategy. The calculation consisted of the following steps:

1. Average the snapback values across the six hours after each ex post event;
2. Develop a ratio between snapback in each hour and snapback in the first hour;
3. Multiply the snapback value in the first hour by the ratios previously used to scale the ex post reference load to ex ante weather conditions; and
4. Multiply the adjusted snapback values for each set of ex ante weather conditions by the snapback ratios to get snapback values for the six hours after each ex ante event.

Nonresidential snapback was assumed to be zero as there is little prior evidence of CAC snapback after Summer Saver events for nonresidential participants.

4 Ex Post Load Impact Estimates

This section contains the ex post load impact estimates for program year 2015. Residential load impacts are presented first, followed by nonresidential load impacts.

4.1 Residential Ex Post Load Impact Estimates

Fifteen Summer Saver events were called in 2015, and each one lasted for four hours, except for the event called on September 20. This event was called for an emergency and only lasted two hours, from 1:35 to 3:35 PM. For the remaining 14 events, 9 were called from 3 to 7 PM, and the others were called from 2 to 6 PM and 4 to 8 PM, respectively. Table 4-1 presents ex post load impacts for the residential program segment for program years 2015 and 2014, for comparison. Aggregate load impacts ranged from a low of 7.6 MW on October 13, 2015 to a high of 17.8 MW on August 16, 2015. The nine events with the common event hours of 3 to 7 PM produced, on average, 13.3 MW of load reduction. These load impacts are, on average, higher than those observed in 2014, however observed temperatures during event and pre-event hours were higher and more comparable to those observed in years prior to 2014. Additionally, 2015 was the first program year since 2012 during which events were called on the weekend. In 2015, three weekend events were called—August 16, 2015, September 20, 2015, and October 10, 2015. On average, the load impacts on weekend events were almost 10% higher than those observed on weekday events, likely due to higher home occupancy (and cooling demands) on the weekends.

Table 4-1: Summer Saver Residential Ex Post Load Impact Estimates

Year	Date	Impact			Mean17 (°F)
		Per CAC Unit (kW)	Per Premise (kW)	Aggregate (MW)	
2014	5/14/2014	0.26	0.31	6.9	82
	5/15/2014	0.41	0.49	10.9	84
	5/16/2014	0.22	0.27	6.0	82
	7/29/2014	0.45	0.54	12.2	79
	8/27/2014	0.23	0.27	6.1	79
	9/15/2014	0.68	0.81	18.2	83
	9/16/2014	0.73	0.87	19.5	85
	9/17/2014	0.53	0.64	14.3	85
	Average*	0.42	0.50	11.2	81
2015	8/13/2015	0.42	0.50	10.5	78
	8/14/2015	0.36	0.43	9.0	79
	8/16/2015	0.70	0.84	17.8	82
	8/26/2015	0.35	0.42	9.0	80
	8/27/2015	0.54	0.64	13.7	82
	8/28/2015	0.59	0.70	14.9	84
	9/9/2015	0.68	0.81	17.2	88
	9/10/2015	0.45	0.54	11.4	86
	9/11/2015	0.51	0.61	13.0	84
	9/20/2015**	0.34	0.41	8.7	84
	9/24/2015	0.48	0.58	12.2	78
	9/25/2015	0.40	0.47	10.1	79
	10/9/2015	0.43	0.51	10.8	81
	10/10/2015	0.45	0.54	11.4	88
	10/13/2015	0.30	0.36	7.6	82
	Average***	0.53	0.63	13.3	83

*Reflects the average 4-hour event from 2-6 PM

**Reflects the emergency event called from 1:35 to 3:35 PM

***Reflects the average 4-hour weekday event from 3-7 PM

Table 4-2 shows the average per premise reference loads, load impacts, and percent impact for residential customers by cycling option. Across the nine days with the common event hours of 3 to 7 PM, reference loads for the 50% cycling strategy group is 42% higher than the reference load for the 100% cycling strategy. Put another way, customers who use their CAC units more are less likely to select the 100% cycling option. So, even though the cycling percentage between these groups differs by a factor of two, load impacts for the 100% group are only 33% higher than that of the 50% cycling segment.

Table 4-2: Summer Saver Residential Average (kW per Premise) Reference Load, Impacts and Percent Impacts by Cycling Option

Event Date	Average Reference Load per Premise* (kW)		Average Load Impact per Premise* (kW)		Average Percent Impact	
	100%	50%	100%	50%	100%	50%
8/13/2015	1.37	2.16	0.64	0.40	47%	18%
8/14/2015	1.91	2.58	0.53	0.34	28%	13%
8/16/2015	2.33	3.02	1.09	0.64	46%	21%
8/26/2015	1.87	2.43	0.48	0.38	25%	15%
8/27/2015	1.73	2.59	0.67	0.62	39%	24%
8/28/2015	2.15	2.84	0.90	0.55	42%	19%
9/9/2015	2.10	3.00	0.95	0.71	45%	24%
9/10/2015	2.15	2.72	0.76	0.37	35%	13%
9/11/2015	1.81	2.72	0.64	0.59	35%	22%
9/20/2015	2.22	3.02	0.64	0.24	30%	9%
9/24/2015	1.30	1.98	0.55	0.60	42%	30%
9/25/2015	1.61	2.29	0.71	0.31	43%	14%
10/9/2015	1.66	2.44	0.48	0.54	29%	22%
10/10/2015	2.15	2.64	0.79	0.34	37%	13%
10/13/2015	1.67	2.29	0.33	0.38	20%	17%
Average*	1.85	2.64	0.72	0.54	39%	20%

*Reflects the average hour in event window

*Reflects the average weekday 3-7 PM 2015 Summer Saver event

Table 4-3 shows the estimated load impacts for residential participants on each event day segmented by cycling option. On a per premise level, load impacts for 100% cycling range from a high of 1.09 kW to a low of 0.33 kW. Load impacts for 50% cycling range from 0.24 kW to 0.71 kW per premise

In the case of three event days—September 24, 2015, October 9, 2015, and October 13, 2015—the load impacts for 100% cycling are actually lower than impacts for 50% cycling. While the differences between the estimated load impacts for 50% and 100% cycling are not statistically significant, on these three days, reference loads for customers on the 50% cycling option are about 50% higher than for customers on the 100% cycling option. Similar outcomes have been observed in prior evaluations of the Summer Saver program, but given the relatively small sample sizes at the cycling option level of aggregation, this result may just be due to random fluctuation. There may also have been slightly different weather patterns for the two groups that caused the larger reference load increase for the 50% cycling customers on these days—100% cycling customers are more highly concentrated in the moderate coastal climate zone than are 50% cycling customers, so there are small differences in average weather for the two groups.

Table 4-3: Summer Saver Residential Average (kW per Premise) and Aggregate (MW) Load Impacts by Cycling Option

Event Date	Average Load Impact per Premise (kW)		Aggregate Load Impact (MW)	
	100%	50%	100%	50%
8/13/2015	0.64	0.40	5.9	4.7
8/14/2015	0.53	0.34	4.9	4.0
8/16/2015	1.09	0.64	10.0	7.7
8/26/2015	0.48	0.38	4.4	4.5
8/27/2015	0.67	0.62	6.2	7.4
8/28/2015	0.90	0.55	8.3	6.6
9/9/2015	0.95	0.71	8.7	8.5
9/10/2015	0.76	0.37	7.0	4.4
9/11/2015	0.64	0.59	5.9	7.1
9/20/2015	0.64	0.24	5.9	2.9
9/24/2015	0.55	0.60	5.1	7.1
9/25/2015	0.71	0.31	6.5	3.7
10/9/2015	0.48	0.54	4.4	6.4
10/10/2015	0.79	0.34	7.3	4.1
10/13/2015	0.33	0.38	3.0	4.6
Average*	0.72	0.54	6.6	6.4

*Reflects the average weekday 3-7 PM 2015 Summer Saver event

Table 4-4 shows estimated event impacts for residential customers segmented by usage quintiles, and Table 4-5 shows the same, but segmented by usage deciles. Each customer was placed into one of five quintiles (or one of ten deciles, in the case of Table 4-5) based on their average usage during peak hours from 11 AM to 6 PM on hot non-event weekdays in 2015. Impact estimates were calculated separately for each quintile and decile using the treatment group loads during the average event hour of the average 3-7 PM 2015 Summer Saver event.

Tables 4-4 and 4-5 show both the average impact as well as the standard error of the estimates for each quintile. Load impacts increase across the quintiles, likely reflecting an underlying pattern, but the estimates at the quintile and decile level have fairly large standard errors.

Table 4-4: Summer Saver Residential Average (kW per Premise) Load Impacts by Usage Quintile and Cycling Option

Quintile	Residential Customers			
	50% Cycling		100% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.57	0.04	-0.54	0.03
2	0.06	0.05	0.24	0.04
3	0.59	0.06	0.45	0.05
4	0.96	0.07	1.18	0.07
5	1.66	0.10	2.21	0.11

*Reflects the average 3-7 PM 2015 weekday Summer Saver event

Table 4-5: Summer Saver Residential Average (kW per Premise) Load Impacts by Usage Decile and Cycling Option

Quintile	Residential Customers			
	50% Cycling		100% Cycling	
	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* Per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-1.11	0.04	-1.01	0.03
2	-0.08	0.04	-0.08	0.03
3	-0.15	0.04	0.15	0.04
4	0.27	0.05	0.35	0.04
5	0.49	0.06	0.27	0.04
6	0.68	0.06	0.66	0.05
7	0.85	0.07	1.11	0.06
8	1.07	0.08	1.24	0.07
9	1.41	0.09	1.61	0.09
10	1.90	0.11	2.82	0.13

*Reflects the average 3-7 PM 2015 weekday Summer Saver event

4.2 Nonresidential Ex Post Load Impact Estimates

Table 4-6 presents ex post load impact estimates for nonresidential customers for each 2015 event day and an average event day across the nine Summer Saver events in 2015 with common event hours from 3 to 7 PM. Table 4-4 also shows the 2014 ex post load impacts for comparison. Nonresidential customers represent 17.6% of total Summer Saver participants and 31% of enrolled CAC tonnage. Nonresidential aggregate impacts varied from a low of 0.4 MW on October 13 to a high of 2.5 MW on September 24. Nonresidential load impacts experience their peaks and lows differently than the residential segment. The three events with the latest event hours, 4-8 PM show average load impacts of 0.16 kW per premise; the nine events with event hours 3-7 PM show an average load impact of 0.31 kW, while the two events with event hours of 2-6 PM show the highest load impacts averaging 0.50 kW per premise, even though the temperatures recorded before and during those events are among the coolest across all events. While nonresidential load impacts are not very weather sensitive, they do demonstrate sensitivity to whether or not the event includes more or fewer standard business hours.

Table 4-6: Summer Saver Nonresidential Ex Post Load Impact Estimates

Year	Date	Impact			Mean17 (°F)
		Per CAC Unit (kW)	Per Premise (kW)	Aggregate (MW)	
2014	14-May-14	0.16	0.37	1.7	82
	15-May-14	0.25	0.60	2.8	84
	16-May-14	0.33	0.79	3.7	81
	29-Jul-14	0.04	0.10	0.5	78
	27-Aug-14	0.31	0.74	3.5	78
	15-Sep-14	0.24	0.56	2.6	82
	16-Sep-14	0.36	0.85	4.0	85
	17-Sep-14	0.32	0.76	3.5	84
	Average*	0.29	0.69	3.2	80
2015	13-Aug-15	0.12	0.28	1.3	77
	14-Aug-15	0.08	0.19	0.8	78
	16-Aug-15	0.12	0.29	1.3	80
	26-Aug-15	0.09	0.21	1.0	79
	27-Aug-15	0.12	0.30	1.3	80
	28-Aug-15	0.10	0.25	1.1	83
	9-Sep-15	0.11	0.26	1.2	87
	10-Sep-15	0.15	0.36	1.7	85
	11-Sep-15	0.14	0.34	1.6	83
	20-Sep-15	0.06	0.14	0.6	83
	24-Sep-15	0.23	0.54	2.5	77
	25-Sep-15	0.20	0.47	2.1	78
	9-Oct-15	0.14	0.34	1.6	80
	10-Oct-15	0.15	0.35	1.6	87
	13-Oct-15	0.04	0.08	0.4	81
	Average**	0.13	0.30	1.4	82

*Reflects the average 4-hour event from 2-6 PM

**Reflects the average 4-hour weekday event from 3-7 PM

A comparison of average impacts per CAC unit in Tables 4-1 and 4-5 shows that the impact for nonresidential customers is roughly 25% of the value for residential customers. Much of the difference is certainly due to the lower average cycling options used for nonresidential customers, but per CAC unit load impacts can be compared across residential and nonresidential participants on the same cycling strategy to determine if other factors may be at play.

Table 4-7 shows the comparison of average load impact per CAC for 50% cycling residential and 50% nonresidential customers, respectively. Prior Summer Saver evaluations, except for 2014, have found larger overall differentials between residential and nonresidential 50% cycling load impacts. On average across all 2015 Summer Saver events, the average load impacts per CAC unit are more than three times as large for residential 50% cycling, compared to nonresidential 50% cycling.

Table 4-7: Comparison of Residential and Nonresidential Summer Saver 50% Cycling Load Impacts

Event Date	Average Load Impact per CAC Unit (kW)	
	Residential 50%	Nonresidential 50%
8/13/2015	0.34	0.11
8/14/2015	0.29	0.08
8/16/2015	0.55	0.15
8/26/2015	0.32	0.06
8/27/2015	0.53	0.15
8/28/2015	0.47	0.08
9/9/2015	0.61	0.12
9/10/2015	0.31	0.20
9/11/2015	0.51	0.14
9/20/2015	0.21	0.06
9/24/2015	0.51	0.22
9/25/2015	0.26	0.19
10/9/2015	0.46	0.14
10/10/2015	0.29	0.17
10/13/2015	0.33	0.01
Average*	0.46	0.13

*Reflects the average weekday 3-7 PM 2015 Summer Saver event

Figure 4-1 shows the reference and observed loads for residential and nonresidential 50% cycling customers. As shown, the difference in impacts between residential and nonresidential customers on the 50% cycling strategy can be explained by the relative behaviors of the reference loads during the event hours, highlighted in pink. For residential customers, reference loads (denoted by the blue curve) are increasing during the average event window, whereas nonresidential reference loads (denoted by the green curve) are decreasing during this period.

Figure 4-1: Reference and Observed Loads for the Average Event Day Residential and Nonresidential 50% Cycling

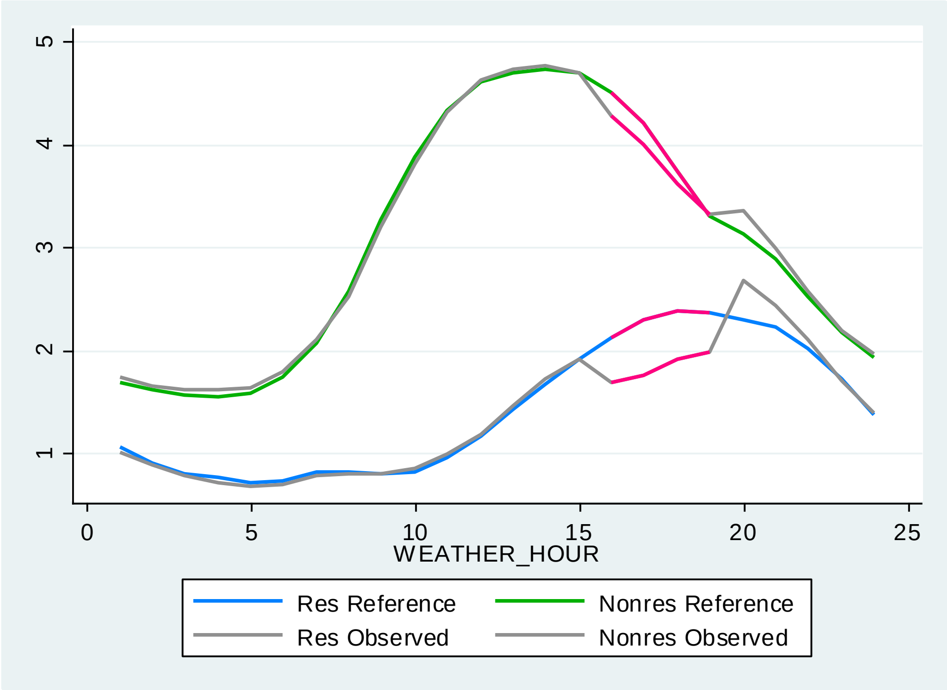


Table 4-8 shows the estimated load impacts for nonresidential participants on each event day segmented by cycling strategy. On a per premise basis, load impacts for 50% cycling range from 0.02 kW to 0.50 kW. Per premise load impacts for 30% cycling range from 0.12 kW to 0.66 kW. Across the nine days with the same event times, load impacts for 50% cycling are very similar to that of 30% cycling 0.30 kW versus 0.32 kW, respectively.

Table 4-8: Summer Saver Nonresidential Average (kW per Premise) and Aggregate (MW) Load Impacts by Cycling Option

Event Date	Average Impact per Premise (kW)		Aggregate Impact (MW)	
	50%	30%	50%	30%
8/13/2015	0.24	0.38	0.83	0.44
8/14/2015	0.18	0.20	0.62	0.23
8/16/2015	0.33	0.17	1.11	0.19
8/26/2015	0.14	0.42	0.48	0.48
8/27/2015	0.33	0.18	1.14	0.20
8/28/2015	0.18	0.46	0.61	0.52
9/9/2015	0.27	0.22	0.91	0.25
9/10/2015	0.44	0.13	1.49	0.15
9/11/2015	0.32	0.42	1.08	0.48
9/20/2015	0.14	0.12	0.48	0.13
9/24/2015	0.50	0.66	1.70	0.76
9/25/2015	0.43	0.59	1.46	0.67
10/9/2015	0.31	0.46	1.04	0.52
10/10/2015	0.38	0.25	1.29	0.29
10/13/2015	0.02	0.28	0.07	0.32
Average*	0.30	0.32	1.01	0.37

Table 4-9: Summer Saver Nonresidential Average (kW per Premise) Load Impacts by Usage Quintile and Cycling Option

Quintile	30% Cycling		50% Cycling	
	Average* per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* per Premise Load Impact (kW)	Load Impact Standard Error (kW)
1	-0.12	0.10	-0.03	0.04
2	0.06	0.14	0.06	0.06
3	0.16	0.19	0.22	0.09
4	0.28	0.32	0.25	0.14
5	1.24	2.01	1.00	1.04

Table 4-10: Summer Saver Nonresidential Average (kW per Premise) Load Impacts by Usage Decile and Cycling Option

Decile	30% Cycling		50% Cycling	
	Average* per Premise Load Impact (kW)	Load Impact Standard Error (kW)	Average* per Premise Load Impact (kW)	Average* per Premise Load Impact (kW)
1	-0.02	0.07	-0.05	0.03
2	-0.21	0.15	-0.02	0.06
3	0.07	0.12	0.02	0.08
4	0.05	0.25	0.10	0.09
5	0.15	0.24	0.20	0.10
6	0.18	0.27	0.24	0.13
7	0.27	0.32	0.22	0.16
8	0.29	0.42	0.29	0.19
9	0.76	0.74	0.61	0.29
10	1.71	3.41	1.37	1.76

4.3 Free Riders

An important issue for the cost-effectiveness of the Summer Saver program is the fraction of customers who sign up for the program but who do not use their CAC unit much or at all. These customers are compensated for their enrollment in the program, but are likely to provide little load impact. Sub-meter data can be used to estimate the fraction of each program segment that had little CAC usage in 2015. Sub-metered data was collected from a sample of 274 residential and 253 nonresidential CAC units divided approximately evenly among cycling options.

Table 4-11 shows the fraction of CAC units with zero or small CAC usage. First, customers with sub-metered usage equal to 0 kW on hot nonevent days[7] in 2015 were considered across the entire summer considered all nonevent days in the summer of 2014. The residential program segment shows significantly higher incidence of 0 kW usage than the nonresidential program segment.

A second check for customers with sub-metered usage equal to nearly 0 kW—thresholds of 0.02 kW and 0.05 kW were used—was also made. Residential 100% cycling participants are more likely to show very low CAC usage than 50%; nonresidential participants in the 30% cycling segment are more likely to have very low CAC usage as nonresidential participants in the 50% cycling segment. The lower incidence of zero or very low CAC usage in the nonresidential segment likely reflects the fact that nonresidential cooling needs and preferences are usually less flexible than those of residential customers.

[7] Hot nonevent days in 2015 were selected for analysis if the average temperature between 11 AM and 6 PM was greater than 80°F.

**Table 4-11: Fraction of CAC Units with Low Average Usage
Sub-meter Sample – Hot Non-event Days in 2015**

Average Usage	Residential		Nonresidential	
	50%	100%	30%	50%
0 kW	6%	9%	0%	3%
<0.02 kW	12%	23%	7%	14%
<0.05 kW	15%	29%	9%	15%

4.4 Control Device Communications Failure

Summer Saver load control switches rely on radio signals for activating load control during program events. If the switch is broken, if the signal is blocked, or if the signal is sent on a frequency that the device is not set up to receive, then load control will not occur for that device. This is referred to as control device communication failure.

There was no direct verification of control device communication for the 2015 evaluation. However, the sub-sample of Summer Saver participants (see Section 4.3) with sub-metered data is available to provide some limited information on the prevalence of control device communication failure. The sub-sample includes 129 participants on the 100% cycling option. The sub-metered data from these customers[8] on event days should show load reductions very close to 100%; otherwise, they can be presumed to be affected by communication failure. Of the 129 participants in the sub-sample, 29 customers (22.5%) had zero kWh during all of the event hours. 110 customers (85.4%) had zero kWh during at least 50% of all event hours, and 1 customer (.78%) had complete signal failure and experienced non-zero kWh during all event hours.

Since there is no obvious reason why customers on 100% cycling should have different communication failure rates from residential customers on other cycling options, this analysis likely reflects communication across the residential Summer Saver population. Commercial Summer Saver customers may have different rates of communication failure due to differing building types and switch locations.

As shown in Table 4-12, an analysis of the number of customers in the 100% cycling group that had nonzero load during each event hour of 2015 revealed that communication failure was variable in 2015, but averaged 17% after the first hour of the event. The higher percentage (26%) of nonzero loads in the first hour can be attributed to the fact that for each customer, events actually begin sometime in the first half-hour of the event, rather than immediately at the top of the hour.

[8] About half of these 157 customers are held back from load control during each event, so the number of sub-metered CAC units available for this analysis is about half that for each event.

Table 4-12: Percentage of Premises on 100% Cycling with Nonzero Load during Each Event Hour in 2015

Event Date	Event Hour			
	1	2	3	4
13-Aug-15	22%	13%	13%	13%
14-Aug-15	24%	16%	16%	14%
16-Aug-15	30%	19%	17%	17%
26-Aug-15	25%	13%	13%	10%
27-Aug-15	29%	20%	17%	16%
28-Aug-15	26%	16%	19%	20%
9-Sep-15	31%	20%	21%	22%
10-Sep-15	24%	15%	18%	19%
11-Sep-15	34%	18%	20%	20%
20-Sep-15	13%	36%	N/A	N/A
24-Sep-15	24%	16%	17%	17%
25-Sep-15	22%	17%	16%	17%
9-Oct-15	21%	16%	14%	13%
10-Oct-15	29%	16%	15%	14%
13-Oct-15	30%	17%	15%	12%
Average	**26%**	**18%**	**17%**	**16%**

5 Ex Ante Load Impact Estimates

This section presents ex ante load impact estimates for SDG&E's Summer Saver program. Residential ex ante estimates are provided first, followed by estimates for nonresidential customers. The last subsection provides a detailed discussion of the differences between ex post and ex ante estimates.

5.1 Ex Ante Estimates

The model described in Section 3 was used to estimate load impacts based on ex ante event weather conditions and enrollment projections for the years 2016–2026. Enrollment in the Summer Saver program is not expected to change over the forecast horizon so the tables in this section represent predictions for each of the 11 years from 2016 to 2026, under the assumption that the program would continue to be operated as it is currently throughout that period of time.

The Protocols require that ex ante load impacts be estimated assuming weather conditions associated with both normal and extreme utility operating conditions. Normal conditions are defined as those that would be expected to occur once every 2 years (1-in-2 conditions) and extreme conditions are those that would be expected to occur once every 10 years (1-in-10 conditions). Since 2008, the California IOUs have based the ex ante weather conditions on system operating conditions specific to each individual utility for estimating demand response load impacts. However, ex ante weather conditions could alternatively reflect 1-in-2 and 1-in-10 year operating conditions for the CAISO rather than the operating conditions for each IOU. While the protocols are silent on this issue, a letter from the CPUC Energy Division to the IOUs dated October 21, 2014 directed the utilities to provide impact estimates under two sets of operating conditions starting with the April 1, 2015 filings: one reflecting operating conditions for each IOU and one reflecting operating conditions for the CAISO system.

In order to meet this new requirement, California's IOUs contracted with Nexant to develop ex ante weather conditions based on the peaking conditions for each utility and for the CAISO system. The previous ex ante weather conditions for Pacific Gas and Electric Co. and Southern California Edison Co. were developed in 2009; the previous ex ante weather conditions were developed in 2012 for SDG&E. These scenarios were updated this year along with the development of the new CAISO-based conditions. Both sets of estimates used a common methodology, which is documented in a report delivered to the IOUs.[9]

The extent to which utility-specific ex ante weather conditions differ from CAISO ex ante weather conditions largely depends on the correlation between individual utility and CAISO peak loads. Based on CAISO and SDG&E system peak loads for the top 25 CAISO system load days each year from 2006 to 2013, the correlation coefficient for SDG&E is 0.56, indicating that there are many days on which the CAISO system loads are high while SDG&E loads are more modest. This correlation for SDG&E tends to be weakest when CAISO loads have been below 46,000 MW. CAISO loads often reach 43,000 MW when loads in the Los Angeles area are extreme but San Diego loads are moderate—or vice-versa. However, whenever CAISO loads have exceeded 45,000 MW, loads typically have been high across all three IOUs.

[9] See *Statewide Demand Response Ex Ante Weather Conditions*. Nexant, Inc. January 30, 2015.

Table 5-1 shows the Summer Saver enrollment-weighted average temperature from midnight to 5 PM (mean17) for the typical event day and the monthly system peak day under the four sets of weather conditions for which load impacts are estimated. The differences in mean17 values based on SDG&E peak conditions and CAISO peak conditions, and also based on normal and extreme weather, can be quite large. There are also large differences across months. As seen later, even small differences in the value of mean17 can have large impacts on aggregate load impacts.

Table 5-1: Summer Saver Enrollment-weighted Ex Ante Weather Values (mean17)

Customer Type	Cycle	Day Type	CAISO-based Weather (°F)		SDG&E-based Weather (°F)	
			1-in-2	1-in-10	1-in-2	1-in-10
Nonresidential	30%	Typical Event Day	74	77	73	78
		May Peak Day	65	74	68	77
		June Peak Day	69	74	68	74
		July Peak Day	72	74	73	79
		August Peak Day	77	77	75	79
		September Peak Day	77	82	76	82
		October Peak Day	68	75	71	77
	50%	Typical Event Day	73	76	73	78
		May Peak Day	65	73	68	76
		June Peak Day	69	73	68	73
		July Peak Day	72	74	72	78
		August Peak Day	76	77	75	79
		September Peak Day	77	81	75	81
		October Peak Day	68	75	71	76
Residential	50%	Typical Event Day	74	78	74	79
		May Peak Day	65	74	69	77
		June Peak Day	69	74	69	75
		July Peak Day	72	75	73	80
		August Peak Day	77	78	75	80
		September Peak Day	78	83	77	83
		October Peak Day	68	76	72	78
	100%	Typical Event Day	74	77	73	79
		May Peak Day	65	74	69	77
		June Peak Day	69	74	68	74
		July Peak Day	72	75	73	79
		August Peak Day	77	78	75	80
		September Peak Day	78	83	76	83
		October Peak Day	68	75	72	77

While Summer Saver events can be called any time between noon and 8 PM, ex ante load impacts reported here represent the average load impact across the hours from 1 to 6 PM, reflecting the peak period as defined by the CPUC for determining resource adequacy requirements.

Tables 5-2 and 5-3 summarize the average and aggregate load impact estimates per premise under SDG&E-specific peaking conditions and CAISO peaking conditions, respectively. For a typical event day in a 1-in-2 year, SDG&E-specific weather conditions, the impact per premise is 0.43 kW for residential customers. The 1-in-10 year typical event day estimate is 35% higher at 0.58 kW. Under 1-in-2 CAISO peak conditions, the typical event day residential load impact per premise is 0.45 kW; for the 1-in-10 scenario, it is 0.53 kW, or 18% higher. These large differences between 1-in-2 and 1-in-10 load impacts are driven by the larger differences in mean17, which vary by 5 or 6 degrees across some of the above conditions; a difference of 5 degrees on average over 17 hours represents a very large difference in temperature conditions and air conditioning requirements.

Nonresidential Summer Saver load impacts for the typical event day are 0.63 kW per premise under 1-in-2 SDG&E-specific peak conditions, and 0.67 kW for 1-in-10. Under CAISO peak conditions, nonresidential typical event day load impacts are also 0.63 kW per premise for 1-in-2 and 0.66 kW per premise for 1-in-10 weather. The 1-in-2 to 1-in-10 increase in load impacts is 4% for CAISO peak conditions and 6% for SDG&E-specific peak conditions.

The aggregate program load reduction potential for residential customers is 9.4 MW for a typical event day under SDG&E-specific 1-in-2 year weather conditions and 12.6 MW under SDG&E-specific 1-in-10 year weather conditions. Residential aggregate load impacts for 1-in-2 CAISO peaking conditions are 9.8 MW and 11.6 MW for the 1-in-10 weather scenario. For SDG&E peaking conditions, nonresidential aggregate program load reduction potential is 2.9 MW under the 1-in-2 scenario and 3.1 MW under the 1-in-10 scenario for the typical event day. For CAISO peaking conditions, the nonresidential typical event day load impacts for 1-in-2 and 1-in-10 conditions are similar: 3.0 MW and 3.1 MW, respectively.

Comparison of Ex Ante Load Impacts by Month

September ex ante conditions are much hotter than typical event day conditions. The residential program is estimated to provide an average impact of 14.6 MW over the 5 hour event window from 1 to 6 PM on a 1-in-10 September monthly system peak day and 11.1 MW on the September monthly system peak day under 1-in-2 year weather conditions for SDG&E-specific peaking conditions. Under CAISO peak conditions, residential aggregate load reduction on a September monthly system peak day is 11.9 MW for 1-in-2 and 14.7 MW for 1-in-10.

There is significant variation in load impacts across months and weather conditions. Based on 1-in-2 year weather, the low temperatures in May and June typically experienced in San Diego result in the smallest average and aggregate load impacts. The May and June 1-in-2 year impacts for residential customers are only about 60% of the September estimate, which is the highest of any month under 1-in-2 year weather conditions. For residential customers, the May and June 1-in-10 year estimates are 1.7 times greater than the 1-in-2 year estimates as a result of the 1-in-10 year temperatures being much warmer than the 1-in-2 year temperatures for May and June.

The nonresidential segment of the program is far less weather sensitive than the residential segment. For example, May 1-in-2 load impacts are 81% of the September 1-in-2 load impacts, and the 1-in-2 May load impacts are only 13% lower than the 1-in-10 load impacts.

On a per premise basis, the nonresidential segment provides more load impacts than residential customers. But in aggregate, the residential segment provides far more MW of load reduction due to the much greater numbers of residential participants than nonparticipants.

Table 5-2: Summer Saver Ex Ante Load Impact Estimates by CAISO and SDG&E-specific Weather and Day Type (1 to 6 PM, 1-in-10 Conditions)

Customer Type	Day Type	Per Premise Impact (kW)		Aggregate Impact (MW)	
		CAISO	SDGE	CAISO	SDGE
Residential	Typical Event Day	0.53	0.58	11.6	12.6
	May Monthly Peak	0.45	0.53	9.8	11.4
	June Monthly Peak	0.45	0.46	9.7	10.0
	July Monthly Peak	0.47	0.58	10.1	12.7
	August Monthly Peak	0.55	0.60	11.9	13.1
	September Monthly Peak	0.68	0.67	14.7	14.6
	October Monthly Peak	0.49	0.54	10.5	11.6
Non-Residential	Typical Event Day	0.66	0.67	3.1	3.1
	May Monthly Peak	0.63	0.66	3.0	3.1
	June Monthly Peak	0.63	0.63	3.0	3.0
	July Monthly Peak	0.64	0.67	3.0	3.1
	August Monthly Peak	0.66	0.68	3.1	3.2
	September Monthly Peak	0.69	0.69	3.2	3.2
	October Monthly Peak	0.65	0.66	3.0	3.1

Table 5-3: Summer Saver Ex Ante Load Impact Estimates by CAISO and SDG&E-specific Weather and Day Type (1 to 6 PM, 1-in-2 Conditions)

Customer Type	Day Type	Per Premise Impact (kW)		Aggregate Impact (MW)	
		CAISO	SDGE	CAISO	SDGE
Residential	Typical Event Day	0.45	0.43	9.8	9.4
	May Monthly Peak	0.22	0.31	4.8	6.7
	June Monthly Peak	0.33	0.31	7.1	6.6
	July Monthly Peak	0.40	0.43	8.6	9.2
	August Monthly Peak	0.53	0.48	11.5	10.5
	September Monthly Peak	0.55	0.51	11.9	11.1
	October Monthly Peak	0.30	0.39	6.5	8.4
Non-Residential	Typical Event Day	0.63	0.63	3.0	2.9
	May Monthly Peak	0.57	0.59	2.6	2.8
	June Monthly Peak	0.60	0.59	2.8	2.8
	July Monthly Peak	0.62	0.62	2.9	2.9
	August Monthly Peak	0.66	0.65	3.1	3.0
	September Monthly Peak	0.66	0.65	3.1	3.0
	October Monthly Peak	0.59	0.62	2.8	2.9

Tables 5-4 and 5-5 provide ex ante impact estimates on an hourly basis for residential and nonresidential customers, respectively. The hours reflect the peak period as defined by the CPUC resource adequacy requirements, 1 to 6 PM. Residential impacts peak in the hour from 4 to 5 PM, while nonresidential impacts are relatively flat across these hours.

Table 5-4: Summer Saver Ex Ante Load Impact Estimates (MW) by Weather Year, Day Type and Hour – Residential Customers – SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day					Average (MW)
		1 to 2 PM (MW)	2 to 3 PM (MW)	3 to 4 PM (MW)	4 to 5 PM (MW)	5 to 6 PM (MW)	
1-in-2	Typical Event Day	7.8	8.9	10.0	10.5	9.6	9.4
	May Monthly Peak	5.7	6.5	7.1	7.5	6.7	6.7
	June Monthly Peak	5.7	6.4	7.1	7.4	6.7	6.6
	July Monthly Peak	7.7	8.8	9.8	10.4	9.4	9.2
	August Monthly Peak	8.7	10.0	11.1	11.8	10.8	10.5
	September Monthly Peak	9.2	10.5	11.8	12.5	11.4	11.1
	October Monthly Peak	7.1	8.1	9.0	9.5	8.6	8.4
1-in-10	Typical Event Day	10.4	11.9	13.4	14.2	13.0	12.6
	May Monthly Peak	9.4	10.9	12.2	12.9	11.8	11.4
	June Monthly Peak	8.3	9.5	10.6	11.2	10.2	10.0
	July Monthly Peak	10.4	12.0	13.5	14.3	13.1	12.7
	August Monthly Peak	10.8	12.4	13.9	14.8	13.5	13.1
	September Monthly Peak	12.0	13.8	15.5	16.5	15.1	14.6
	October Monthly Peak	9.6	11.1	12.4	13.1	12.0	11.6

Table 5-5: Summer Saver Ex Ante Load Impact Estimates (MW) by Weather Year, Day Type and Hour – Nonresidential Customers – SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day					Average (MW)
		1 to 2 PM (MW)	2 to 3 PM (MW)	3 to 4 PM (MW)	4 to 5 PM (MW)	5 to 6 PM (MW)	
1-in-2	Typical Event Day	3.1	3.4	3.1	3.0	2.1	2.9
	May Monthly Peak	2.9	3.2	3.0	2.8	2.0	2.8
	June Monthly Peak	2.9	3.2	3.0	2.8	2.0	2.8
	July Monthly Peak	3.0	3.4	3.1	3.0	2.1	2.9
	August Monthly Peak	3.1	3.5	3.2	3.1	2.2	3.0
	September Monthly Peak	3.2	3.5	3.3	3.1	2.2	3.0
	October Monthly Peak	3.0	3.3	3.1	2.9	2.1	2.9
1-in-10	Typical Event Day	3.3	3.6	3.3	3.2	2.2	3.1
	May Monthly Peak	3.2	3.5	3.3	3.1	2.2	3.1
	June Monthly Peak	3.1	3.4	3.2	3.0	2.1	3.0
	July Monthly Peak	3.3	3.6	3.4	3.2	2.2	3.1
	August Monthly Peak	3.3	3.7	3.4	3.2	2.3	3.2
	September Monthly Peak	3.4	3.7	3.5	3.3	2.3	3.2
	October Monthly Peak	3.2	3.6	3.3	3.1	2.2	3.1

Table 5-6 provides program-level ex ante aggregate estimates for each hour. The program is expected to provide its highest impact under 1-in-10 year conditions in September. Under those conditions, the average impact over the event window is expected to be 17.8 MW, with an hourly peak of 19.8 MW from 4 to 5 PM.

Table 5-6: Summer Saver Ex Ante Load Impact Estimates (MW) by Weather Year, Day Type and Hour – All Customers – SDG&E Peaking Conditions

Weather Year	Day Type	Hour of Day					Average (MW)
		1 to 2 PM (MW)	2 to 3 PM (MW)	3 to 4 PM (MW)	4 to 5 PM (MW)	5 to 6 PM (MW)	
1-in-2	Typical Event Day	10.9	12.3	13.1	13.5	11.7	12.3
	May Monthly Peak	8.6	9.7	10.1	10.3	8.7	9.5
	June Monthly Peak	8.6	9.6	10.0	10.2	8.7	9.4
	July Monthly Peak	10.8	12.2	12.9	13.3	11.5	12.1
	August Monthly Peak	11.8	13.5	14.4	14.9	12.9	13.5
	September Monthly Peak	12.3	14.0	15.0	15.5	13.6	14.1
	October Monthly Peak	10.1	11.4	12.1	12.4	10.7	11.3
1-in-10	Typical Event Day	13.6	15.6	16.7	17.4	15.2	15.7
	May Monthly Peak	12.6	14.4	15.4	16.0	14.0	14.5
	June Monthly Peak	11.4	12.9	13.8	14.2	12.3	12.9
	July Monthly Peak	13.7	15.7	16.8	17.5	15.3	15.8
	August Monthly Peak	14.1	16.1	17.3	18.0	15.8	16.2
	September Monthly Peak	15.3	17.6	19.0	19.8	17.5	17.8
	October Monthly Peak	12.8	14.6	15.7	16.2	14.2	14.7

5.2 Comparison of 2014 Ex Ante Load Impacts to 2015 Ex Ante Load Impacts

While average per premise load impacts for residential customers on the typical event day under 1-in-2 conditions increased slightly over 2014 (0.43 kW over 0.41 kW), they were about 9% lower under 1-in-10 year conditions (0.58 kW over 0.64 kW). Enrollment has also decreased by 5.6% since the 2014 evaluation. Together, these decreases in average per premise load impact and enrollment result in no change in aggregate load impacts for the 1-in-2 year scenario, but a 13.6% decrease in load impacts for the 1-in-10 year scenario. These estimates assume SDG&E-specific peaking conditions. Under CAISO peaking conditions, aggregate load impacts for 1-in-2 CAISO peak conditions on the typical event day are 2% lower than projected in 2014 and 10.7% lower for the 1-in-10 scenario.

Under SDG&E-specific peaking conditions the nonresidential program segment shows that average per premise load impacts increased by 10% for 1-in-2 conditions and decreased by 13% for 1-in-10 conditions. Nonresidential enrollment also decreased 2.9%, since 2014, which is quite a bit less than the change in residential enrollment. Altogether, aggregate nonresidential load impacts under the 1-in-2 year scenario increased by 7% under 1-in-2 conditions and decreased by 16% under 1-in-10 conditions, assuming SDG&E-specific peaking conditions.

While year-to-year enrollment fluctuations in a mature load control program such as Summer Saver are not unusual—for example, 2013 enrollments were 3% greater than 2012 enrollments but in 2014 they were 2% lower than in 2013—significant changes in per premise load impacts are of interest. The decreases in residential and nonresidential ex ante per premise load impacts are driven by the fact that the 2015 ex post load impacts are generally lower than in prior years.

Figures 5-1 through 5-4 illustrate the ex post load impacts from 2010 through 2015 that were used to model the relationship between load impact and temperature. The y-axis represents average ex post load impacts (kW) per ton for the 3 to 5 PM period. The x-axis represents mean17 temperatures—the average temperature from midnight to 5 PM. Ex post load impacts are color-coded in the graphs to illustrate how load impacts vary across years. Load impacts for 2015 are denoted with dark blue, diamond-shaped markers. The purple line represents the linear relationship of load impacts with mean17 temperature that is used to determine load impacts under ex ante temperature conditions. Notably, in Figures 5-1 through 5-4, it can be seen that the residential load impacts are lower than they have been in previous years in similar temperature ranges.

Figure 5-1: Summer Saver Ex Post Load Impacts (kW/ton) vs. mean17 Residential 100% Cycling

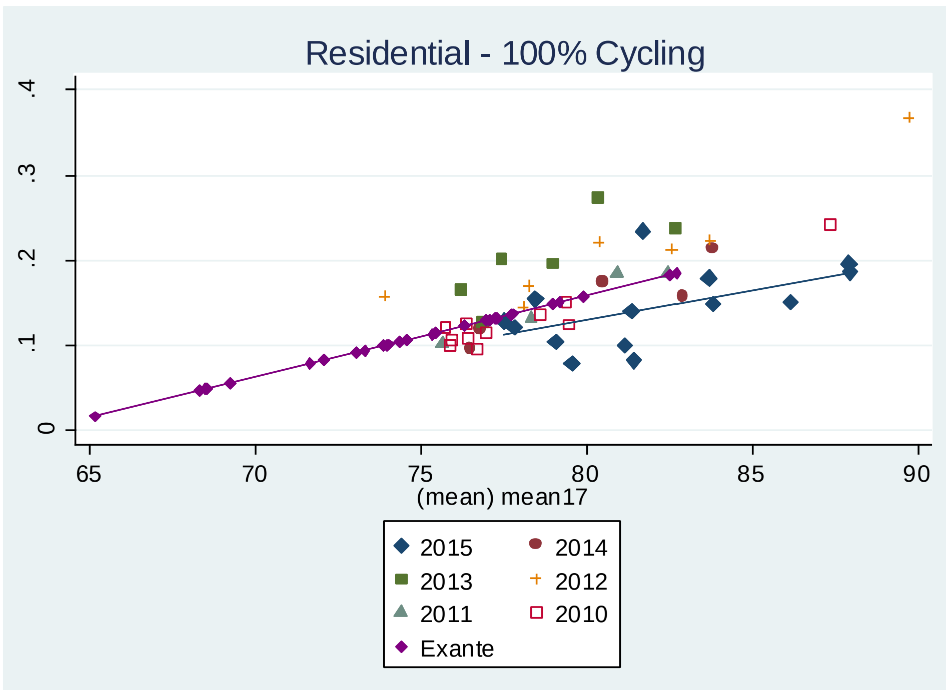


Figure 5-2: Summer Saver Ex Post Load Impacts (kW/ton) vs. mean17 Residential 50% Cycling

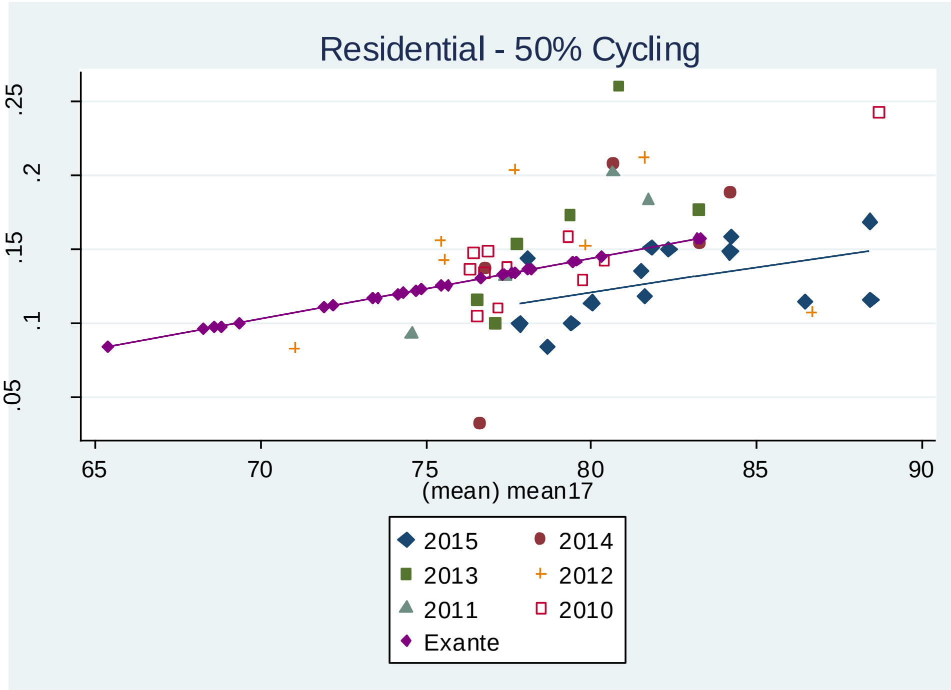


Figure 5-3: Summer Saver Ex Post Load Impacts (kW/ton) vs. mean17 Nonresidential 50% Cycling

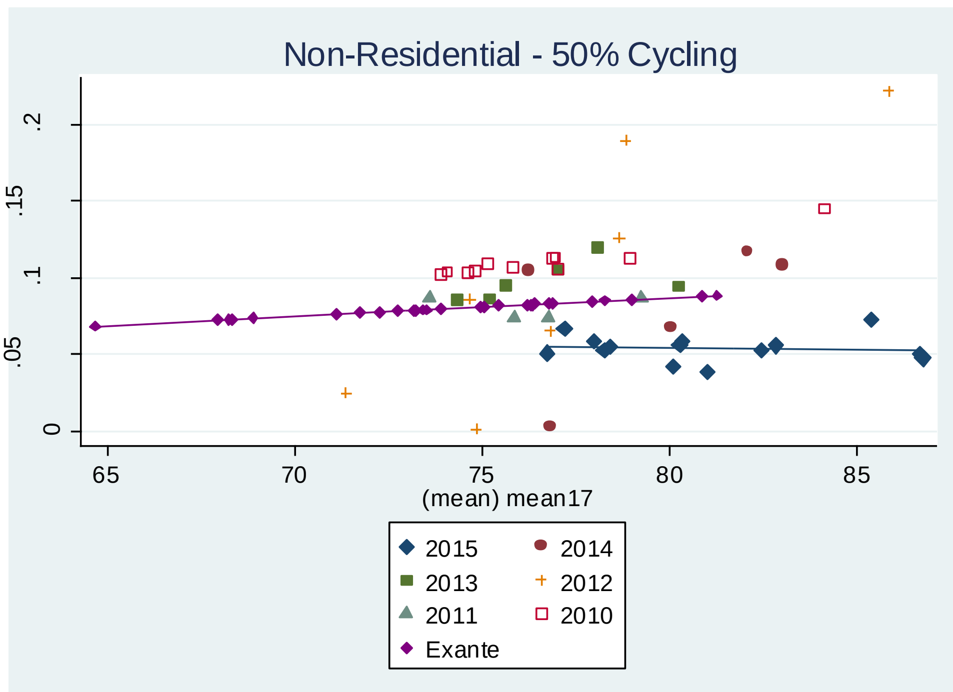
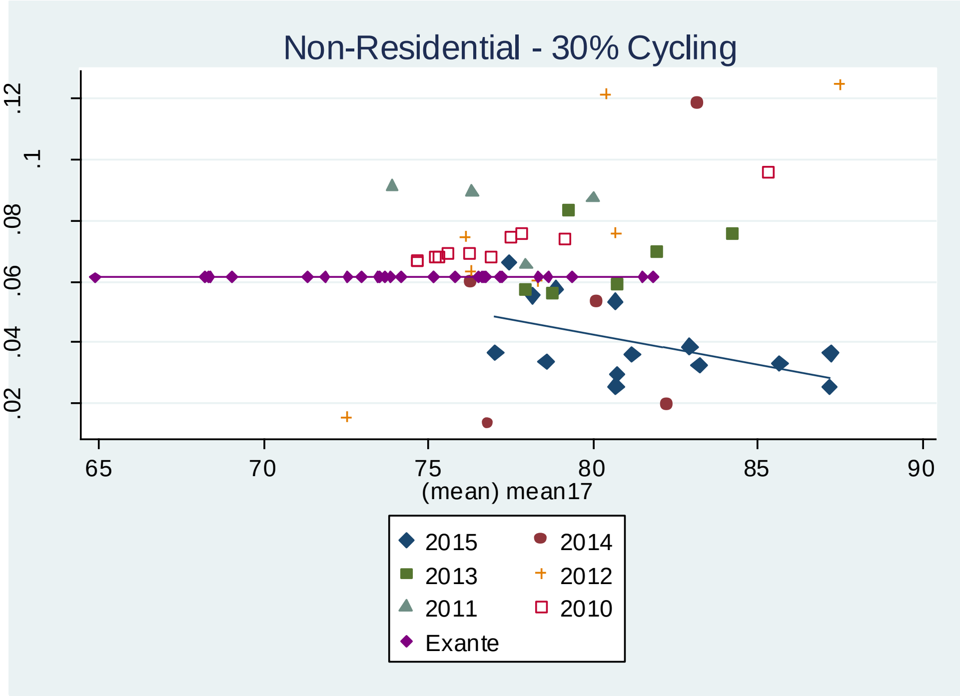


Figure 5-4: Summer Saver Ex Post Load Impacts (kW/ton) vs. mean17 Nonresidential 30% Cycling



5.3 Relationship between Ex Post and Ex Ante Estimates

Ex post and ex ante load impacts may differ for a variety of reasons, including differences in weather conditions, the timing and length of the event window, and other factors such as changes in expected enrollment. Table 5-8 below presents an overall comparison of 2015 ex post load impacts and the ex ante load impacts as estimated for years 2016 through 2026.

Table 5-8: Comparison of 2015 Ex Post Load Impacts to Ex Ante Load Impacts by Month

Month	Ex Post Average Aggregate Impacts* (MW)	Ex Ante Impact** CAISO 1-in-2 (MW)
August	13.9	14.5
September	14.2	15.0
October	11.4	9.3

*Average of 2015 events by month

**For RA hours of 1-6 PM

Tables 5-9 and 5-10 show how aggregate load impacts for residential participants change as a result of differences in the factors underlying ex post and ex ante estimates. Table 5-6 pertains to residential customers in the 50% cycling option and Table 5-7 pertains to 100% cycling participants.

Columns A through E describe the particular circumstances of each 2015 Summer Saver load control event. Each event is denoted by its date, shown in Column A. Column B shows the time of the event window, and column C shows the average hourly ex post load impact for that event aggregated to the 2015 enrollment population. Column D shows the average hourly ex post load impact as in column C, but aggregated to the 2016 projected enrollment population.

Column F presents the load impacts that the ex ante model predicts for the ex post event window (Column B) and for the ex post weather conditions (Column E). Column G makes a final adjustment to the predicted load impacts shown in Column F by recalculating the predicted load impacts for the ex ante event window, which is always 1 to 6 PM.

Columns H and I compare Column G with the ex ante load impact estimate given the SDG&E-specific ex ante weather conditions for 1-in-2 and 1-in-10 year system peaking scenarios. Columns H and I are divided into three rows: orange, blue, and purple. The orange rows represent the August monthly system peak day ex ante estimates, which is appropriate to compare with the values in Column G for the August events. The blue rows show the September monthly system peak day ex ante estimates, which are most representative of the September events. Finally, the purple rows show the October monthly peak day ex ante estimates, for comparison with the October event load impacts shown in Column G.

Columns J through K, like Columns H and I, show ex ante load impacts for 1-in-2 and 1-in-10 year conditions, but for CAISO peaking conditions rather than SDG&E peaking conditions.

Tables 5-11 and 5-12 show the commensurate information for the nonresidential segment. Taken together, Tables 5-9 through 5-12 demonstrate the following information on how 2015 load impacts relate to the projected ex ante impacts that consider load impacts as measured for the program from 2010 through 2015:

- Comparing Columns C and D, the ex ante load impacts reflect negligible changes in projected enrollment.
- By comparing Columns D and G, one can observe that, with the exception of the 30% cycling load impacts (Table 5-10), relative to the historic relationship between load impacts and mean17 temperatures, the 2015 load impacts are below average. This relationship can also be seen in Figures 5-1 through 5-4: most of the blue diamonds, which represent 2015 load impacts, fall below the purple regression line. A year with higher than average load impacts would show Column D with values usually greater than Column G.
- Columns E, H, and I indicate that the temperatures observed in many of the 2015 events are hotter than the expected temperatures for monthly system peak days under both 1-in-2 and 1-in-10 SDG&E system peaking conditions. Examining weather datasets updated through 2015 to explore whether or there is evidence of warming in recent years that should be reflected in ex ante weather conditions may be warranted.
- However, for those 2015 Summer Saver events with weather conditions in the range of 1-in-2 and 1-in-10 weather conditions, predicted load impacts are comparable to ex post load impacts.

Table 5-9: Differences in Ex Post and Ex Ante Load Impacts Due to Key Factors Residential 50% Cycling

<table>
<tr><th rowspan="2">Date</th><th colspan="4">2015 Ex Post</th><th colspan="6">2015 Ex Ante Model</th></tr>
<tr><th>Event Window</th><th>Ex-Post Aggregate Impacts (MW)</th><th>Ex-Post Aggregate Impacts using SDG&E Forecast (MW)</th><th>Mean17 using KSAN KNKX Only (°F)</th><th>Ex-Ante Impact with Ex-Post Event Window and Weather (MW)</th><th>Ex-Ante Impact (1pm-6pm) using Ex Post Weather (MW)</th><th>Ex-Ante Impact SDG&E 1-in-2 (MW)</th><th>Ex-Ante Impact SDG&E 1-in-10 (MW)</th><th>Ex-Ante Impact CAISO 1-in-2 (MW)</th><th>Ex-Ante Impact CAISO 1-in-10 (MW)</th></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td></tr>
<tr><td>8/13/2015</td><td>3-7 pm</td><td>4.7</td><td>5.0</td><td>78</td><td>6.9</td><td>6.6</td><td rowspan="6">6.1
(75°F)</td><td rowspan="6">7.1
(80°F)</td><td rowspan="6">6.5
(77°F)</td><td rowspan="6">6.6
(78°F)</td></tr>
<tr><td>8/14/2015</td><td>4-8 pm</td><td>4.0</td><td>4.2</td><td>79</td><td>7.1</td><td>6.9</td></tr>
<tr><td>8/16/2015</td><td>3-7 pm</td><td>7.7</td><td>8.1</td><td>82</td><td>7.8</td><td>7.5</td></tr>
<tr><td>8/26/2015</td><td>4-8 pm</td><td>4.5</td><td>4.7</td><td>80</td><td>7.2</td><td>7.0</td></tr>
<tr><td>8/27/2015</td><td>3-7 pm</td><td>7.4</td><td>7.8</td><td>82</td><td>7.7</td><td>7.4</td></tr>
<tr><td>8/28/2015</td><td>3-7 pm</td><td>6.6</td><td>6.9</td><td>84</td><td>8.2</td><td>7.9</td></tr>
<tr><td>9/9/2015</td><td>3-7 pm</td><td>8.5</td><td>8.9</td><td>88</td><td>9.1</td><td>8.7</td><td rowspan="6">6.4
(77°F)</td><td rowspan="6">7.7
(83°F)</td><td rowspan="6">6.7
(78°F)</td><td rowspan="6">7.7
(83°F)</td></tr>
<tr><td>9/10/2015</td><td>3-7 pm</td><td>4.4</td><td>4.6</td><td>86</td><td>8.7</td><td>8.3</td></tr>
<tr><td>9/11/2015</td><td>3-7 pm</td><td>7.1</td><td>7.5</td><td>84</td><td>8.2</td><td>7.9</td></tr>
<tr><td>9/20/2015</td><td>2-4 pm</td><td>2.9</td><td>3.0</td><td>84</td><td>8.0</td><td>7.8</td></tr>
<tr><td>9/24/2015</td><td>2-6 pm</td><td>7.1</td><td>7.5</td><td>78</td><td>6.8</td><td>6.6</td></tr>
<tr><td>9/25/2015</td><td>2-6 pm</td><td>3.7</td><td>3.9</td><td>79</td><td>6.9</td><td>6.8</td></tr>
<tr><td>10/9/2015</td><td>3-7 pm</td><td>6.4</td><td>6.8</td><td>82</td><td>7.6</td><td>7.3</td><td rowspan="3">5.4
(72°F)</td><td rowspan="3">6.6
(78°F)</td><td rowspan="3">4.7
(68°F)</td><td rowspan="3">6.2
(76°F)</td></tr>
<tr><td>10/10/2015</td><td>3-7 pm</td><td>4.1</td><td>4.3</td><td>88</td><td>9.1</td><td>8.7</td></tr>
<tr><td>10/13/2015</td><td>4-8 pm</td><td>4.6</td><td>4.8</td><td>82</td><td>7.6</td><td>7.4</td></tr>
</table>

Table 5-10: Differences in Ex Post and Ex Ante Impacts Due to Key Factors Residential 100% Cycling

Date	2015 Ex Post				2015 Ex Ante Model					
	Event Window	Ex-Post Aggregate Impacts (MW)	Ex-Post Aggregate Impacts using SDG&E Forecast (MW)	Mean17 using KSAN KNKX Only (°F)	Ex-Ante Impact with Ex-Post Event Window and Weather (MW)	Ex-Ante Impact (1pm-6pm) using Ex Post Weather (MW)	Ex-Ante Impact SDG&E 1-in-2 (MW)	Ex-Ante Impact SDG&E 1-in-10 (MW)	Ex-Ante Impact CAISO 1-in-2 (MW)	Ex-Ante Impact CAISO 1-in-10 (MW)
A	B	C	D	E	F	G	H	I	J	K
8/13/2015	3-7 pm	5.88	5.78	78	5.76	5.13	4.3 (75°F)	6.0 (80°F)	5.0 (77°F)	5.2 (78°F)
8/14/2015	4-8 pm	4.93	4.85	79	6.58	5.71				
8/16/2015	3-7 pm	10.02	9.85	82	7.49	6.68				
8/26/2015	4-8 pm	4.41	4.34	80	6.79	5.89				
8/27/2015	3-7 pm	6.19	6.08	81	7.35	6.55				
8/28/2015	3-7 pm	8.33	8.19	84	8.32	7.41				
9/9/2015	3-7 pm	8.74	8.59	88	10.08	8.98	4.7 (76°F)	7.0 (83°F)	5.2 (78°F)	7.1 (83°F)
9/10/2015	3-7 pm	7.03	6.91	86	9.34	8.32				
9/11/2015	3-7 pm	5.87	5.77	84	8.38	7.47				
9/20/2015	2-4 pm	5.88	5.78	84	7.27	7.40				
9/24/2015	2-6 pm	5.09	5.01	78	5.60	5.25				
9/25/2015	2-6 pm	6.51	6.40	78	5.86	5.49				
10/9/2015	3-7 pm	4.41	4.34	81	7.28	6.48	3.0 (72°F)	5.1 (77°F)	1.7 (68°F)	4.4 (75°F)
10/10/2015	3-7 pm	7.30	7.18	88	10.09	8.99				
10/13/2015	4-8 pm	3.02	2.97	81	7.59	6.59				

Table 5-11: Differences in Ex Post and Ex Ante Impacts Due to Key Factors
Nonresidential 30% Cycling

Date	2015 Ex Post				2015 Ex Ante Model					
	Event Window	Ex-Post Aggregate Impacts (MW)	Ex-Post Aggregate Impacts using SDG&E Forecast (MW)	Mean17 using KSAN KNKX Only (°F)	Ex-Ante Impact with Ex-Post Event Window and Weather (MW)	Ex-Ante Impact (1pm-6pm) using Ex Post Weather (MW)	Ex-Ante Impact SDG&E 1-in-2 (MW)	Ex-Ante Impact SDG&E 1-in-10 (MW)	Ex-Ante Impact CAISO 1-in-2 (MW)	Ex-Ante Impact CAISO 1-in-10 (MW)
A	B	C	D	E	F	G	H	I	J	K
8/13/2015	3-7 pm	0.4	0.4	77	0.7	0.7	0.7 (75°F)	0.7 (79°F)	0.7 (77°F)	0.7 (77°F)
8/14/2015	4-8 pm	0.2	0.2	79	0.6	0.7				
8/16/2015	3-7 pm	0.2	0.2	81	0.7	0.7				
8/26/2015	4-8 pm	0.5	0.5	79	0.6	0.7				
8/27/2015	3-7 pm	0.2	0.2	81	0.7	0.7				
8/28/2015	3-7 pm	0.5	0.5	83	0.7	0.7				
9/9/2015	3-7 pm	0.3	0.3	87	0.7	0.7	0.7 (76°F)	0.7 (82°F)	0.7 (77°F)	0.7 (82°F)
9/10/2015	3-7 pm	0.1	0.1	86	0.7	0.7				
9/11/2015	3-7 pm	0.5	0.5	83	0.7	0.7				
9/20/2015	2-4 pm	0.1	0.1	83	0.8	0.7				
9/24/2015	2-6 pm	0.8	0.8	77	0.7	0.7				
9/25/2015	2-6 pm	0.7	0.7	78	0.7	0.7				
10/9/2015	3-7 pm	0.5	0.5	81	0.7	0.7	0.7 (71°F)	0.7 (77°F)	0.7 (68°F)	0.7 (75°F)
10/10/2015	3-7 pm	0.3	0.3	87	0.7	0.7				
10/13/2015	4-8 pm	0.3	0.3	81	0.6	0.7				

Table 5-12: Differences in Ex Post and Ex Ante Impacts Due to Key Factors
Nonresidential 50% Cycling

Date	2015 Ex Post				2015 Ex Ante Model					
	Event Window	Ex-Post Aggregate Impacts (MW)	Ex-Post Aggregate Impacts using SDG&E Forecast (MW)	Mean17 using KSAN KNKX Only (°F)	Ex-Ante Impact with Ex-Post Event Window and Weather (MW)	Ex-Ante Impact (1pm-6pm) using Ex Post Weather (MW)	Ex-Ante Impact SDG&E 1-in-2 (MW)	Ex-Ante Impact SDG&E 1-in-10 (MW)	Ex-Ante Impact CAISO 1-in-2 (MW)	Ex-Ante Impact CAISO 1-in-10 (MW)
A	B	C	D	E	F	G	H	I	J	K
8/13/2015	3-7 pm	0.83	0.86	77	2.17	2.30	2.3 (75°F)	2.4 (79°F)	2.3 (76°F)	2.3 (77°F)
8/14/2015	4-8 pm	0.62	0.64	78	2.06	2.35				
8/16/2015	3-7 pm	1.11	1.16	80	2.28	2.42				
8/26/2015	4-8 pm	0.48	0.50	78	2.07	2.36				
8/27/2015	3-7 pm	1.14	1.18	80	2.29	2.42				
8/28/2015	3-7 pm	0.61	0.64	82	2.35	2.49				
9/9/2015	3-7 pm	0.91	0.94	87	2.49	2.64	2.3 (75°F)	2.4 (81°F)	2.3 (77°F)	2.5 (81°F)
9/10/2015	3-7 pm	1.49	1.55	85	2.45	2.59				
9/11/2015	3-7 pm	1.08	1.12	83	2.37	2.51				
9/20/2015	2-4 pm	0.48	0.50	83	2.77	2.50				
9/24/2015	2-6 pm	1.70	1.77	77	2.30	2.32				
9/25/2015	2-6 pm	1.46	1.52	78	2.33	2.35				
10/9/2015	3-7 pm	1.04	1.09	80	2.29	2.42	2.1 (71°F)	2.3 (76°F)	2.0 (68°F)	2.2 (75°F)
10/10/2015	3-7 pm	1.29	1.34	87	2.49	2.64				
10/13/2015	4-8 pm	0.07	0.07	81	2.14	2.45				

Appendix A Out-of-Sample Testing for Nonresidential Matched Control Group

Out-of-sample testing of the PSM control group selection approach was conducted to verify the quality of the matching algorithm, which is conducted within NAICS category, that takes into account electric usage on non-event day during typical event hours in addition to event-day morning hours. The PSM selection is conducted separately for each event day.

Seven hot non-event days used here are 8/15, 9/8, 9/13, 9/14, 9/28, 10/12, and 10/14/2015. The out-of-sample test is conducted by running the matching algorithm using all but one of the hot non-event days, and using the one non-event day that was held out to verify how well the matching selection works. The process is repeated for all seven hot-non event days. Figures A-1 and A-2 illustrate the comparison of the matched control group to each hot non-event day, for nonresidential 30% cycling and 50% cycling, respectively.

Figure A-1: Out-of-sample Testing for Matched Control Groups
Nonresidential 30% Cycling

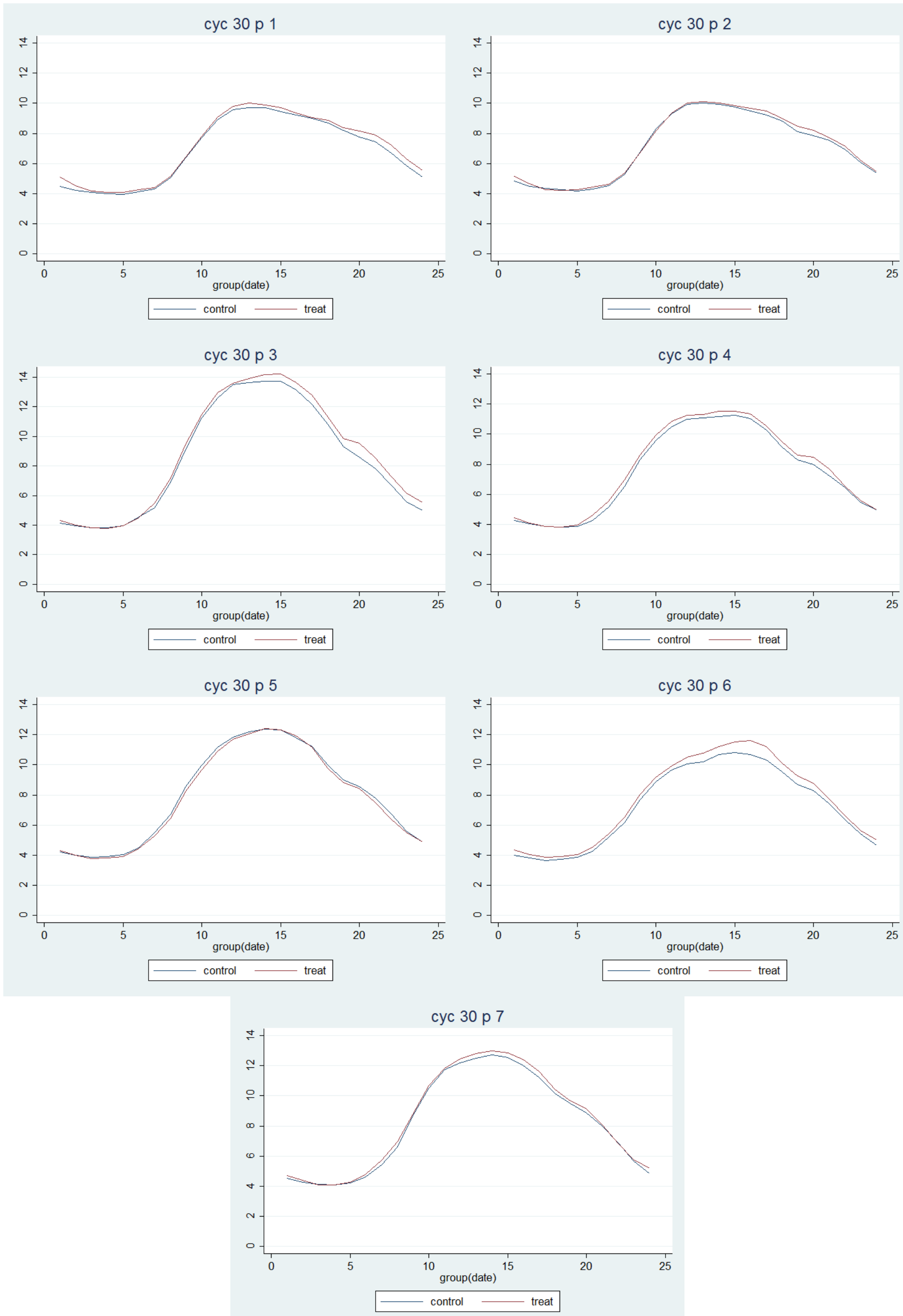


Figure A-2: Out-of-sample Testing for Matched Control Groups Nonresidential 50% Cycling