AUTOMATED DEMAND RESPONSE SYSTEM PILOT

Final Report
Volume 2

Load Impact Results

Summer 2005, Summer 2004
and
Comparison of Summer 2005 and Summer 2004 Results

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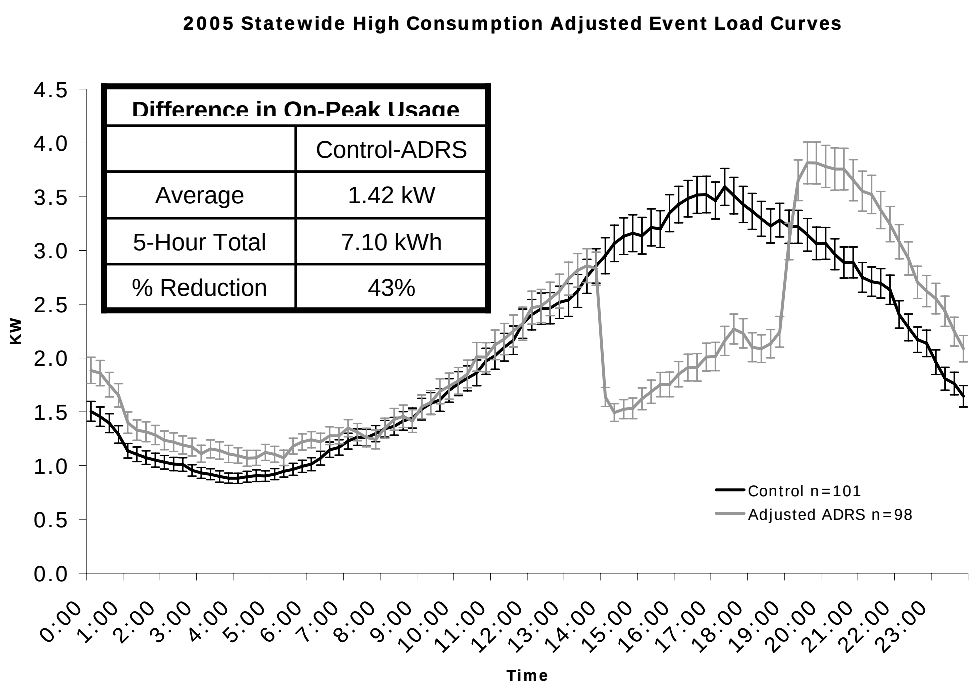
Chapter 1 Summer 2005 Load Impact Results

The following section presents in detail load reduction performance of ADRS homes with technology and subject to experimental CPP-F rates, compared to homes without technology and subscribed to standard tiered rates, from July through September 2005. Load reductions are first reported on a statewide basis for high consumption homes, followed by results for high consumption ADRS participants in each utility service territory of PG&E, SCE, and SDG&E, respectively. A summary of results for low consumption ADRS homes is then provided on a statewide basis, as well as for each utility individually. All load impact results have been adjusted for selection bias of ADRS homes. Details of RMI's investigation into selection bias are presented in Appendix C.

1.1 Statewide 2005 High Consumption ADRS Load Impact Results

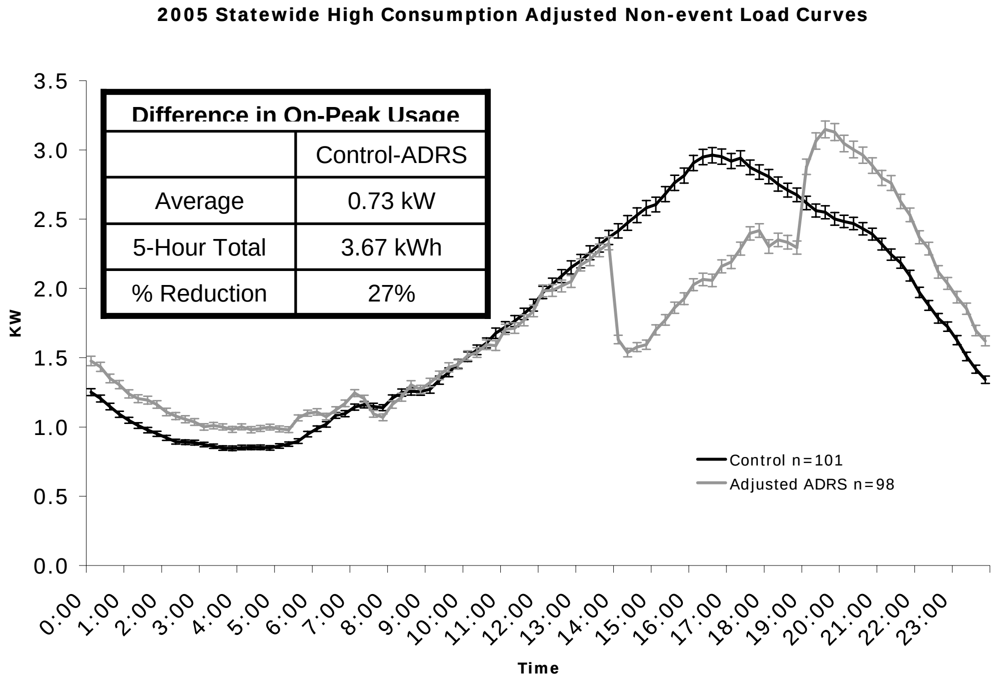
Figure 1 and Figure 2 chart the 2005 statewide high consumption home load curves for event days and non-event days respectively. On event days, high consumption ADRS customers reduced load by an average of 1.4 kW over the Super Peak period, corresponding to a 43% load reduction from control customers. Ninety percent confidence intervals across the Super Peak period were ±0.17 kW for control homes and ±0.12 kW for ADRS homes[1].

Figure 1: 2005 statewide high consumption event load curves



[1]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, Data Collection and Load Impact Analysis Methodology. Ninety percent confidence intervals for control homes varied from ±0.155 kW to ±0.172 kW across the Super Peak period; ADRS confidence intervals varied from ±0.082 kW to ±0.142 kW.

Figure 2: 2005 statewide high consumption non-event load curves



On non-event days, ADRS homes reduced peak period load by an average of 0.73 kW, or 27% load reduction compared to control customers. Peak period 90% confidence intervals on non-event weekdays averaged ±0.053 kW for control homes and ±0.042 kW for ADRS homes[2]. Note the dramatic increase in consumption of ADRS homes during post-peak recovery periods on both event and non-event days, between 7 p.m. and 9 p.m. Control and ADRS loads matched closely through the morning period until the peak period for all days.

Refer to the section "Comparison of summer 2005 and summer 2004 ADRS load impact results" in this report for additional discussions of statewide ADRS high consumption load impact results.

1.2 PG&E high consumption summer 2005 load impact results

Figure 3 plots the load curves for PG&E high consumption homes on event days and Figure 4 plots the corresponding non-event days. During the Super Peak period, ADRS homes reduced load by an average of 0.83 kW, or 4.2 kWh on event days. This translates to a 29% reduction in consumption compared to control homes. Ninety percent confidence intervals for the Super Peak period averaged ±0.26 kW for control homes and ±0.19 kW for ADRS homes[3].

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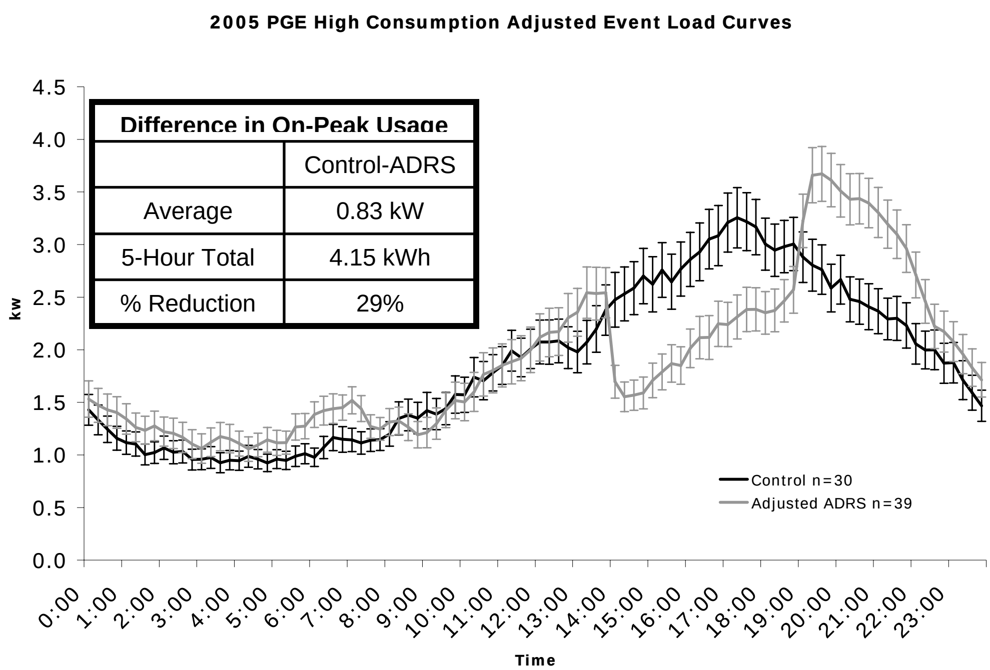
[2]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, Data Collection and Load Impact Analysis Methodology. Non-event peak period 90% confidence intervals for control homes varied from ±0.049 kW to ±0.056 kW 90% confidence intervals for ADRS high consumption homes varied from ±0.030 kW to ±0.049 kW

[3]Super Peak period 90% confidence intervals for control homes load varied from ±0.25 kW to ±0.29 kW; 90% confidence intervals for ADRS homes across the Super Peak period varied from ±0.14 kW to ±0.22 kW

On non-event days, peak period average reduction was slightly more than half of that on event days, at 0.47 kW. Ninety percent confidence intervals for the peak period averaged ±0.09 kW for control homes and ±0.07 kW for ADRS homes[4]. This translates to approximately 2.4 kWh energy savings during the peak period. As a percentage, ADRS homes reduced load by 18% of control load on non-event days.

Both event and non-event days showed a dramatic increase in ADRS consumption during a post-peak recovery period between 7 p.m. and 9 p.m. where ADRS homes consumed substantially more than control homes. At the end of the Super Peak or peak period, the thermostats in ADRS homes automatically reset from their warmer Super Peak setting to their cooler off-peak setting. This resulted in a sudden jump in load at 7 p.m. as air conditioners suddenly turned on to meet the new, cooler set point. Otherwise, ADRS and control loads were fairly similar for much of the off-peak period.

Figure 3: 2005 PG&E high consumption event day load curves



[4]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, Data Collection and Load Impact Analysis Methodology. Non-event peak period confidence intervals for control varied from ±0.082 kW to ±0.091 kW; ADRS confidence intervals varied from ±0.051 kW to ±0.074 kW.

Figure 4: 2005 PG&E high consumption non-event load curves

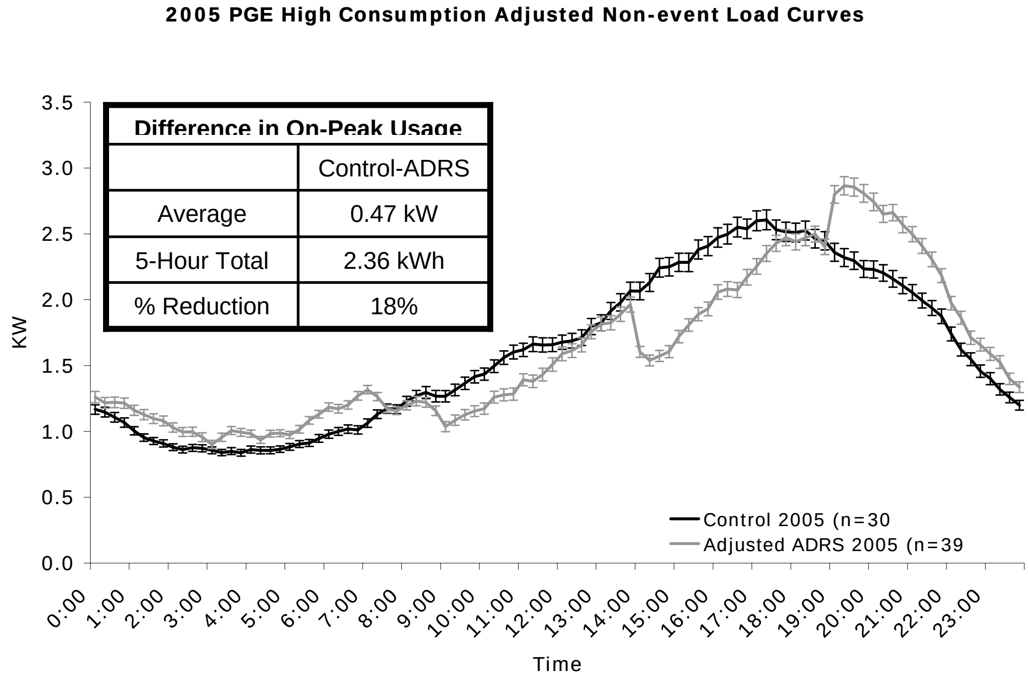
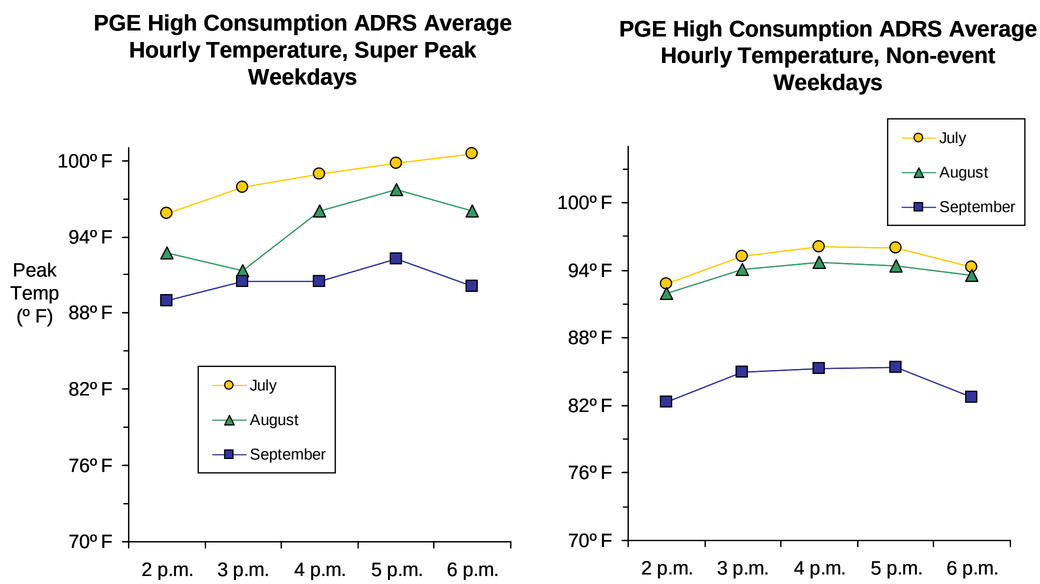


Figure 5 displays the average temperature in ADRS homes for each hour of the peak period on event and non-event days. Average hourly temperatures are reported by month from July through September 2005. On event days, July was the hottest month, with temperatures rising from 96°F at 2 p.m. to just over 100°F at 6 p.m. September event days were the coolest month, peaking at 92°F and falling modestly to 89° F during the last Super Peak hour at 6 p.m.

Figure 5: 2005 PG&E high consumption homes-- average hourly peak period temperatures at ADRS homes



Non-event days in PG&E territory portray a much wider range of peak period temperatures across months than event days. July and August were the warmest months, with peak period temperatures that were comparable to the event day temperatures, ranging from 91°F-96°F. September non-event days were 10°F cooler, ranging from 82°F-85°F.

Figure 6 illustrates the hourly trend of load savings across the Super Peak period for PG&E high consumption ADRS homes. During the first hour at 2 p.m., ADRS homes reduced load by almost 1 kW compared to control homes. By the second hour, the load savings declined to 0.89 kW. ADRS homes maintain this level of kW savings for the 3rd and 4th hour. However, ADRS savings as a percentage of control load steadily declined from the 1st through the 3rd Super Peak hours because control load also increased (refer to Figure 3). During the 4th hour, control loads began to decline as ADRS loads continued to increase. ADRS homes continued warming to the higher temperature set points induced by Super Peak signal initially sent at 2 p.m. Air conditioners in some homes cycled on periodically to maintain temperatures inside. By the 5th hour, savings declined to 0.54 kW, or 56% of first hour load reduction. This is due to controls' load declining while ADRS load was still increasing during the final Super Peak hour. On a percentage basis, high consumption ADRS homes reduced load compared to control homes by 38% during the first Super Peak hour, declining steadily to 18% reduction by the end of the Super Peak period at 7 p.m.

Figure 6: 2005 PG&E high consumption Super Peak period hourly load reductions

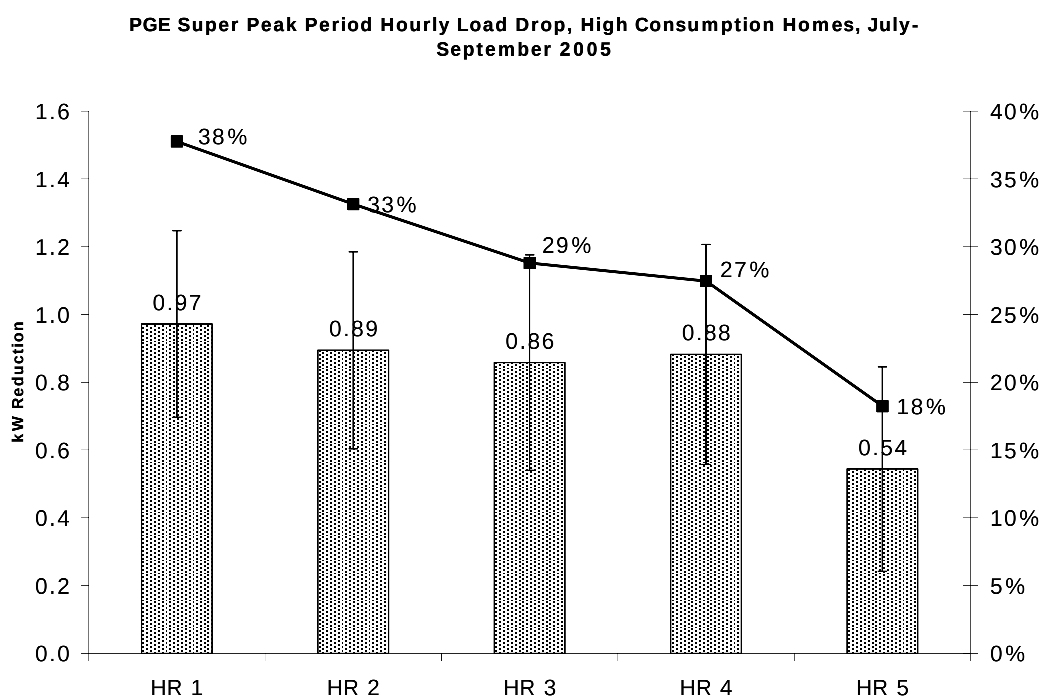


Figure 7 shows ADRS homes' on-peak savings compared to control homes on non-event weekdays. ADRS homes show a sizable savings of 0.72 kW during the first hour of the peak period. Savings declined to 0.56 kW, or 20% savings by the 3rd hour, and then declined more steeply to 0.12 kW (4%) during the last peak period hour. Referring to the load curves in Figure 4, the first 3 hours of the peak period show ADRS load ascended more rapidly than control load, resulting in gradually declining savings during this period. During the 4th peak period hour, control load peaked with ADRS load still increasing. This corresponds with the 0.20 kW reduction in savings between the 3rd and 4th hour. By the 5th hour, ADRS load flattened while control load declined, causing a 0.22 kW reduction in savings between the 4th and 5th hour. ADRS and control loads during this last hour were virtually the same, producing the modest 0.12 kW, or 4% savings.

Figure 7: 2005 PG&E non-event peak period hourly load reductions

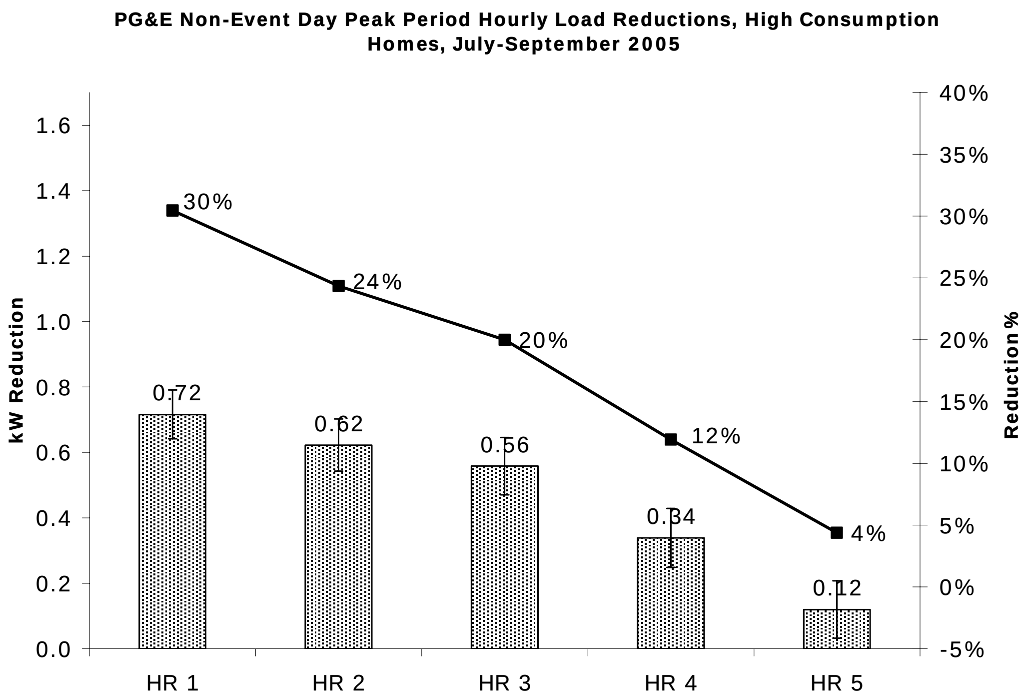


Figure 8 and Figure 9 plot ADRS Super Peak savings on event days by temperature bin, in kW and percent basis, respectively. ADRS homes are assigned into temperature bins based on the maximum temperature experienced each day, averaged across Super Peak days. Absolute savings averaged about 0.65 kW on event days when the temperatures were in the 90°F to 100°F range. Above 100°F, the savings nearly doubled to 1.07 kW. This trend indicates a positive correlation between temperature and kW savings.

On a percentage basis, however, Super Peak savings were consistent across temperature bins on event days. Percent savings ranged narrowly between 23% in the 96°F-100°F temperature bin to 29% for the 91°F-95°F, and 101°F-105°F temperature bins.

Figure 8: 2005 PG&E high consumption Super Peak period reductions by temperature bin: in kW

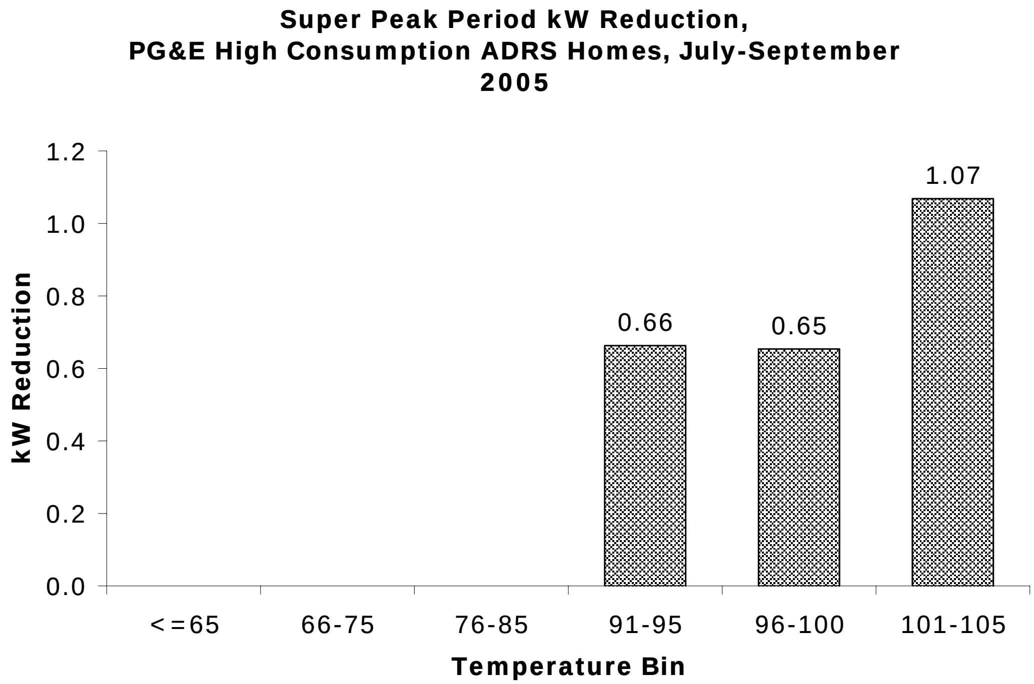
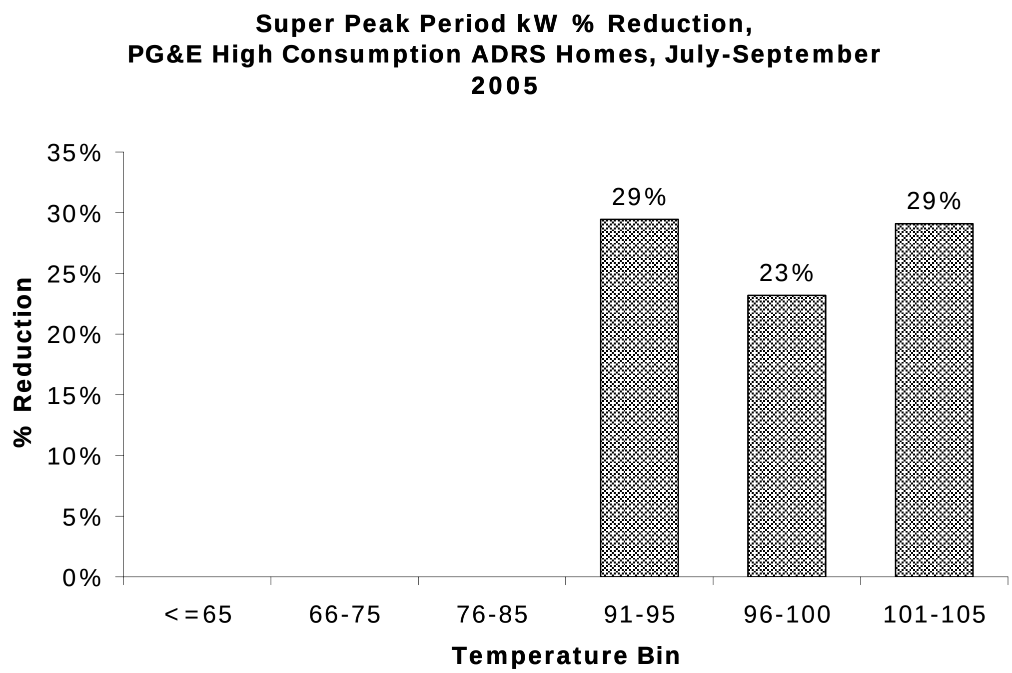


Figure 9: PG&E high consumption Super Peak period reductions by temperature bin: in percent



Peak period ADRS reductions by temperature bin on non-event days are shown in Figure 10 and Figure 11. ADRS homes reduced load relative to control only when the temperatures rose above 76° F, which corresponds reasonably to the temperature that air conditioners would begin to have significant load in the average home. Above 76°F, load savings increased with each hotter temperature bin, until temperatures exceeded 100° F. On a kW load basis, ADRS load savings increased from near zero in the 76°F temperature bin to a maximum savings of 0.86 kW in the 96°F -100°F temperature bin. Load reductions declined to 0.71 for the 101-105°F bin, likely a result of increased ADRS cooling consumption to maintain comfort at these extreme temperatures.

On a percent basis, high consumption ADRS reductions were stable and consistent for warmest temperatures in the 91°F-105°F range. Load reductions in this range were stable at 25% compared to control homes in the 91°F -100°F bins, and declined modestly to 19% in the 101°F-105°F bin.

Figure 10: 2005 PG&E high consumption non-event day peak period reductions by temperature bin: in kW

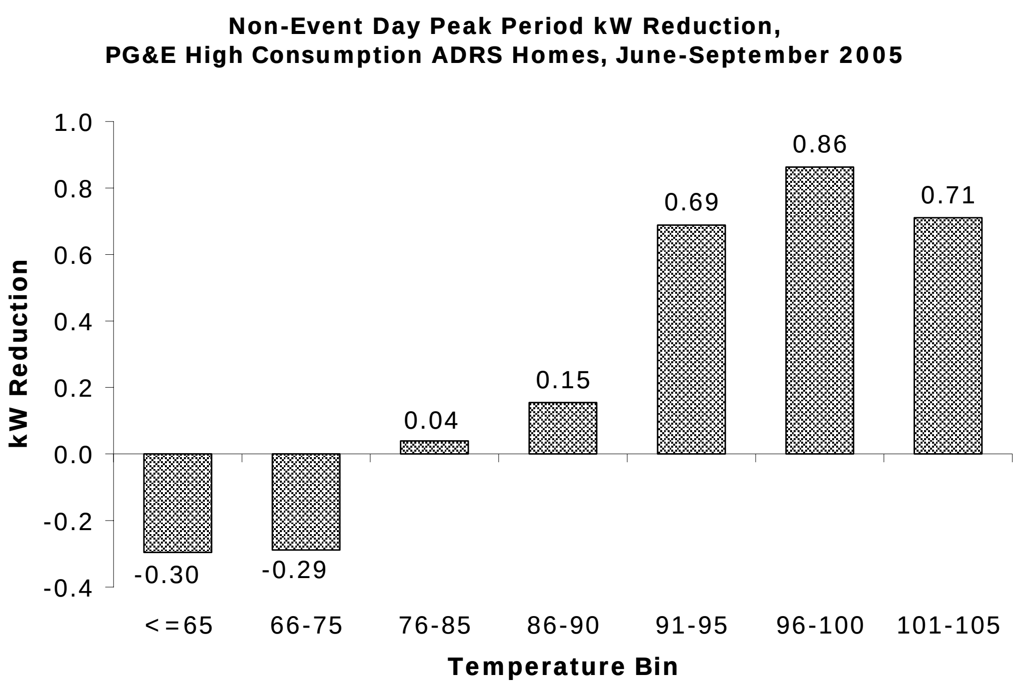
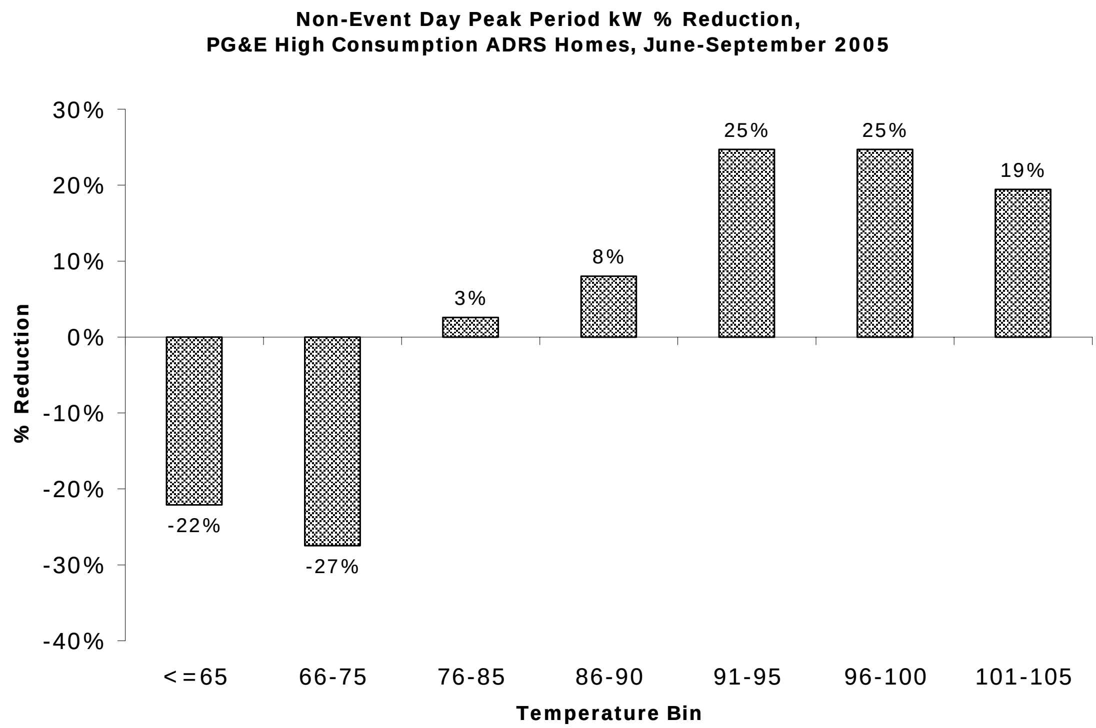


Figure 11:PG&E high consumption non-event peak period reductions by temperature bin: in percent



1.3 SCE high consumption summer 2005 load impact results

Average daily load curves for high consumption ADRS and control homes in SCE territory are plotted in Figure 12 and Figure 13 for event and non-event weekdays, respectively. On event days, ADRS homes reduced load by an average of 1.85 kW or 9.2 kWh during the Super Peak period. Ninety percent confidence intervals for the Super Peak period averaged ±0.25 kW for control homes and ±0.16 kW for ADRS homes[5]. On a percentage basis, ADRS homes reduced load relative to control homes by 49% on event days.

On non-event days, SCE's high consumption ADRS customers reduced peak period load by 0.89 kW or 4.5 kWh on average. Ninety percent confidence intervals for the non-event peak period averaged ±0.08 kW for control homes and ±0.06 kW for ADRS homes[6]. As a percentage, ADRS homes reduced load by 30% of control load on non-event days.

[5]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, Data Collection and Load Impact Analysis Methodology. Super Peak period 90% confidence intervals for control homes varied from ±0.24 kW to ±0.26 kW; 90% confidence intervals for high consumption ADRS homes varied from ±0.11 kW to ±0.20 kW.

[6]Non-event peak period 90% confidence intervals for control varied from ±0.074 kW to ±0.083 kW; 90% confidence intervals for ADRS homes varied from ±0.04 kW to ±0.07 kW.

Both event and non-event days show a recovery period where ADRS homes consumed substantially more than control homes. Otherwise, ADRS and load curves on event days matched for much of the off-peak period. On non-event days, however, ADRS load was significantly higher than control load during most of the off-peak period.

Figure 12: 2005 SCE high consumption event day load curves

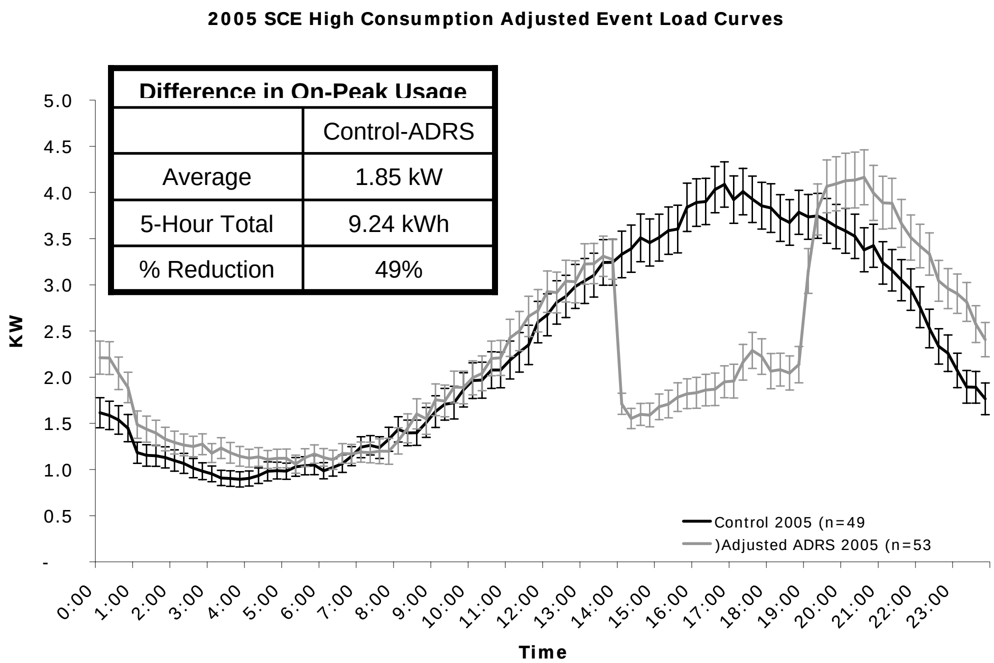


Figure 13: 2005 SCE high consumption non-event weekday load curves

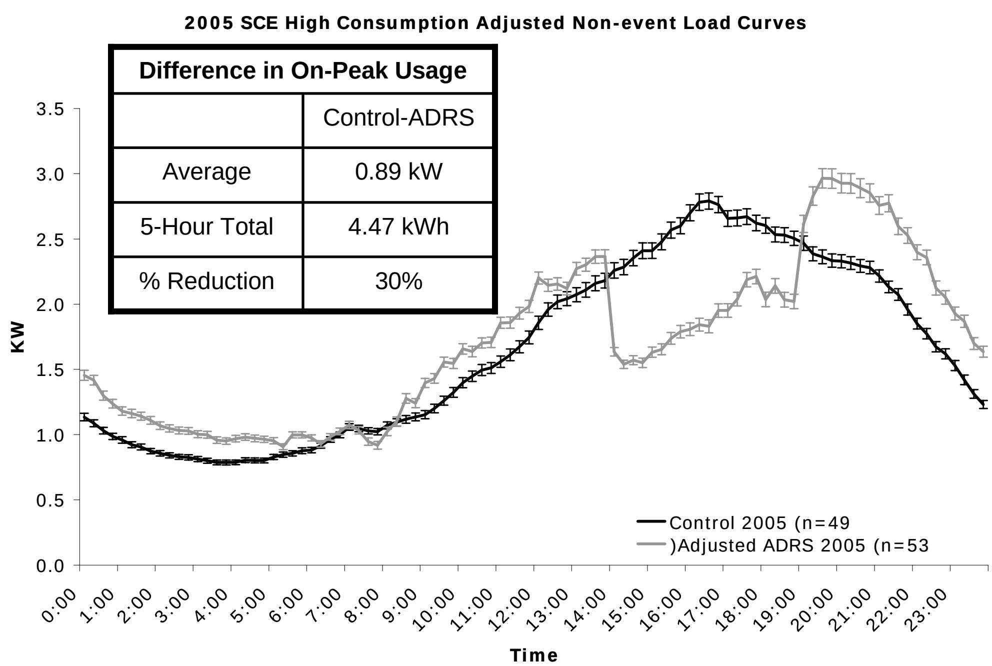
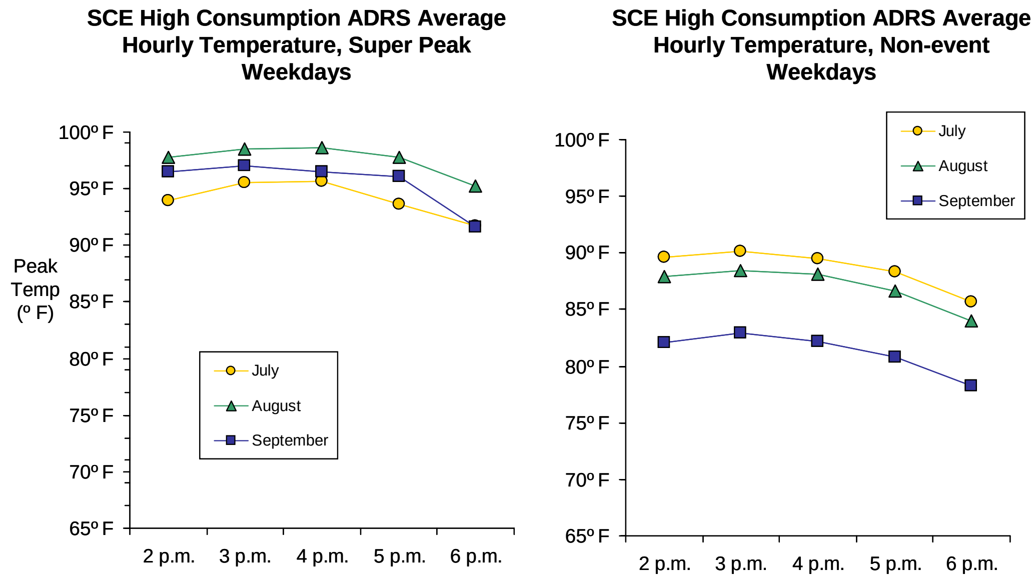


Figure 14 illustrates the average temperature at ADRS homes for each hour of the peak period on event and non-event days. August was the warmest month, with temperatures ranging between 95°F and 98°F, peaking at 4 p.m. September was the next warmest month, with temperatures peaking at 97°F at 3 p.m. and dropping steeply in the final Super Peak hours, which is indicative of autumn sunset during the last Super Peak hour.

Figure 14: 2005 SCE high consumption ADRS peak period hourly temperatures



Non-event weekday peak periods exhibited much more variability in hourly temperatures. July and August were the two warmest months, with peak hourly temperatures, topping out at 90°F and 88° F, respectively, before declining to 86°F and 84°F, respectively, at the end of the peak period. Peak period temperatures for all months peaked at 3 p.m. in SCE territory.

Hourly load reductions for Super Peak hours are shown in Figure 15**.** On a kW basis, high consumption ADRS savings compared to control rise from 1.81 kW during the 2 p.m. hour to a considerable peak savings of 2.1 kW during the 4 p.m. hour. Savings fell off modestly to 1.67 kW during the last Super Peak hour beginning at 6p.m. During the first three Super Peak hours, control load grew more rapidly than ADRS load (refer to Figure 12), resulting in the gradual increase in kW savings through the 4 p.m. hour. Around 5 p.m., control load peaked while ADRS load continued to climb, resulting in falling ADRS savings during the last two Super Peak hours.

On a percent basis, high consumption ADRS customer reductions were substantial and constant during the first three Super Peak hours with average load reduction of 53% compared to control homes load. During the last two Super Peak hours, percent load reductions declined modestly to 45%.

Figure 15: 2005 SCE high consumption Super Peak period hourly load reductions

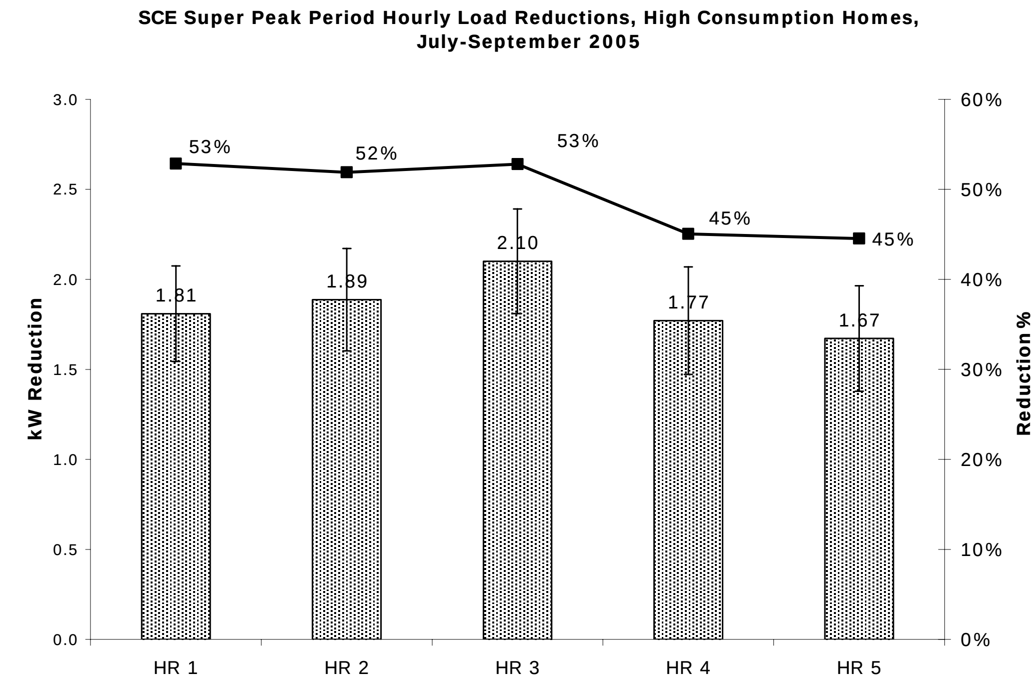


Figure 16: 2005 SCE high consumption non-event peak period hourly load reductions

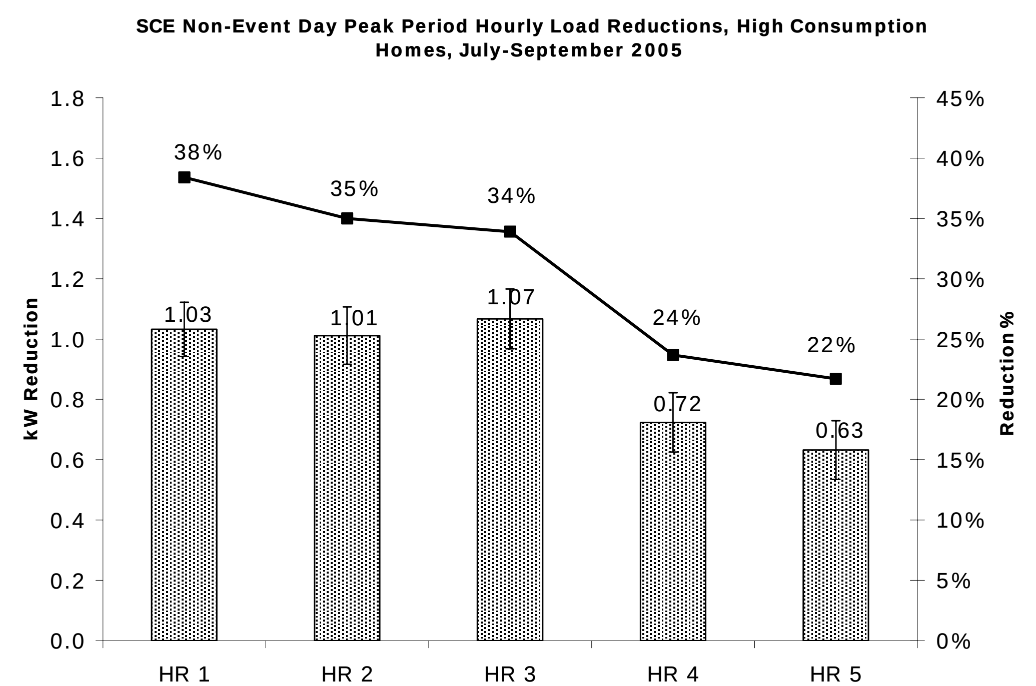


Figure 16 shows the on-peak hourly load savings of ADRS from control load for non-event weekdays. On a kW basis, savings display a mild positive trend during the first three hours of the peak period, starting at 1.03 kW savings and peaking at 1.07 kW savings during the third hour. Savings dropped markedly during the 4th and 5th hours to 0.72 and 0.63 kW, respectively. This decline in savings during the last two peak period hours corresponds to control load peaking while ADRS load was still increasing (refer to Figure 13). ADRS homes continued warming throughout the Super Peak period to the higher temperature set points induced by Super Peak signal initially sent at 2 p.m. Air conditioners in some homes cycled on periodically to maintain temperatures inside. On a percentage basis, hourly savings show a negative trend over the peak period. Maximum percent savings occurred during the 2 p.m. hour at 38%, and then declined to 22% by the last peak hour.

Super Peak period ADRS savings on event days declined with increasing temperature bins, which is illustrated in Figure 17 and Figure 18. The figures display ADRS load savings on event days according to temperature bin on a kW and percent basis, respectively. Savings ranged from 2.68 kW in the 76^{o}F-85^{o}F temperature bin to 1.69 kW in the 100^{o}F-105^{o}F temperature bin. On a percentage basis, savings declined from a high of 75% in the 76^{o}F-85^{o}F temperature bin to a still substantial 41% reduction in the 100^{o}F-105^{o}F bin.

Figure 17: SCE high consumption Super Peak period reductions by temperature bin: in kW

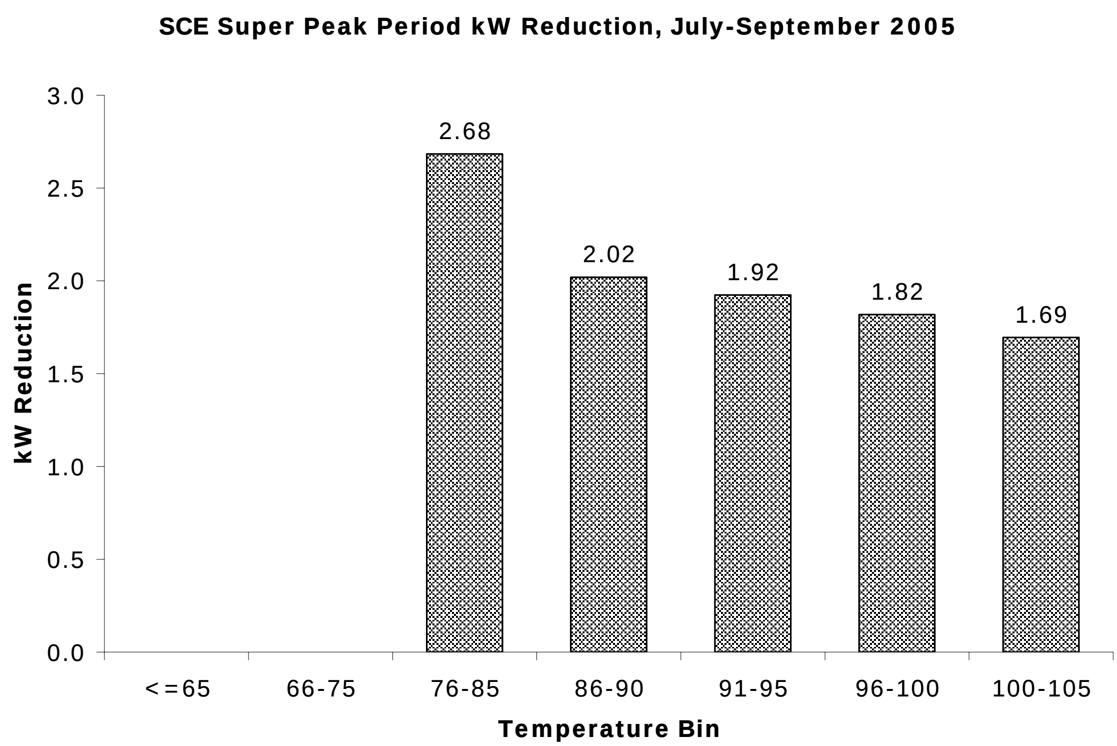
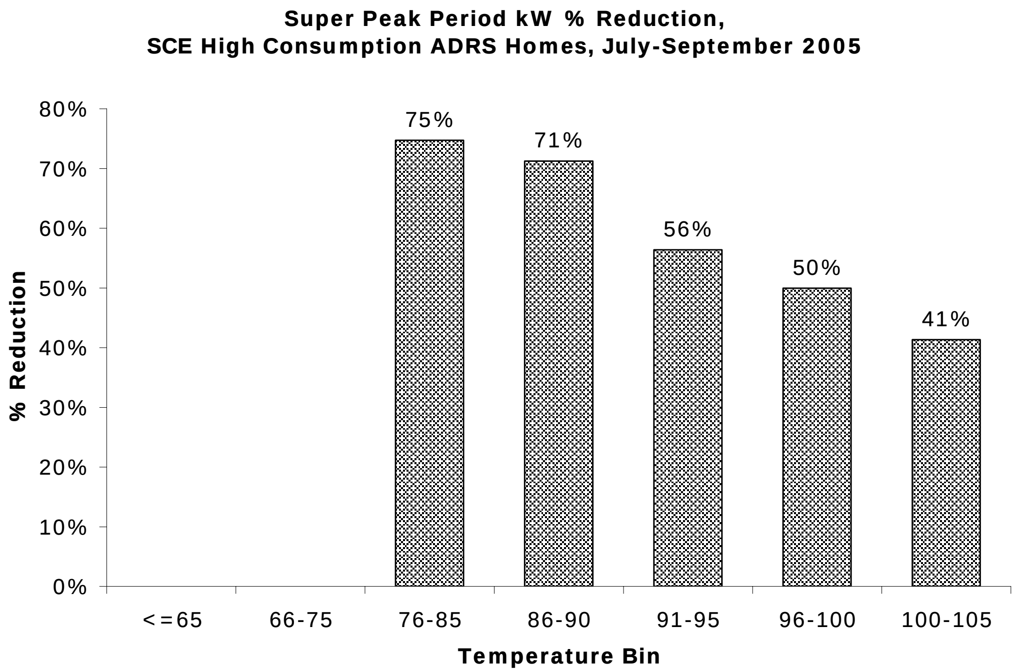


Figure 18: SCE high consumption Super Peak period reductions by temperature bin: in percent



Further investigation yields two insights that possibly explain this counterintuitive trend. First, the average peak temperature over all event days in SCE territory was 97°F. Thus the temperature bins below 91°F consisted of only a few customer-days. For example, the 76°F-85°F bin contained only three ADRS customer-days and thirteen control customer-days. The 86°F-90°F bin contained only six ADRS customer days and eleven control customer days. Hence, the large reductions in the 76°F -85°F and 86°F-90° F temperature bins should be interpreted with caution due to the small sample sizes in these bins.

Second, an examination of ADRS and control loads by temperature bin reveals that control loads increased only slightly in hotter temperature bins while ADRS loads show a larger positive response to increasing temperature. For example, in the 76°F-85°F temperature bin, control load during the peak period averaged 3.6 kW while ADRS averaged 0.94 kW. In the 101-105° F bin, peak period control load averages at 4.1 kW while ADRS load averages at 2.4 kW. This suggests that control customers were already running their air-conditioners at near full loads at lower temperatures while ADRS customers used the technology to minimize consumption while maintaining comfort through the range of summer temperatures. In other words, ADRS customers could not save more on the hottest days than the amount they were already saving during the slightly cooler days. Because of these different sensitivities to temperature and differences in ability to control comfort settings between the ADRS and control groups, load savings dropped on both a percent and kW basis with increasing temperatures.

Non-event weekday load reductions by temperature bin are displayed in Figure 19 and Figure 20. On a kW basis, savings generally show a positive trend across increasing temperature bins with a minimum reduction of 0.45 kW in the 76°F-85°F bin, increasing to 1.15 kW reduction in temperatures exceeding 100°F. On a percent basis, savings were nearly flat across 76°F-105°F range, maintaining a robust 24%-28% savings from control load. This consistency in percent savings indicates that ADRS customers were able to use technology to maintain load reductions across a wide range of temperatures.

Figure 19: SCE high consumption non-event peak period reductions by temperature bin: in kW

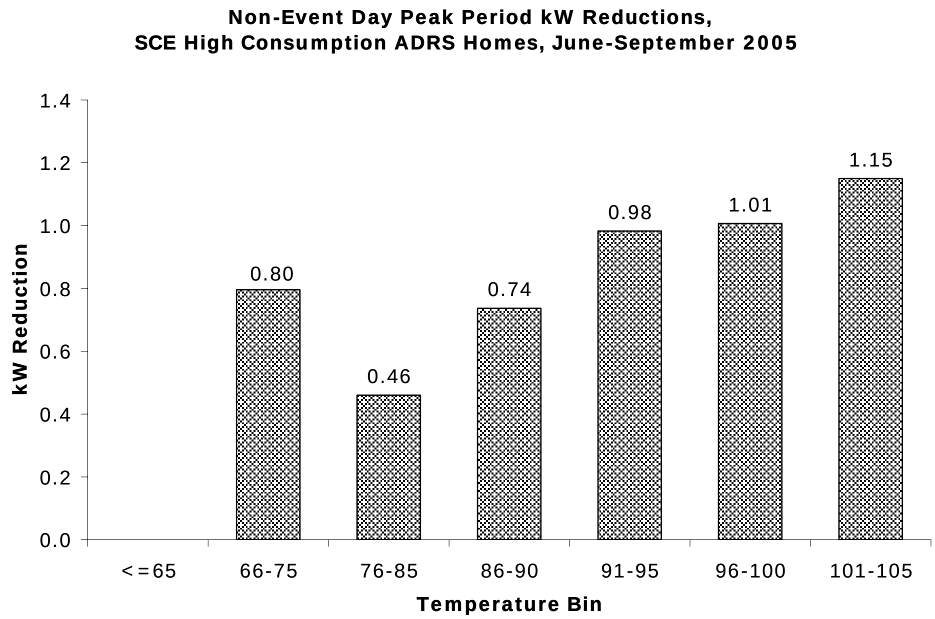
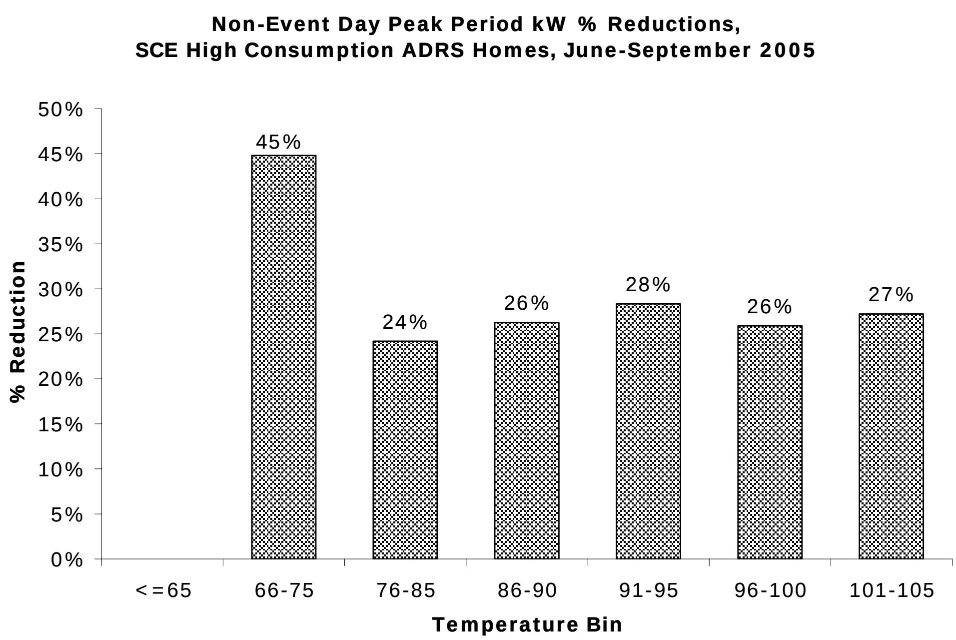


Figure 20: 2005 SCE high consumption non-event peak period reductions by temperature bin: in percent

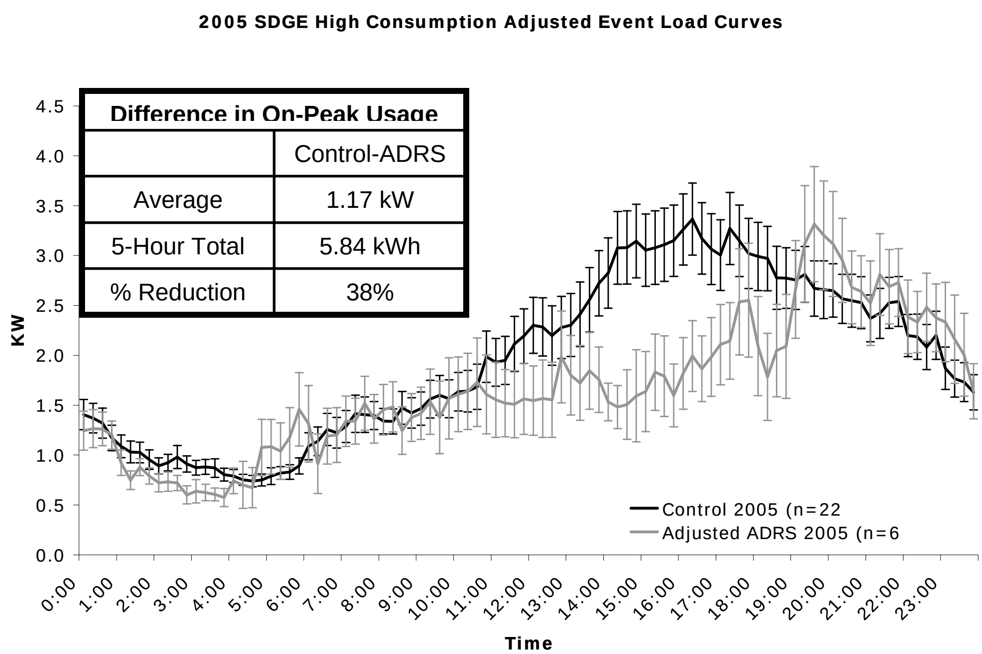


The percentage reduction in the 66^{o}F-75^{o}F temperature bin seems anomalous at first glance. However, the impressive performance is likely due to relatively large kW savings compared to a relatively small control load in that temperature bin. ADRS load savings are 0.80 kW in this temperature bin, which is consistent with kW savings in the warmer temperature bins from 86^{o}F to 95^{o}F. Control loads are very similar during the peak period between each bin, while ADRS loads increase more substantially in response to increased temperature.

1.4 SDG&E high consumption summer 2005 load impact results

Load curves for SDG&E's high consumption homes are displayed in Figure 21 and Figure 22 for event days and non-event days, respectively. Note that these results are not statistically significant because there are only six high consumption ADRS homes within San Diego territory. Notwithstanding small sample size, ADRS homes in San Diego show substantial peak period reductions, with peak period savings of 1.17 kW (38%) on event-days and 0.69 kW (27%) on non-event days. Ninety percent confidence intervals for the Super Peak period averaged ±0.35 kW for control homes and ±0.40 kW for ADRS homes[7]. On non-event weekdays, the peak period confidence intervals averaged ±0.11 kW for control homes and ±0.12 kW for ADRS homes[8].

Figure 21: 2005 SDG&E high consumption event day load curves



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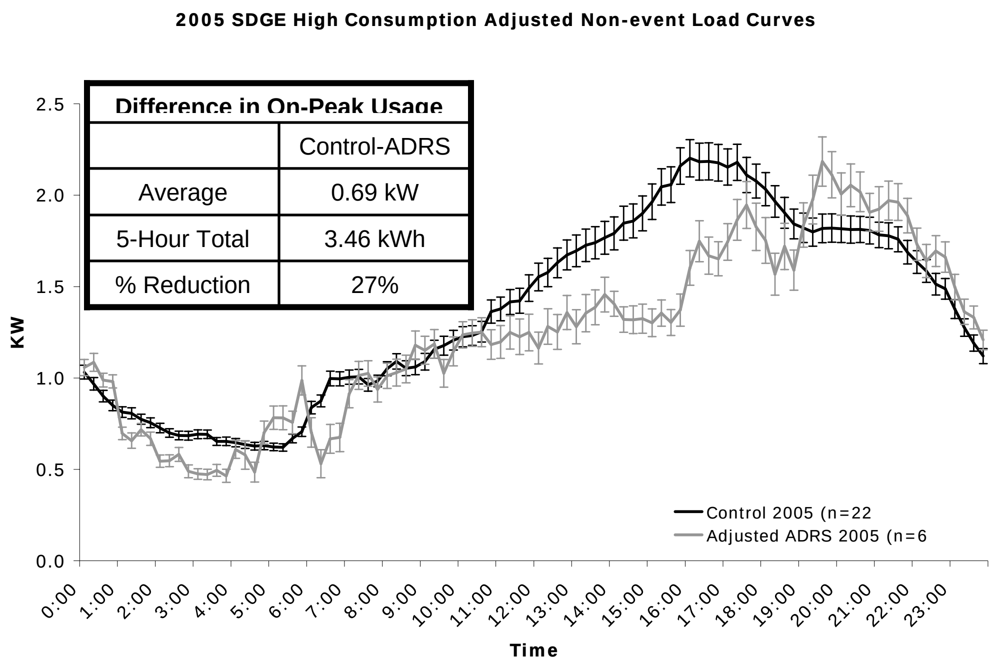
[7]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, Data Collection and Load Impact Analysis Methodology. Ninety percent confidence intervals for control homes actually varied from ±0.30 kW to ±0.37 kW across the Super Peak period; ADRS confidence intervals varied from ±0.19 kW to ±0.57 kW.

[8] Non-event peak period 90% confidence intervals for control homes varied from ±0.10 kW to ±0.12 kW; 90% confidence intervals for ADRS homes varied from ±0.09 kW to ±0.17 kW across the peak period..

Figure 22: 2005 SDG&E high consumption non-event load curves



Super Peak and peak period temperatures for SDG&E's ADRS homes were averaged for every hour in Figure 23. Temperatures in September and August event days were warmer than July. On event days, only the August temperatures exceeded 90^{o}F, reaching a maximum average of 91^{o}F at 2 p.m. September's event day temperatures were warm for the utility service territory, falling within the 80^{o}F-90^{o}F range. July's temperatures were the coolest of all event days, peaking at a relatively mild 83^{o}F and falling into the upper 70's during the latter half of the Super Peak period. With the exception of September event days, hourly temperatures across all months peaked at 2 p.m. and cooled steadily (1.4^{o}F per hour, on average) through the rest of the Super Peak period.

On non-event days, hourly peak period temperatures were mild across all months compared to event days. Again, August 2005 was the hottest summer month in SDG&E territory on average for non-event days, peaking at 78^{o}F at 2 p.m. Average on-peak temperatures were within the 70^{o}F- 80^{o}F range for July through September. Non-event hourly peak period temperatures show the same trend as on event days— temperatures peaked at 2 p.m. and cooled steadily through the rest of the peak period.

Figure 23: 2005 SDG&E average hourly peak period temperatures

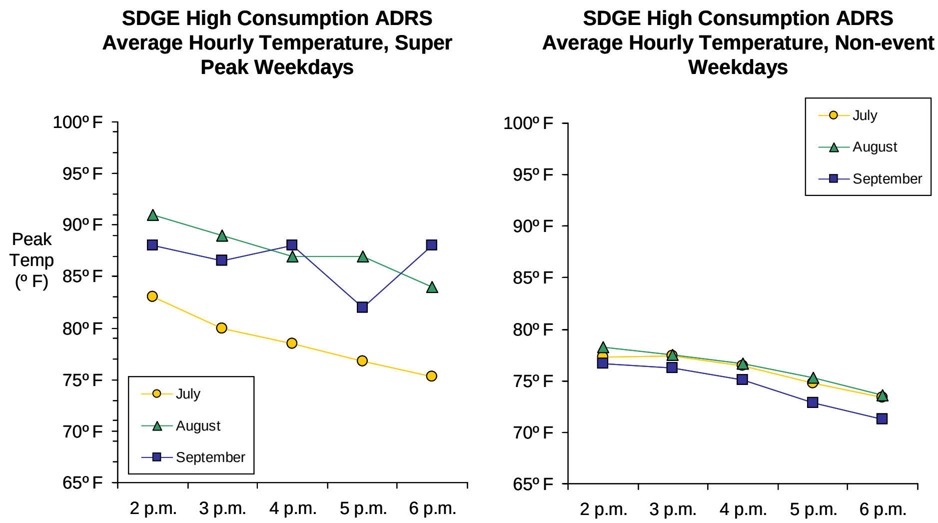
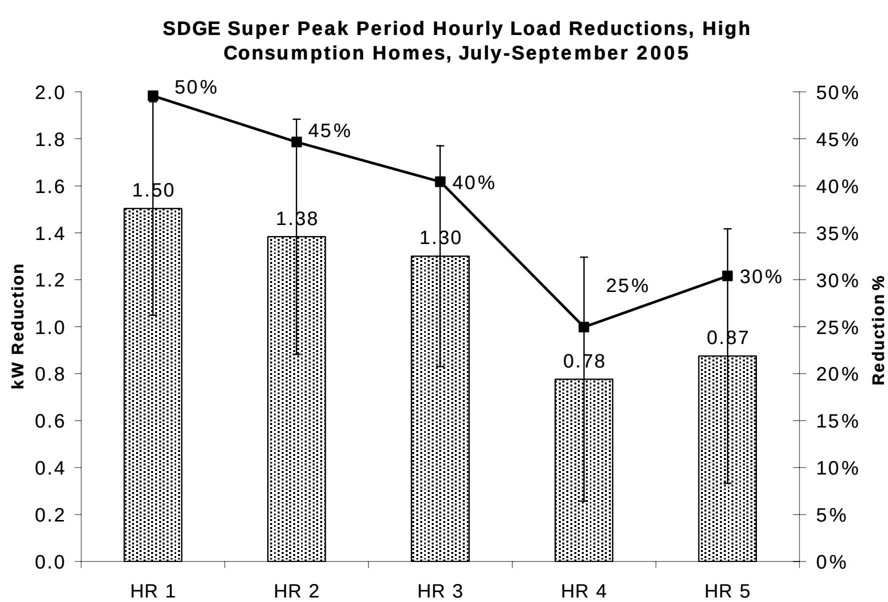


Figure 24 shows high consumption ADRS customer savings from control for every hour of the Super Peak period. Reductions at 2 p.m. were considerable at 1.5 kW, or 50% of SDG&E high consumption control load. Savings then dropped steadily for the rest of the Super Peak period, settling at a still substantial 0.87 kW, or 30% savings during the last Super Peak hour. The smallest hourly load reduction occurred during the fourth hour at 5 p.m., corresponding with an inexplicable spike in ADRS load during this time (Figure 21). Recall in the above discussion that temperatures reach their maximum at the beginning of the Super Peak period in SDG&E territory and cool throughout the Super Peak period. This curious behavior in consumption at 5 p.m. thus could be an artifact of the small sample size.

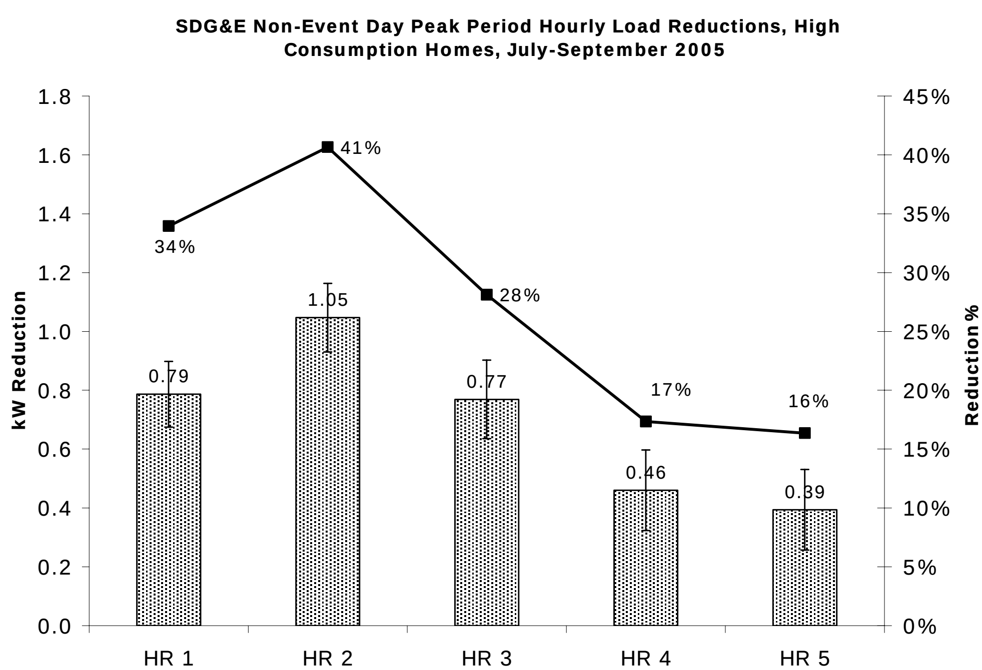
Figure 24: 2005 SDG&E high consumption Super Peak hourly reductions



The steady decline in savings over the Super Peak period generally corresponds with ADRS load increasing throughout the period while control load gradually decreased. Control load on event days appears to match well with hourly peak period temperatures shown in Figure 23. Control load gradually decreased along with the temperature. In contrast, ADRS load increased throughout the Super Peak period though temperatures were falling. In fact, it appears that ADRS homes were conserving *before* the peak period, as suggested by the divergence of ADRS and control load curves in the late morning in Figure 21. Cooling demand caught up with ADRS homes by afternoon during the Super Peak period, resulting in the diminishing savings during the peak period. Cooling demand (in spite of cooling temperatures in the range of 65^{o}F to 70^{o}F) was further implicated by the significant rise in ADRS load during the recovery period from 7 p.m. to 9 p.m.

Figure 25 plots the peak period hourly reductions for SDG&E high consumption ADRS homes on non-event weekdays. ADRS load reduction compared to control homes was greatest during the second peak period hour at 1.05 kW, or 41% then declined steadily throughout the rest of the peak period, settling to 0.39 kW or 16% savings during the final peak period hour. First hour reductions were 0.79 kW or 34% from control home loads. Reviewing these results against the non-event load curves in Figure 22, the control homes' average load rose substantially during the first two peak period hours from 2 p.m. to 4 p.m. while the ADRS customer load remained flat. This caused the increase in savings at the beginning of the peak period from 2 p.m. to 3 p.m. During the third hour, ADRS load increased sharply as control homes' average load peaked. The ADRS and control curves gradually converged during the last three peak period hours as outside temperatures fell and ADRS homes warmed up to the higher thermostat settings, resulting in the successively reduced, but substantial, savings.

Figure 25: 2005 SDG&E high consumption non-event peak period hourly reductions



High consumption ADRS load reductions temperature bin charts in Figure 26 and Figure 27 illustrate the positive effect that temperature has on the ADRS savings during the Super Peak period. Overall, high consumption ADRS homes in SDG&E territory achieved substantial savings on event days when temperatures exceeded 85°F. ADRS homes experiencing maximum temperatures above 85°F on event days on average gave an impressive performance, saving 1.44 kW from control in the 86°F-90° F bin and 1.82 kW in the 91°F-95°F temperature range. On a percentage basis, ADRS load savings in the hotter temperature bins were consistently around 46-48% of control homes.

The negative savings calculated for the 66°F-76°F bin on event days were a result of low peak period air conditioning demand. ADRS homes consumed more load than control homes at cooler temperatures in SDG&E territory. Total control and ADRS customer loads in this bin were both modest, averaging at 1 kW and 1.5 kW, respectively, during the peak period.

Figure 26: 2005 SDG&E high consumption Super Peak reductions by temperature bins: in kW

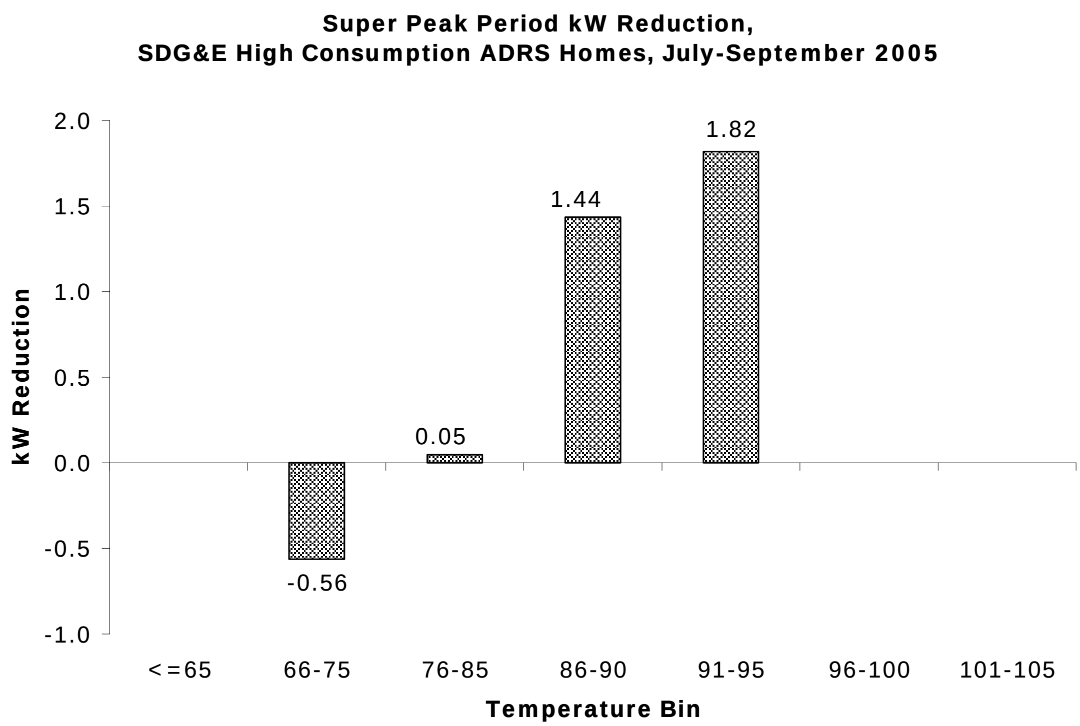


Figure 27: 2005 SDG&E high consumption Super Peak period reductions by temperature bin: in percent

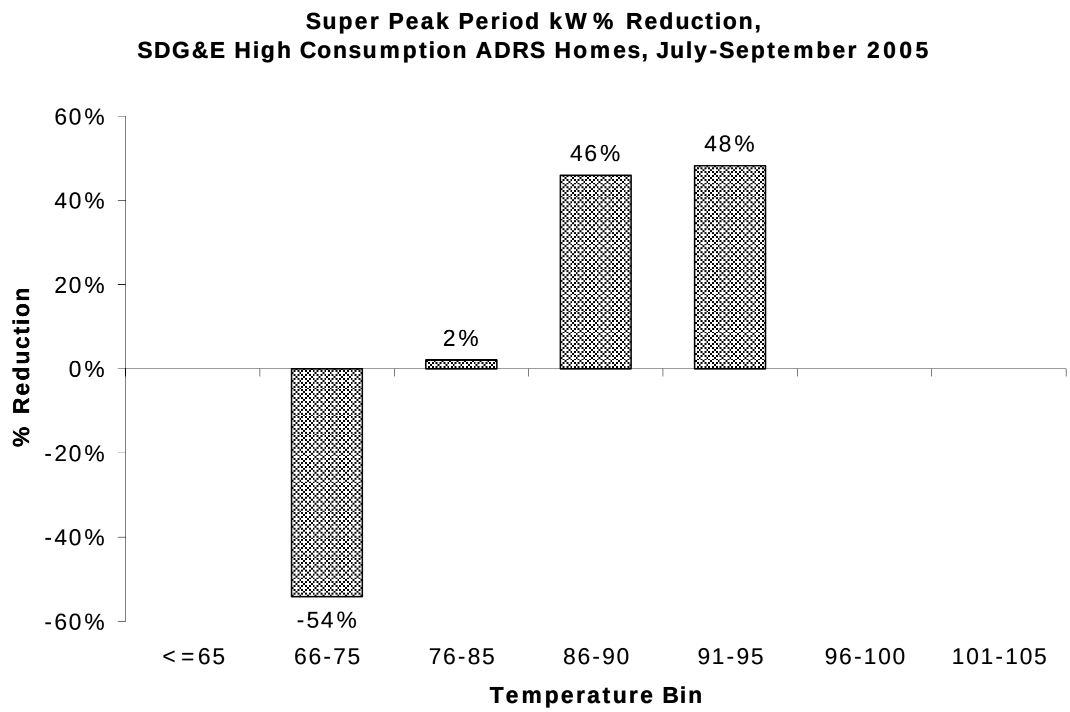


Figure 28 and Figure 29 reports high consumption ADRS peak period load reductions on non-event days by temperature bin in SDG&E territory. Since non-event days were mild on average, the volume of data is sparse in the temperature bins above 85°F. Notwithstanding, ADRS peak period savings show a positive response to increased temperature. ADRS customers generated substantial savings in temperature bins above 76°F, reducing load by an average of 0.66 kW during the peak period for customers experiencing maximum temperatures between 76°F and 85°F on non-event days. Reductions consistently exceeded 1.5 kW in the temperature bins above 85°F in SDG&E territory.

On a percentage basis, ADRS performance in the temperatures above 76°F varied more widely, but was still sizable. In the mild 76°F-85°F range, ADRS homes reduced load by 25% of control load on non-event days. Percent reductions in the hotter temperature bins were larger: 47% for the 86°F-90°F bin and 39% for the 91°F-95°F.

The negative savings calculated for the 66°F-76°F bin on non-event days are a result of low peak period air conditioning demand. ADRS homes consumed more load than control homes at these cooler temperatures in SDG&E territory. Total control and ADRS customer loads in this bin were both modest, averaging at 1.4 kW and 1.6 kW, respectively, during the peak period.

Figure 28: SDG&E high consumption non-event peak period reductions by temperature bin: in kW

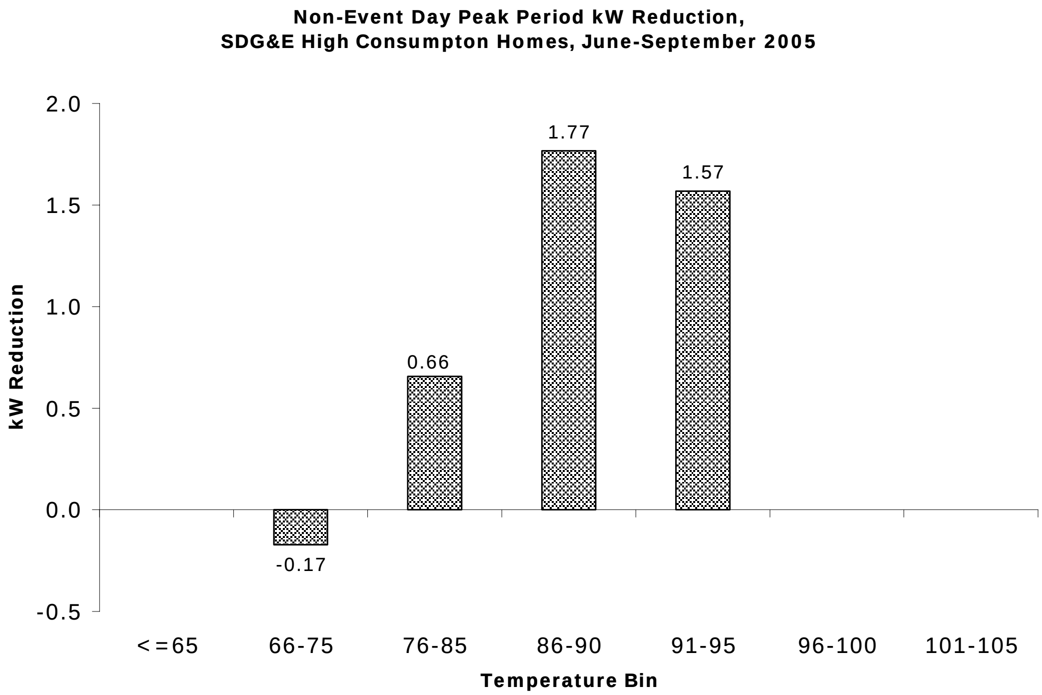
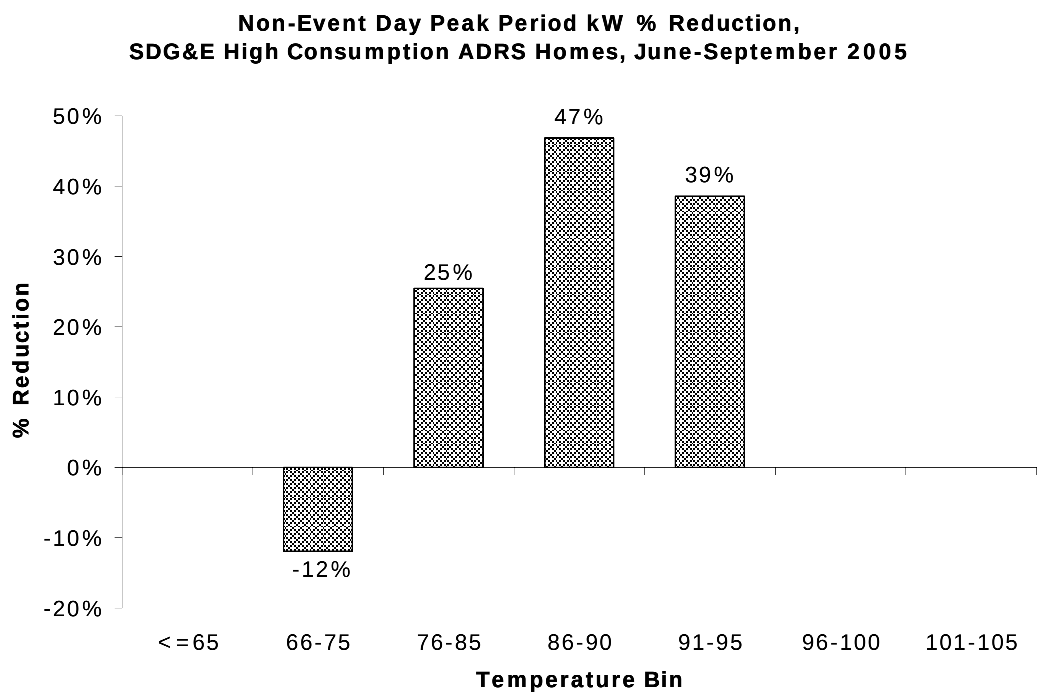


Figure 29: SDG&E high consumption non-event peak period reductions by temperature bin: in percent



1.5 2005 load impact results, low consumption homes

Load impact results for low consumption homes during summer 2005 are reported here for completeness, but it should be noted that the numbers are not statistically meaningful, due to small sample size of both the control and ADRS homes. Results corresponding to low consumption homes 2005 load impact results reported in this section are provided for reference in Appendix D to this report, Low Consumption ADRS 2005 and 2004 Load Impact Results Charts.

Table 1: Population of Low Consumption ADRS and control homes by utility

	PG&E		**SCE**		**SDG&E**	
	ADRS	control	ADRS	control	ADRS	control
Low Consumption	24	2	4	14	15	3

Statistical significance of load reductions of low consumption ADRS homes compared to control homes were limited by the group with the least number of homes. Table 1 shows the number of homes in the low consumption data set for each utility and group. For PG&E, the maximum resolution was constrained by only two homes in the control sample. For SCE, the constraint was the only four homes in the ADRS sample. For SDG&E, the constraint was the three homes in the control sample. Statewide results for low consumption homes were not statistically significant at the 90% confidence level given that total population of control homes statewide was only nineteen. A sample size of 36 homes is needed in each of the ADRS and control home samples for results to be significant with 90% confidence level and accuracy of ± 0.55 kW[9].

Another effect of small sample size is that confidence intervals at the 90% level selected by RMI around average control and ADRS loads are so wide that consumption differences between the two populations were essentially zero in most cases. This is true for the 2005 load impact results with the exception of PG&E peak period reductions. The loads driving the "large" peak period reduction of PG&E low consumption ADRS homes were only two control homes, as noted above.

Statewide, low consumption ADRS homes from July through September reduced load relative to homes by 0.25 kW or 1.25 kWh across the Super Peak period on event days. On a percentage basis, ADRS homes reduced load by 14% relative to low consumption control homes. On non-event days, low consumption ADRS homes consumed *more* load than control homes, by 0.25 kW or 1.23 kWh on average across the peak period. This translates to -20% reduction relative to control homes.

On a utility specific basis, PG&E low consumption ADRS homes showed peak period consumption excess of control homes on both event and non-event days. ADRS homes consumed on average 0.21 kW (12%) *more* than control homes during the Super Peak period and 0.64 kW (52%) more load during peak period.

[9] For a more detailed discussion of minimum sample sizes in designing an experiment, refer to Appendix A of this report, Data Collection and Load Impact Analysis Methodology.

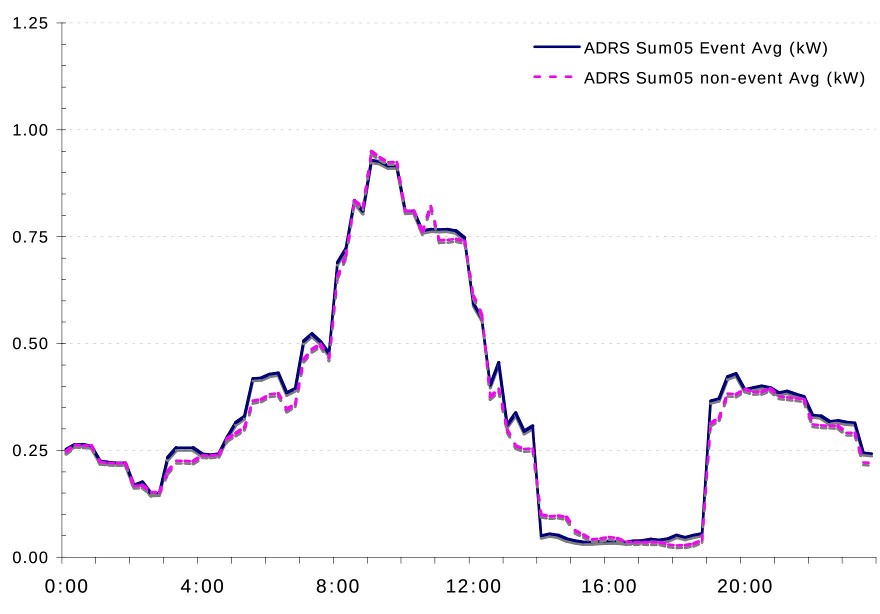
Low consumption ADRS homes in SCE territory reduced load relative control homes on both event and non-event days. On event days, the four SCE low consumption ADRS homes reduced Super Peak load by 0.56 kW, or 30% compared to control homes. On non-event days, ADRS homes reduced peak period load by 0.17 kW, or 14%, from control homes in SCE territory.

For SDG&E low consumption homes, SDG&E ADRS homes reduced Super Peak load by 0.16 kW (13%) during summer 2005 and peak period load by -0.13 kW (-14%), meaning that low consumption homes consumed *more* load than control homes on non-event days. The ADRS and control loads were statistically the same over most hours on event days, however, signifying zero net Super Peak load reductions.

1.6 Contribution of pool pumps to 2005 high consumption ADRS total load impact

Load data recorded by utility interval meters in ADRS and control homes measure whole-house data and cannot segregate consumption by end use. However, ADRS homes are equipped with an additional interval meter as part of the technology package from Invensys Climate Controls. Figure 30 plots average daily pool consumption during summer 2005 on event and non-event days. Reported load is average of all pools and reflects load diversity in scheduling. Load diversity refers to the percentage of customer loads that are not available or not operating at any point in time.

Figure 30: Average high consumption ADRS pool pump load, July-September 2005



The average daily load curve shows that high consumption ADRS customers with swimming pools consistently scheduled pool pump operation outside of the hours between 2 p.m. and 7 p.m. to reduce Super Peak and peak period consumption every day.

Load reductions compared to control customers resulting from shifting pool pump usage cannot be measured directly, as utility meters for control customers measure whole house consumption only. However, ADRS pools load reduction can be estimated based on consumption data of residential customers with identical technology installed in a similar pilot program in operated by Nevada Power Corporation. Since there is no financial incentive for pool owners to shift load away from peak in Nevada Power's residential load management program, operation of pools is presumed to provide an appropriate load shape for comparison purposes[10]. Only the estimated reductions are reported in Table 2 because Nevada Power customer load data are confidential.

Results in Table 2 reveal that residents shifting pool pump operation contribute 32% of the 9.2 kWh total Super Peak reduction for an average home with a pool. Since approximately one out of every three ADRS participant owns a pool, this load reduction contributed about 10% of total Super Peak period reduction on event days. On non-event days, residents shifting pool pump operation contributed over 50% of the 6.1 kWh total peak period reduction for an average home with a pool. This load reduction contributed about 27% of total peak period reduction on non-event days.

Table 2. Average Super Peak and peak load reduction, 2005

	Event day kWh				Non-event day kWh			
ADRS Segment	Pool*	Other**	Total	% Pool Contribution	Pool*	Other**	Total	% Pool Contribution
No Pool (65)	--	6.3	6.3	0%	--	2.9	2.9	0%
With Pool (33)	2.9	6.3	9.2	32%	3.2	2.9	6.1	53%
Wtd. Avg. (98)	1.0	6.3	7.3	13%	1.1	2.9	4.0	27%

*RMI estimate based on ADRS pool pump loads compared against Nevada Power Corporation residential customers using identical technology.
**Reduction of other loads calculated algebraically from total average load reduction and average pool load reduction rather than direct measurement

1.7 Summary of ADRS 2005 load impact results

Customers with ADRS technology and subject to CPP-F rates in climate zone 3 successfully achieved load reductions compared to control customers without ADRS technology on standard tiered rates in 2005. The load reductions are substantial and stable across a range of days and temperatures. Technology appears to be an important driver in reducing load, especially Super Peak load, for high-consumption homes.

Load reductions appeared to be stable for ADRS homes experiencing hottest temperatures relative to other ADRS homes for a particular utility. For PG&E and SCE, load reductions were stable and consistent for homes experiencing maximum temperatures above 91^{o}F on event and non-event days. For SDG&E, load reductions were stable and consistent for homes experiencing maximum temperatures above 86^{o}F on event and non-event days.

[10]The aggregate load profile from Nevada Power customers was scaled down to reflect the smaller operational load of pools participating in ADRS (from 1.8 kW in Nevada to 1.6 kW among ADRS participants)

Load reduction performance for customers with ADRS technology and subject to CPP-F rates varied between utilities across the state. SCE high consumption ADRS customers achieved close to 2 kW reductions on event days across a range of temperatures. PG&E and SDG&E high consumption ADRS customers achieved substantial, but lower reductions, close to 1 kW on event days on average.

Homes with ADRS technology produced a consistent and predictable load profile during Super Peak and peak periods. Reductions were at their maximum at the start of the period, then gradually increased as homes warmed up and air conditioners pulsed on to maintain indoor temperatures at the higher set point. The hotter the outdoor temperature became, typically the faster the load rose throughout the peak period, on average. There was typically a dramatic recovery in load immediately following the Super Peak or peak periods, when thermostats in ADRS homes automatically reset from their warmer Super Peak or peak settings to their cooler off-peak setting.

Where present, pool pumps made a significant contribution to reduction of Super Peak and peak period load. Examination of average daily load profiles showed that high consumption ADRS customers with swimming pools consistently scheduled pool pump operation outside of the hours between 2 p.m. and 7 p.m. to reduce Super Peak and peak period consumption every day. On event days, pool pumps operation contributed 32% of total Super Peak reduction for an average high consumption ADRS home with a pool[11]. On non-event days, residents shifting pool pump operation contributed over 50% of total peak period reduction for an average home with a pool.

[11]Total reduction of Super Peak and peak period load by homes with pools is calculated algebraically rather than by direct measurement.

Chapter 2 Summer 2004 load impact results

This section consists of a restatement of the 2004 Automated Demand Response System (ADRS) pilot load impact results. These results supersede Rocky Mountain Institute's (RMI) reported results for the summer 2004 pilot period published in December 2004[12].

The need for restatement of summer 2004 ADRS load impact results is two-fold. First, one of the ADRS pilot extension objectives was to compare load response levels observed in summer of 2005 to levels observed in the summer of 2004. The 2005 pilot program focused on studying results by utility, rather than statewide as was the convention in the original 2004 load impact analysis. The 2005 ADRS pilot focused furthermore on the performance of high consumption homes by utility: those homes with historical summer average daily usage of 24 kWh and greater. While the ADRS pilot sample was adequate, additional high consumption homes needed to be added to the control sample in order to make the utility-specific evaluation more statistically robust. The additional high consumption control homes were incorporated into the ADRS control sample and 2004 load impacts were re-evaluated in order to facilitate comparison of load impact results between the two pilot years[13].

Second, one major item of discussion from the 2004 ADRS pilot was the possibility of selection bias in the ADRS homes relative to the average California residential population at large. This ensued from discussions around California's pricing-only Statewide Pricing Pilot (SPP), a pilot program closely related to the ADRS pilot. Like ADRS, the SPP was a statewide demand response pilot program sponsored by the California Energy Commission to study the ability and extent of critical peak pricing to change energy consumption behavior during specific times of day.

In the SPP load impact evaluation, significant bias was discovered in the climate zone 3 SPP residential participants (A07) and subsequently corrected. The SPP Evaluation Subcommittee and the California Energy Commission (CEC) stated their concerns for the existence of selection bias in the A07 and ADRS homes, respectively, and suggested the need for adjustments to load impact results in light of possible bias in the samples[14]. While selection bias in A07 homes was identified and corrected by the SPP evaluation team led by Charles River Associates in 2005, RMI had not investigated the existence of possible selection bias for ADRS homes.

Thus, during the pilot extension in 2005, RMI conducted a selection bias evaluation for the ADRS customers. The investigation concluded that ADRS selection bias existed, albeit small in magnitude, particularly during peak periods. Adjustments were thus applied to all load impact results for the summer 2005 ADRS pilot extension. In order to fulfill the 2005 ADRS pilot extension objective of comparing load response levels observed in summer of 2004 to levels

[12]Rocky Mountain Institute (RMI), *ADRS Load Impact Final Report*. December 18, 2004.

[13] In total, utilities provided a total of 68 additional control homes, with 30 from SCE, 19 from PG&E, and 19 from SDG&E. The additional high consumption control homes brought the total high consumption control sample count to 52 for SCE, 30 for PG&E, and 22 for SDG&E.

[14]McAuliffe, Pat and Arthur Rosenfeld, California Energy Commission (CEC), Response of Residential Customers to Critical Peak Pricing and Time-of-Use Rates During 2003 and 2004. January 17, 2005.

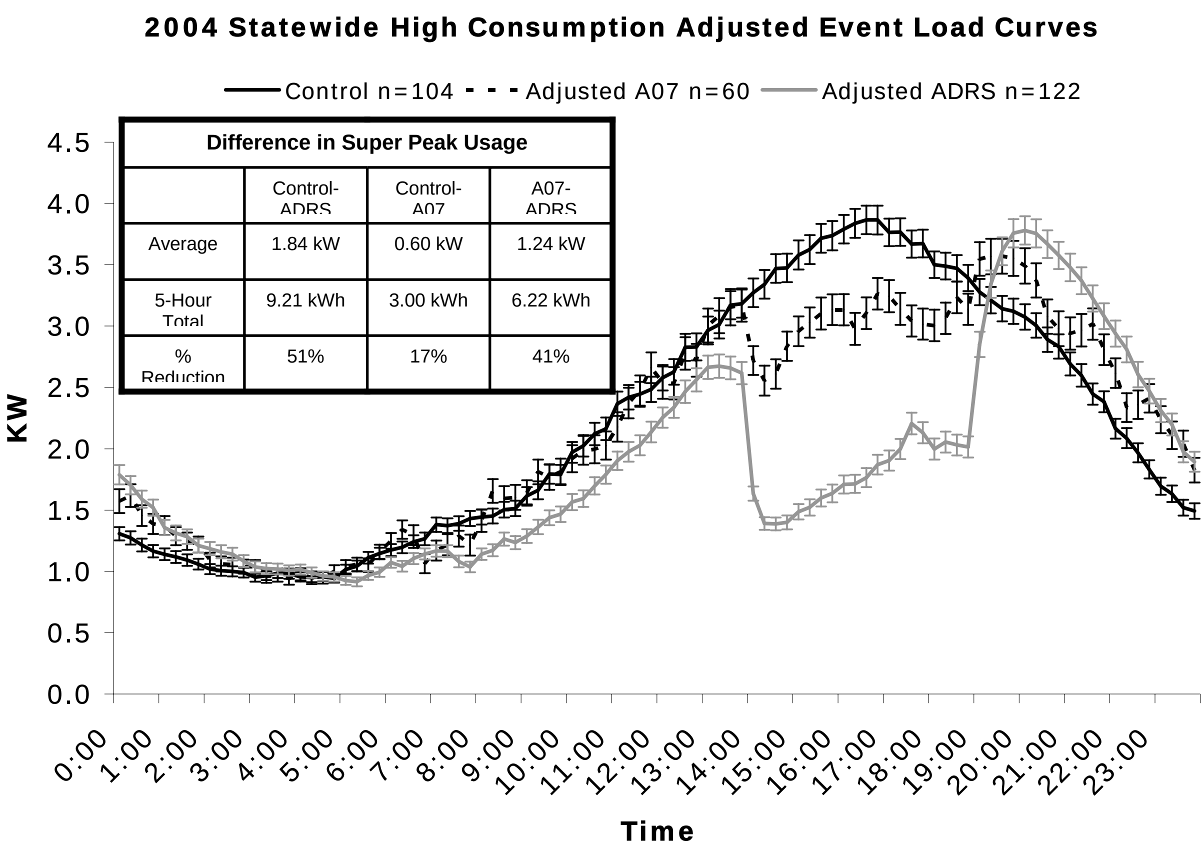
observed in the summer of 2005, RMI also needed to adjust load impact results reported for the 2004 ADRS pilot and restate the results to include the selection bias adjustment.

The restated 2004 ADRS load impact results are thus enumerated in this section, with selection bias adjustments to the ADRS and A07 customers. Details of RMI's confirmation of A07 selection bias and investigation into ADRS selection bias are included for reference in Appendix C to this report.

2.1 Statewide high consumption summer 2004 load impact analysis results

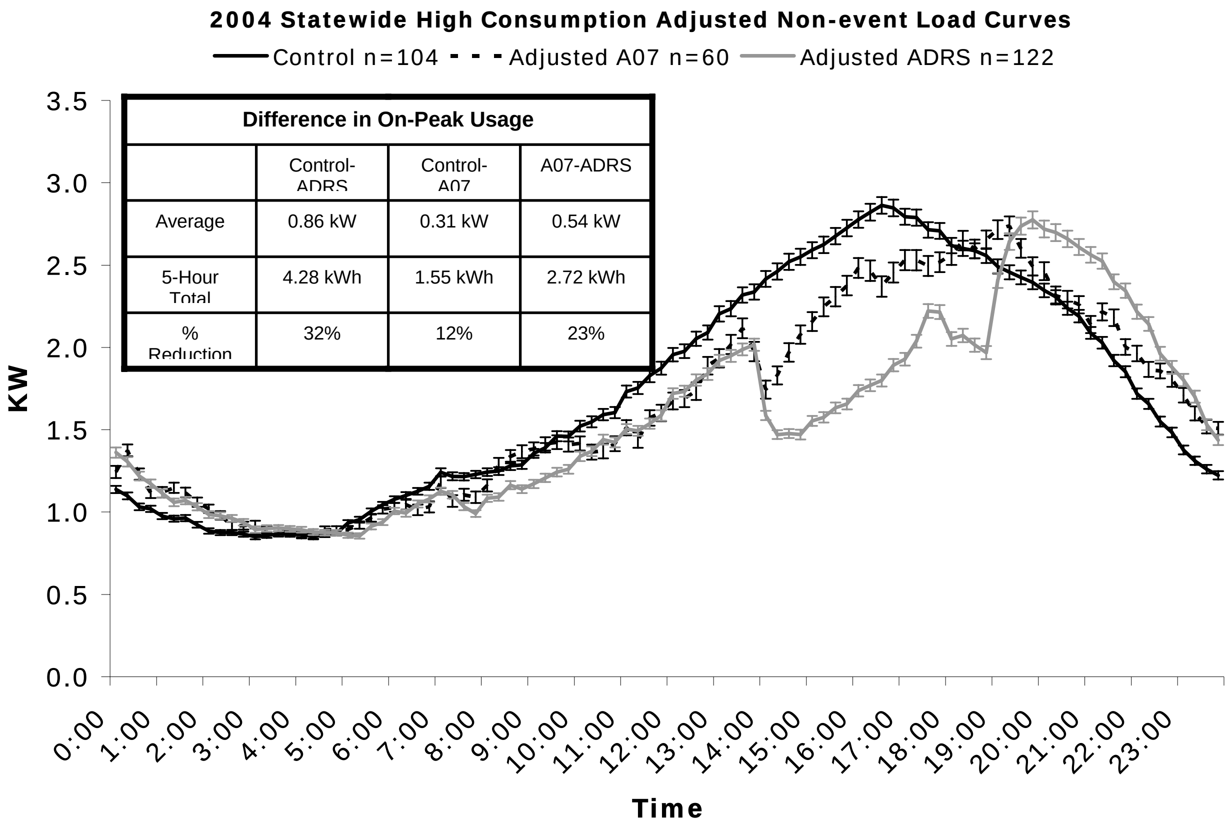
During the period July to September 2004, ADRS high consumption customers successfully and consistently reduced load relative to control homes by 1.84 kW or 9.22 kWh on average during the Super Peak period across twelve event days, called statewide (Figure 31). This translates to a 51% reduction relative to high consumption control homes statewide. The control homes do not possess ADRS technology and are not subject to dynamic critical peak pricing (CPP) rates.

Figure 31: Statewide high consumption event day load curves



Compared to customers on dynamic critical peak pricing rates but without ADRS technology (A07 homes), ADRS high consumption participants successfully and consistently reduced load by an average of 1.24 kW or 6.22 kWh during Super Peak period on event days statewide. This translates to a 41% reduction relative to A07 high consumption homes, statewide. The A07 homes, reducing their load with only the Super Peak rate stimulus on event days but without the assistance of ADRS technology, averaged 0.60 kW reduction relative to control homes or 3.0 kWh during Super Peak period on event days, statewide. This translates to a 17% reduction for A07 high consumption customers relative to control customers on event days, statewide. Ninety percent confidence intervals of loads during the Super peak period averaged ±0.11 kW for control homes, ±0.07 kW for ADRS homes, and ±0.13 kW for A07 homes[15].

Figure 32: Statewide high consumption non-event day load curves



On non-event days statewide, ADRS high consumption customers reduced load relative to control homes by 0.86 kW or 4.28 kWh on average, during the peak period. This translates to a 32% reduction relative to high consumption control homes statewide (Figure 32). Compared to A07 homes statewide, ADRS high consumption customers reduced load by an average of 0.54 kW or 2.72 kWh during the peak period. This translates to a 23% reduction relative to A07 customers. The A07 homes, reducing their load with only the peak rate stimulus on non-event days but without the assistance of ADRS technology, averaged 0.31 kW or 1.55 kWh compared to high consumption control customers. This translates to a 12% reduction for A07 high

[15]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, of the essential companion document to this report, *Automated Demand Response System Pilot, 2005 Summer Load Impact Results and Comparison of 2005 with 2004 Summer Load Impact Results*. Super Peak 90% confidence intervals ranged from ±0.10 kW to ±0.12 kW for control homes, from ±0.05 kW to ±0.08 kW for ADRS homes, and from ±0.12 kW to ±0.13 kW for A07 homes.

consumption customers relative to control customers on non-event days, statewide. Ninety percent confidence intervals during the non-event peak period averaged ±0.05 kW for control homes, ±0.03 kW for ADRS homes, and ±0.06 kW for A07 homes[16].

2.1.1 Comparison of adjusted and unadjusted statewide 2004 load impact results

The load impact results presented above and in the rest of this report include corrections for selection bias in both ADRS and A07 homes along with an augmented control group. RMI conducted a selection bias evaluation for the ADRS customers found small but statistically significant pre-existing differences in the amount of electricity consumption between ADRS customers and the control group, particularly during peak periods. Details of RMI's confirmation of A07 selection bias and investigation into ADRS selection bias are included in the appendix to this document.

Interestingly, the direction of ADRS bias differed between utilities. For PG&E and SDG&E, ADRS customers generally consumed less on-peak energy than control homes. ADRS loads for the two utilities were thus adjusted upward to reflect this bias, reducing the apparent savings. For ADRS customers in SCE's service territory, consumption was generally greater than control homes. ADRS loads for SCE were thus adjusted downward to reflect this bias.

The bias adjustment used to report statewide ADRS load reduction results was calculated in the form of a weighted average of the individual bias adjustments used for each utility. Because the bias adjustments for each utility were different in magnitude and direction, the net adjustment to ADRS customers used in reporting the statewide average results in this report was relatively small, about 0.1 kW.

In contrast, the bias adjustment applied to A07 homes was more substantial, on the order of 0.6 kW during the Super Peak period for event days and 0.15 kW during the peak period for non-event days. RMI calculated the bias adjustment using pretreatment load data from June 2003 for both A07 homes and the augmented control group. A statewide bias adjustment was calculated using combined load data from the utilities, rather than from the weighted average of bias adjustments calculated from each utility in the case of ADRS bias adjustments. No utility-specific adjustments were calculated for the A07 homes, as the quantity of pretreatment data available for each utility was sparse for A07 homes. Details of the selection bias investigation and adjustment calculation for A07 and control homes are included in the appendix to this report.

The effect of adding the additional control homes was to increase control load statewide for all days during summer 2004. On non-event days, the augmented control load increased by 9.6% compared to the original (A03) control group load (Table 3). On event days, the augmented control load increased by 13% compared to the original A03 control group load. While the load difference between augmented and A03-only control customers on event days are slightly higher

[16]Non-event peak period 90% confidence intervals ranged from ±0.0.4 kW to ±0.05 kW for control homes, from ±0.03 kW to ±0.04 kW for ADRS homes, and from ±0.055 kW to ±0.062 kW for A07 homes.

than for non-event days, the overall difference in load across all summer days between augmented and original A03 control group was determined to be statistically insignificant[17].

Table 3. Comparison of 2004 ADRS high consumption load impact before and after correcting for selection bias, kW

	Unadjusted (Dec 2004 report)	**Unadjusted w/ augmented control group**	**Adjusted w/ augmented control group (This report)**	**% difference**
Super Peak period, event days				
Control - ADRS	1.7	1.9	1.8	-5%
Control - A07	0.9	1.2	0.6	-50%
A07 - ADRS	0.8	0.7	1.2	+71%
Peak period, non-event days				
Control - ADRS	0.87	0.95	0.86	-10%
Control - A07	0.37	0.46	0.31	-33%
A07 - ADRS	0.50	0.49	0.54	+10%

The effect of applying the adjustments was that the high consumption ADRS load reduction relative to (augmented) control group statewide decreased slightly by 5% during the Super Peak period, down from 1.93 kW or 9.65 kWh prior to the adjustment (Table 3). Similarly on non-event days, high consumption ADRS load reduction decreased 10% during peak periods, down from 0.95 kW or 4.75 kWh prior to applying the adjustment.

Relative to A07 customers, ADRS high consumption customers statewide load reductions were 0.7 kW and 3.5 kWh prior to applying the adjustment, during Super Peak periods. With the adjustment, load reductions on event days improved 71%. On non-event days, ADRS load reduction relative to A07 customers improved 10% from the unadjusted performance of 0.49 kW and 2.45 kWh during peak periods.

As a result of applying the adjustment, A07 customer load savings relative to the control group declined 50% to 0.6 kW or 3.0 kWh, down from 1.2 kW or 6.0 kWh during Super Peak period in 2004. Similarly on non-event days, A07 high consumption load reductions declined 33% relative to control group, down from 0.46 kW or 2.3 kWh prior to applying the adjustment.

2.1.2 Reconciliation of RMI reported A07 load reductions with results reported by CRA and the CEC

Table 4 summarizes the A07 load impact results based on CRA's and CEC's independent analyses of the SPP program for climate zone 3 customers in summer 2004. The table compares the CRA and CEC results against RMI's results for the A07 customer load reductions relative to a control group reported in RMI's December 2004 report and the restatement of the ADRS summer 2004 results in this report. Note that CEC and RMI used a straight difference of

[17] The two-sided test of significance for the difference in the augmented and A03 groups across all summer days in 2004 produced a p-value of 0.63 indicating a probability of 63% (high) that the difference is due to random chance.

difference approach while CRA used a difference of differences approach based on regression models built from pre-treatment data, treatment data, and household surveys. Details of RMI's confirmation of A07 selection bias and investigation into ADRS selection bias are included in the appendix to this document.

Table 4. Comparison of CRA and CEC's control-A07 results for climate zone 3 SPP participants

Event Weekdays Peak Period Comparison (Climate Zone 3)			
	Zone 3 CPP Change (kW)	Savings (kWh)	% Reduction
CRA[1]	0.22	1.1*	13.37%
CEC[2]	0.30	1.5	16%
RMI Dec 2004[3]	0.94	4.7	28%
RMI Mar 2005[4]	0.60	3.0	17%
Non-event Weekday Peak Period Comparison (Climate Zone 3)			
	Zone 3 CPP Change (kW)	Savings (kWh)	% Reduction
CRA[1]	0.08	0.4*	5.59%
CEC[2]	0.11	0.6	8.5%
RMI Dec 2004[3]	0.37	1.8	15%
RMI Mar 2005[4]	0.31	1.6	12%

* RMI calculation
[1]Charles River Associates (CRA), *Statewide Pricing Pilot Summer 2003 Impact Analysis* Final Report October 11, 2004. p. 7
[2]Pat McAuliffe and Arthur Rosenfeld, *Response of Residential Customers to Critical Peak Pricing and Time-of-Use Rates During 2003 and 2004.* January 17, 2005. September 23, 2004. p. 4
[3]RMI, 2004 ADRS Load Impact Final Report
[3]RMI, ADRS 2005 Summer Load Impact Final Report

Table 4 shows that RMI's reported results in this report for A07 load reductions on event days matches the results reported by the CEC and is similar to the results reported by CRA on a percentage basis. Both RMI and CEC arrived at an A07 percentage load reduction on event days of 16%, while CRA reported 13%. On non-event days, RMI's measured A07 load impact compared to control is 12%, reduced from results reported in December 2004. This result is significantly larger than results reported by CRA and CEC.

The residual differences in load impact results in Table 4 between CRA, the CEC, and RMI are due to the different control home samples and slight differences in the A07 homes evaluated in each study. The homes evaluated by CRA and CEC for the SPP program include both single and multifamily homes in climate zone 3, who may or may not have central air conditioning. The homes RMI evaluated for the ADRS pilot is the subset of the SPP control and participant homes, consisting only of single family homes with central air conditioning in climate zone 3.

Furthermore RMI's results in Table 4 consist only of high consumption homes, whose average daily consumption is greater than 24 kWh, while results reported for CRA and CEC include both high and low consumption homes. As stated in the Introduction section of this report, RMI's restatement of ADRS summer 2004 results includes an augmented population of control homes in climate zone 3 that was not used for the SPP program evaluated by CRA and the CEC.

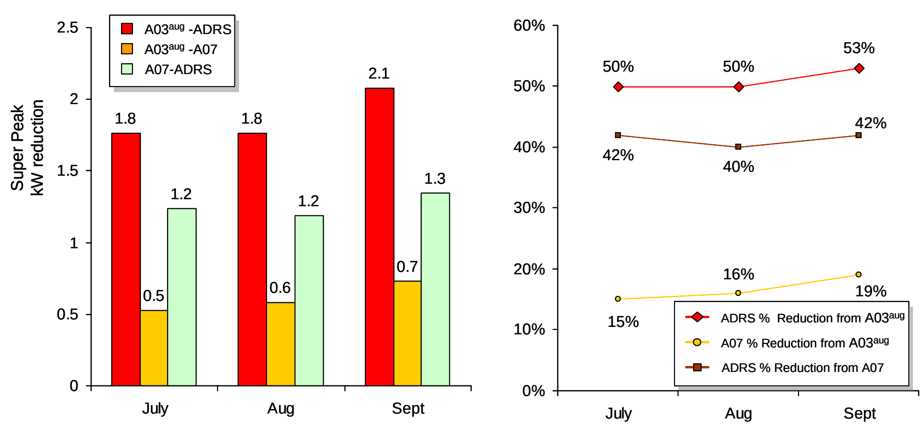
2.1.3 Statewide Monthly performance

Statewide monthly performance of ADRS homes varied little from the summer average (Figure 33). ADRS high consumption load reductions in July and August are equal to the summer average of 1.8 kW or 9 kWh during Super Peak periods on event days. This translates to a 50% savings in July and August. September was strongest performing month of the summer, with ADRS homes reducing load by more than 2 kW on average or 53% during Super Peak periods, compared to control homes.

Statewide monthly load reductions of ADRS homes relative to A07 homes were also similar to the summer average. July, August and September savings were 1.2 kW, 1.2 kW, and 1.3 kW, respectively, with September the strongest performing month of the summer. This translates to 42%, 40%, and 42% reduction in July, August, and September, respectively, compared to A07 homes.

Finally, load reduction of high consumption A07 homes relative to control homes was 0.5 kW in July, 0.6 kW in August and 0.8 kW in September, after adjusting for selection bias. This translates to 15%, 16%, and 19% load reduction in July, August, and September, respectively.

Figure 33: Average reduction in Super Peak load, high consumption homes statewide



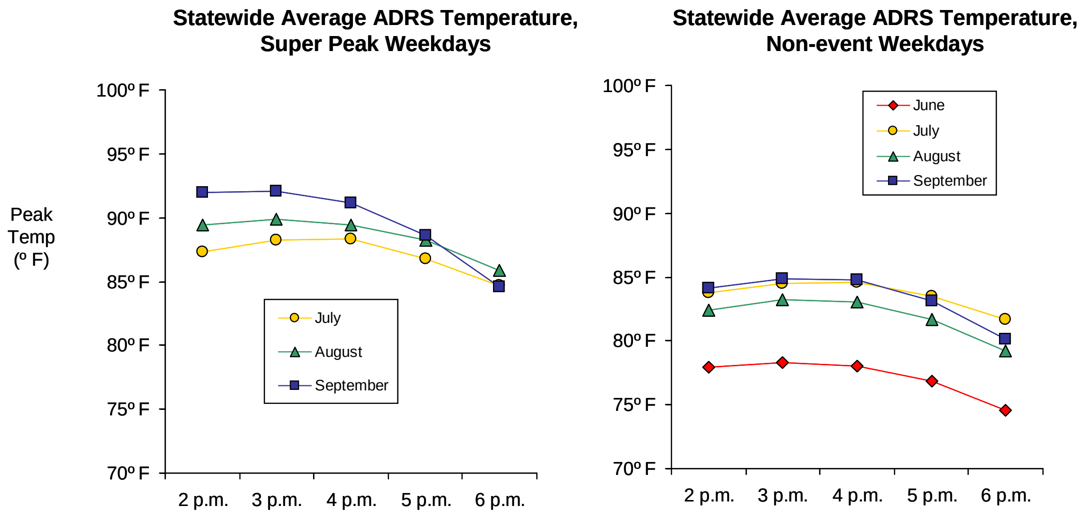
2.1.4 2004 Statewide temperatures

Statewide, temperatures during Super Peak period on event days were hotter than corresponding periods on non-event days[18] (Figure 34). September was the warmest month, with event day temperatures reaching to 92°F on average across the three utility service territories statewide. Event days called in July experienced the coolest temperatures statewide, with temperatures reaching to 88°F by 4 p.m. Super Peak period hourly temperature variations exhibited similar

[18] A total of 15 event days were called during summer 2004. In general, event days were called on the basis of weekly weather forecasts, when temperatures are expected to reach summer season highs. On these hottest of summer days, air conditioning loads are high and stress on the electric power system is relieved when customers curtail their energy consumption, as in the case of ADRS pilot participants.

patterns between months, with temperatures reaching a maximum at 4 p.m. and dropping by 5 degrees by 6 p.m. Statewide, ADRS homes in September experienced the greatest variation in temperature across the Super Peak period, cooling down to 84^{o}F by 6 p.m. from a high of 92^{o}F at 3 p.m.

Figure 34: 2004 Statewide high consumption ADRS temperatures



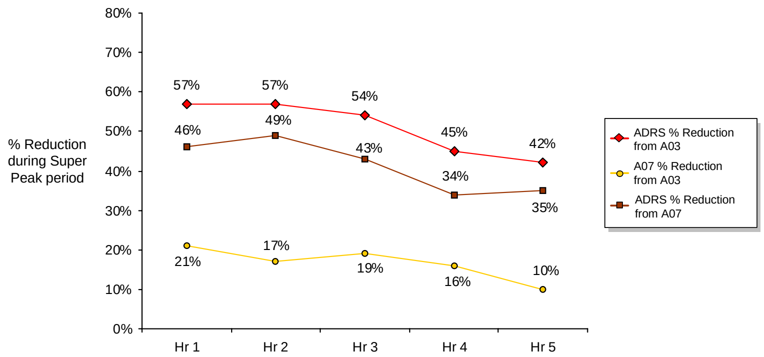
On non-event days, September was again the warmest month overall. Temperatures across the three utility service territories reached an average high of 85^{o}F at 3 p.m. July was also relatively warm month for non-event days, with temperatures reaching 84.5^{o}F by 3 p.m. Hourly temperatures on non-event days follow a similar pattern as for event days, with temperatures peaking at 3 p.m. or 4 p.m. and cooling off substantially by 6 p.m.

2.1.5 Statewide Super Peak period hourly load reductions, high consumption homes

On event days, high consumption ADRS homes reduced the most load during the first three hours of the Super Peak period. Averaged across the summer, ADRS load reductions from 2 p.m. to 4 p.m. was 57%, 57%, and 54%, respectively, compared to control homes (Figure 35). Load reductions during the last two hours of the Super Peak period on event days were lower but still substantial, and ADRS homes statewide achieved average reductions of 45% and 42% relative to control homes at 5 p.m and 6 p.m., respectively.

Compared to A07 customers on dynamic critical peak pricing rates but without ADRS technology, high consumption ADRS customers reduced load consistently between 43% and 46% during the first three hours of Super Peak period, on average. Like the ADRS load reduction relative to control group, savings decline during the last two hours of the Super Peak period. Thus at 5 p.m., ADRS reduced load by 34% compared to A07 customers and at 6 p.m., ADRS customers reduced load by 35%. The slight rebound in ADRS savings at 6 p.m. is a consequence of the A07 behavior during that hour resulting in just 10% load reduction relative to control. It is likely that A07 customers ramped up their use of air conditioning at the last hour of the peak period at 6 p.m. due to the hot weather, thereby reducing their load savings relative to control homes.

Figure 35: ADRS vs. control: statewide percent reduction in Super Peak period load



On event days, high consumption A07 customers reduced load relative to control consistently by 21%, 17%, and 19% during the first three hours of the Super Peak period. A07 load reductions decline steadily during the fourth and fifth hours (5 p.m. and 6 p.m.), to 16% and 10%, respectively. During the last hour, A07 load reductions relative to control customers decline dramatically to 10%, half the reduction of the first hour at 2 p.m. It is likely that A07 customers ramped up their use of air conditioning at the last hour of the Super Peak period at 6 p.m. due to the hot weather, thereby reducing their load savings relative to control homes.

2.1.6 Super Peak reductions by event day, statewide high consumption homes

Figure 36 and Figure 37 plot the Super Peak period performance of high consumption ADRS homes relative to control homes on each event day in the summer of 2004. Figure 36 reports the ADRS savings in kW and Figure 37 reports the savings as a percentage reduction of the control load. In both figures, a secondary axis plots the average peak temperature for ADRS homes on that event day.

Figure 36: Statewide average reduction in ADRS Super Peak period load relative to control homes

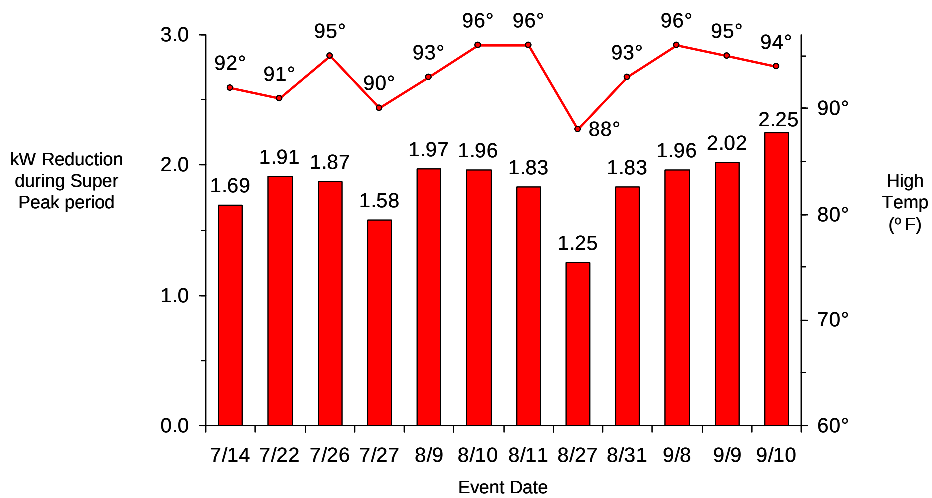
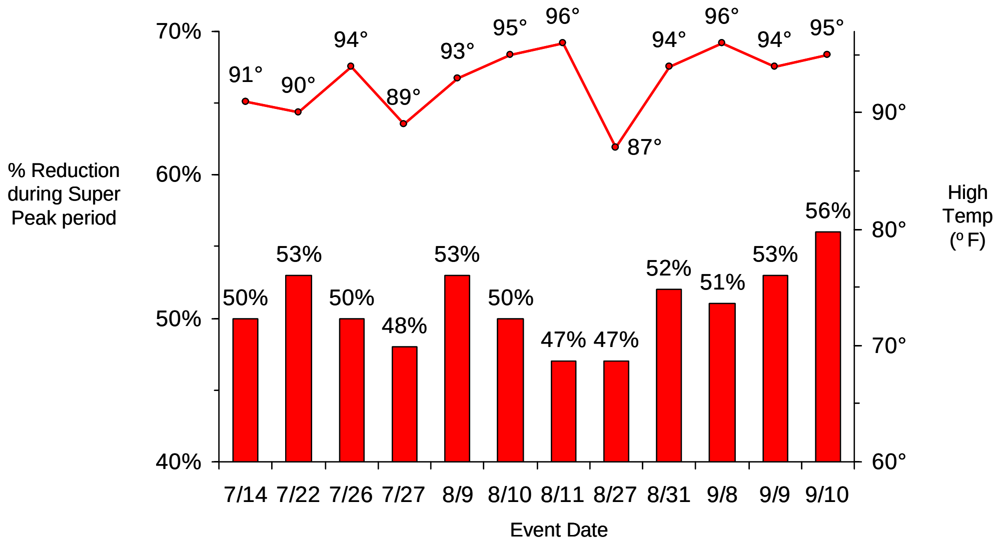


Figure 37: Statewide percent reduction in ADRS Super Peak period load relative to control homes



Statewide, high consumption ADRS homes reduced load by 1.6 kW to 2.25 kW on eleven of twelve Super Peak days called during 2004. Reductions were particularly strong in September, the hottest summer month in 2004, where ADRS load reductions exceeded 2 kW on two of three event days that month. This performance is particularly impressive given that September Super Peak events were consecutive days. High consumption ADRS load reductions fell below 1.6 kW during the Super Peak period on one event day, August 27th. Super Peak reduction was 1.25 kW on August 27th, which also the coolest event day of the year.

On a percentage basis, high consumption ADRS homes reduced load by 50% to 56% on nine of twelve Super Peak days called during 2004, compared to control homes. Two of three event days where load reductions fell below 50% was August 27th, the coolest event day of the year, and July 27th, when average peak temperatures were also below 90°F statewide. Savings on August 11th event day were 47% even though temperatures averaged 96°F statewide. August 11th was the third consecutive event day of steadily increasing temperatures, and control customer loads were also higher as well, resulting in the lower percentage reduction result. On that day, absolute ADRS load reduction relative to control homes was 1.83 kW, a strong statewide performance in spite of the hot weather.

Figure 38 and Figure 39 plot the Super Peak period performance of high consumption ADRS homes relative to A07 homes on each event day in the summer of 2004. Figure 39 reports the ADRS savings in kW and Figure 39 reports the savings as a percentage reduction of the control load. In both figures, a secondary axis plots the average peak temperature for ADRS homes on that event day.

Figure 38: Average statewide reduction in ADRS Super Peak period load relative to A07 homes

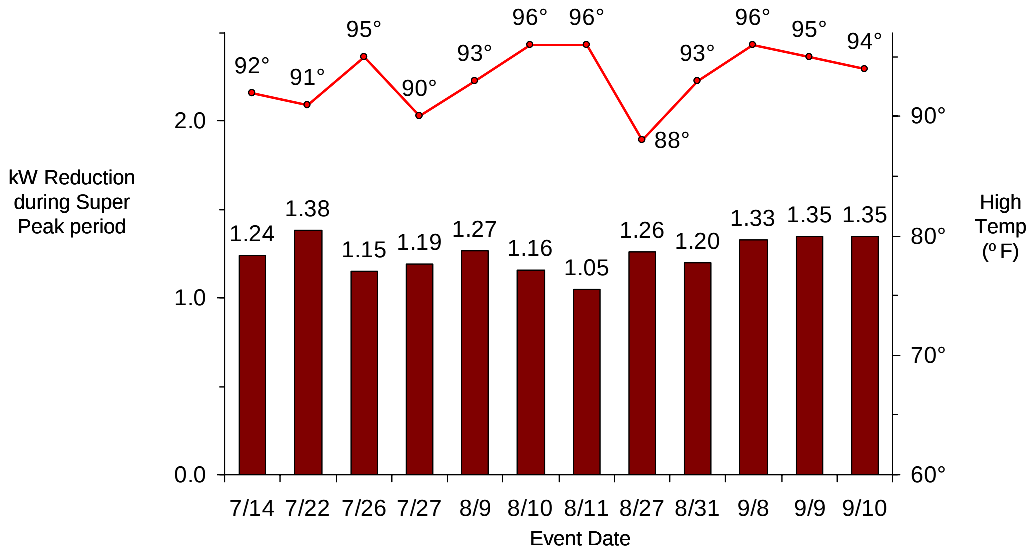
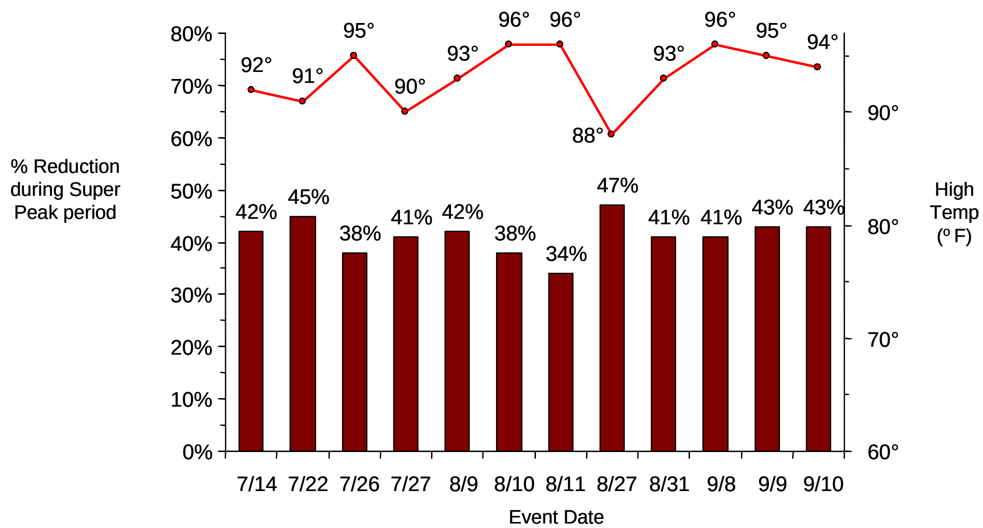
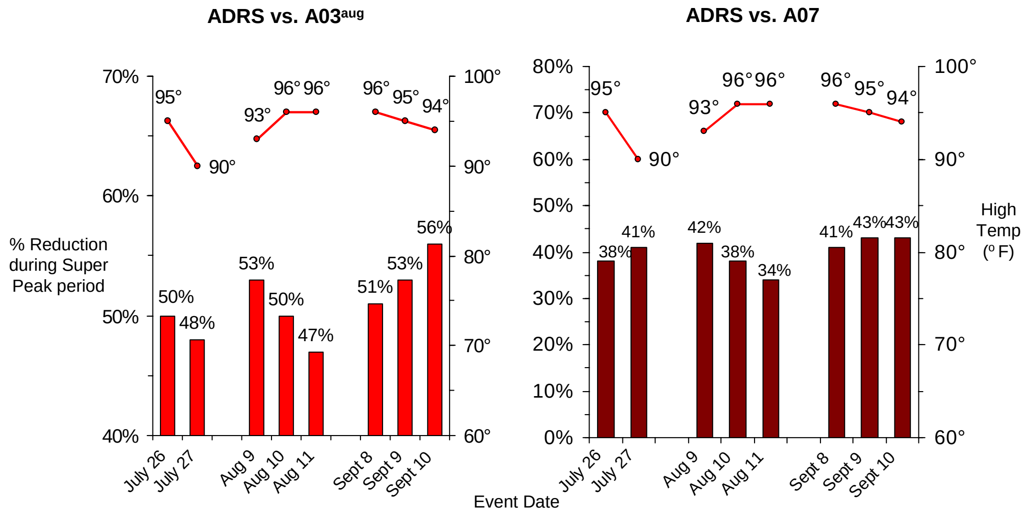


Figure 39: Statewide percent reduction in ADRS Super Peak period load relative to A07 homes



Statewide, high consumption ADRS homes reduced load by 1.1 kW to 1.4 kW relative to A07 homes on eleven of twelve Super Peak days called during 2004. On a percentage basis, ADRS homes reduced load by 41% to 47% relative to A07 homes on nine out of eleven event days. On three event days, ADRS homes reduced load on a percentage basis by 38%, 38%, and 34%, respectively, on July 26, August 10 and August 11. All of the three days are part of consecutive event days, where temperatures increased throughout each consecutive day. While absolute load reductions on those days are very reasonable, it is possible that percentage reductions are lower because the A07 loads increased as a result of warmer weather.

Figure 40 Consecutive event day performance statewide, high consumption ADRS homes compared to control (left) and high consumption ADRS homes compared to A07 homes (right)

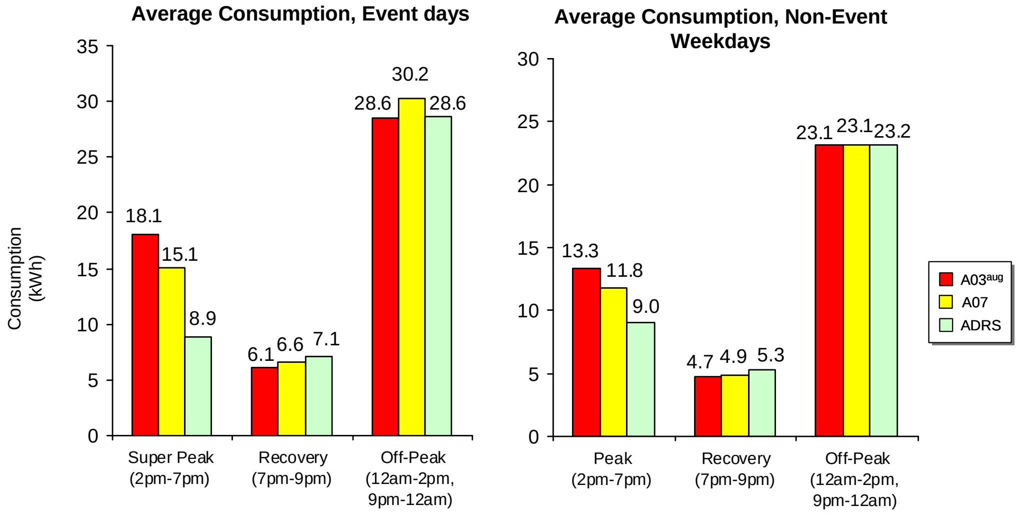


Super Peak period performance on consecutive event days varied both for ADRS load reductions compared to control homes and for ADRS load reductions compared to A07 homes (Figure 40). Compared to control homes, ADRS reductions declined on some consecutive event days (July 26th and 27th, August 9-11) while savings increased throughout other consecutive event days (September 8-10). Compared to A07 homes ADRS reductions also declined on some consecutive event days (August 9-11) but increased throughout other consecutive event days (July 26-27, September 8-10). The variations in performance however corresponded well with temperature variations across consecutive event days in each month.

Figure 41 shows the average energy consumption for ADRS and control homes during peak, recovery, and off-peak periods on event and non-event days. On event days, ADRS homes consumed 50% less energy than control customers and 41% less energy than A07 customers during Super Peak periods, on average, statewide. ADRS homes consumed 0.5 kWh or 8% more load than control and A07 customers during the recovery period on event days.

This reversal of consumption patterns during the recovery period corresponds to the post-peak period rebound, which is exhibited in the increase in ADRS load at 7 p.m. evident in Figure 31 and Figure 32. At the end of the Super Peak period, the thermostats in ADRS homes are automatically reset from their warmer Super Peak setting to their cooler off-peak setting. This results in a sudden jump in load at 7 p.m. as air conditioners suddenly turn on to meet the cooler set point. ADRS homes consume just as much energy as control homes during the off-peak period, reflecting the similarity in off-peak loads.

Figure 41: Statewide average Consumption: event and non-event weekdays



ADRS consumption compared to control and A07 customers on non-event days exhibit similar patterns. ADRS homes' peak period consumption is substantially less than control and A07 customers, while ADRS consumption during the recovery period is slightly more than control and A07 customers. Control homes consume just as much energy as ADRS homes during off-peak periods, indicating similarity in loads during this period. A07 customers tend to consume marginally more energy than both control homes and ADRS homes during off-peak periods, on event days (1.6 kWh more) and just as much energy non-event days, indicating similarity in loads during this period.

Figure 42: Average daily consumption statewide: event (left) and non-event weekdays (right)

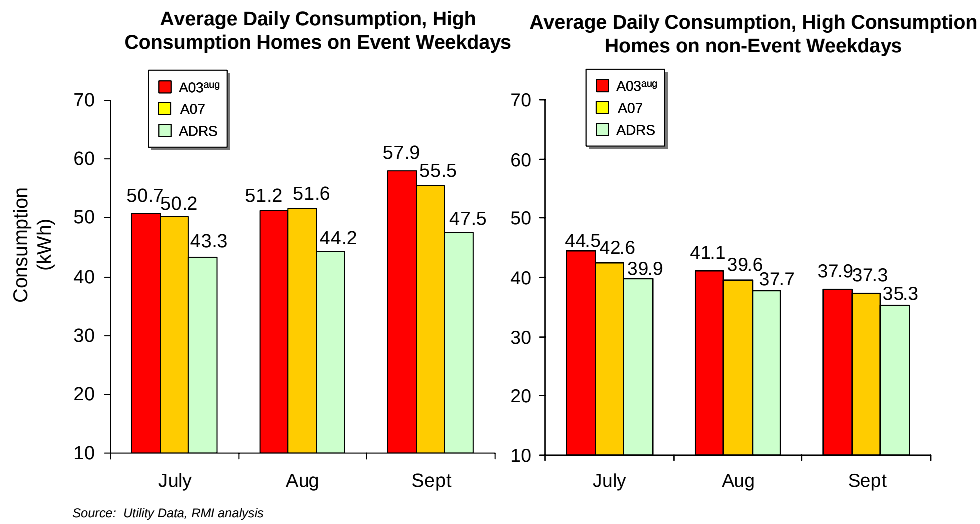


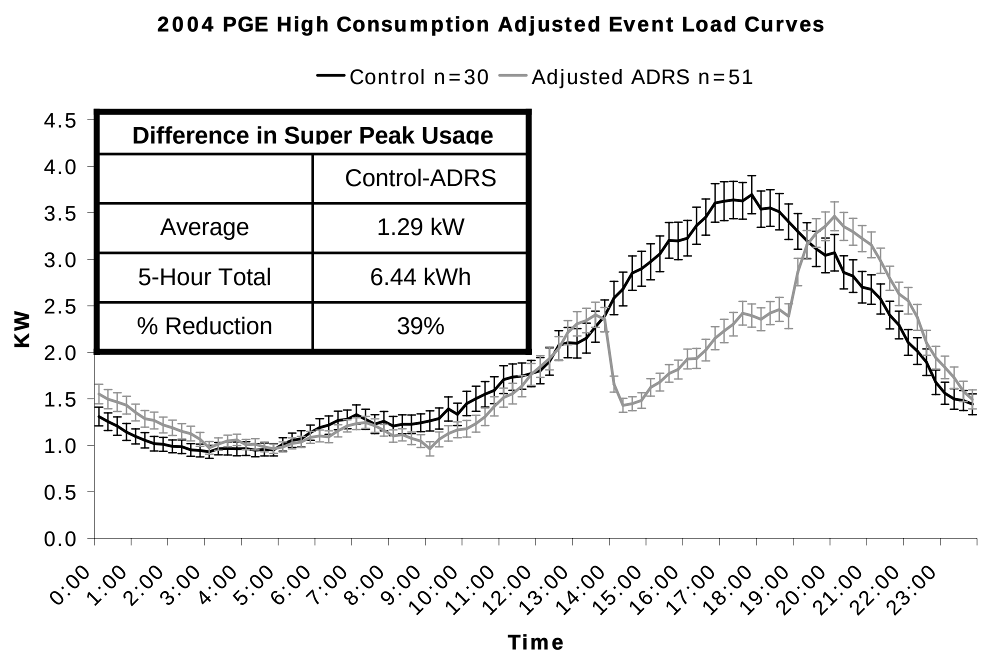
Figure 42 charts the average daily consumption by month for ADRS and control homes. Event days are shown on the left while non-event days are shown on the right. On event days, ADRS homes consistently consume 14% to 18% less energy than control and A07 homes, from July through September. From Figure 41 we observe that most of the difference in consumption comes from ADRS load reduction during the Super Peak period.

On non-event days, ADRS homes also consistently consume less than control and A07 homes. In July, ADRS homes consume an average of 10% less energy than control customers and 6% less energy than A07 customers. High consumption ADRS consumed 7% less energy than control customers and 5% less energy than A07 customers in September, the warmest month of the summer.

2.2 PG&E high consumption summer 2004 load impact analysis results

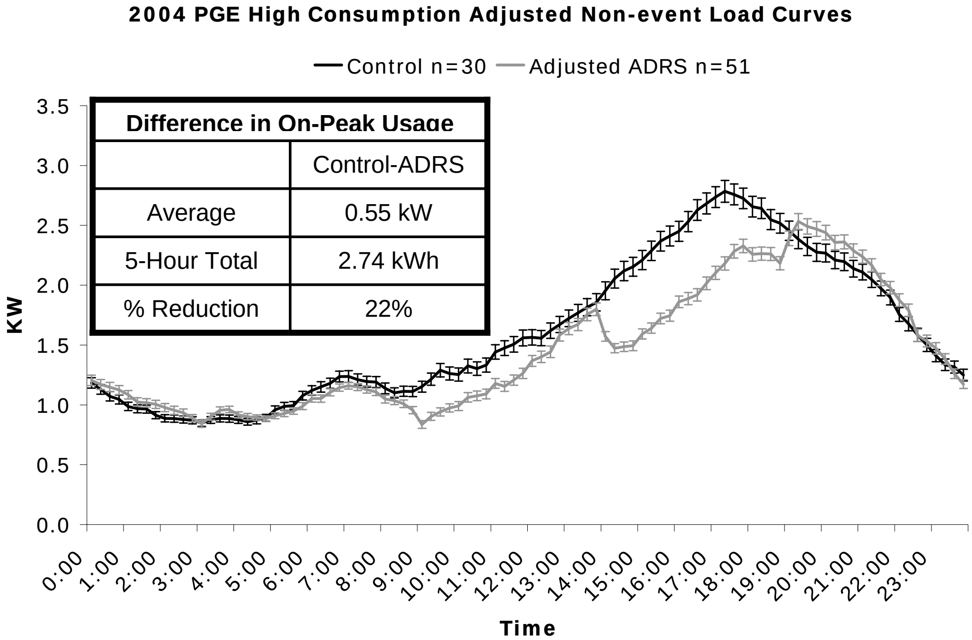
The average event day load curves for PG&E high consumption ADRS and control homes are represented in Figure 43. ADRS homes reduced Super Peak period consumption by an average of 6.4 kWh on event days during the summer of 2004. This equates to an average 1.3 kW load reduction compared to control homes. Overall Super Peak period consumption in ADRS homes was 39% lower than control customers' consumption. Ninety percent confidence intervals during the Super Peak period averaged ±0.20 kW for control homes and ±0.11 kW for ADRS homes[19].

Figure 43: PG&E high consumption event day load curves



[19]Confidence intervals were calculated for each 15-minute interval as described in Appendix A, of the essential companion document to this report, *Automated Demand Response System Pilot, 2005 Summer Load Impact Results and Comparison of 2005 with 2004 Summer Load Impact Results*. Super Peak period 90% confidence intervals ranged from ±0.18 kW to ±0.21 kW for control homes, and from ±0.08 kW to ±0.13 kW for ADRS homes.

Figure 44: PG&E high consumption non-event day load curves



On non-event days, ADRS homes reduced Super Peak period consumption by an average of 2.74 kWh, corresponding to a 0.55 kW and 22% average reduction in load compared to control homes (Figure 44). Ninety percent confidence intervals during the peak period averaged ±0.08 kW for control homes and ±0.04 kW for ADRS homes[20].

Figure 45: Average reduction in Super Peak period load, PG&E high consumption homes on event days

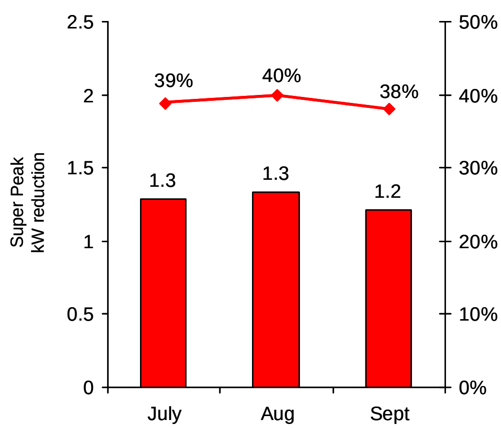
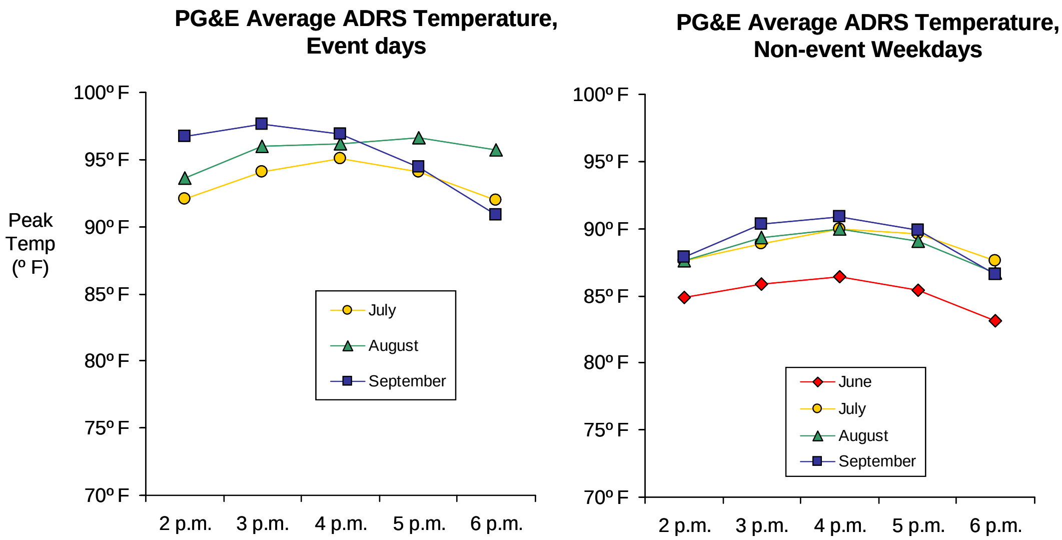


Figure 45 shows ADRS's event day peak period reduction in consumption from control for each summer month. Monthly load reductions for high consumption ADRS homes in PG&E territory

[20]Non-event peak period fifteen-minute 90% confidence intervals ranged from ±0.08 kW to ±0.09 kW for control homes, and from ±0.04 kW to ±0.06 kW for ADRS homes.

varied little from the summer average. Load reductions in July and August are equal to the summer average of 1.3 kW or 6.5 kWh during Super Peak periods on event days. This translates to a 39% and 40% savings in July and August. September reductions were slightly lower, with ADRS homes reducing load by 1.2 kW on average or 38% during Super Peak periods, compared to control homes.

Figure 46: PG&E Average ADRS temperature, event days (left) and non-event weekdays (right)



Hourly average temperatures for PG&E high consumption ADRS homes are illustrated in Figure 46. The left chart displays the Super Peak period temperature averages for each summer month and the right chart displays the average non-event weekday peak period temperature.

Event day average temperatures in PG&E territory are universally higher than non-event day averages. September event days had the hottest peak temperatures, with Super Peak hourly temperatures averaging between 91°F and 98°F. Note the steep drop in temperature for September from 2 p.m. to 6 p.m. Event days called in August averaged between 94°F and 97°F across the Super Peak hours. Unlike September and July, hourly peak temperatures in August remained relatively consistent across the Super Peak period. July event days were also relatively warm, averaging between 92°F and 95°F during Super Peak hours. Super Peak period temperatures in July peaked at 4 p.m. and cooled off by 6 p.m.

For non-event days, June was the coolest month for ADRS customers in PG&E territory, with an average peak afternoon temperature of 86°F. September exhibited the hottest peak period temperatures, reaching a maximum of 91°F at 4 p.m. July and August peak period temperatures were only slightly cooler than September with temperatures peaking at 90°F at 4 p.m.

Figure 47: Average ADRS percent reduction in Super Peak period load for all event weekdays, PG&E high consumption homes

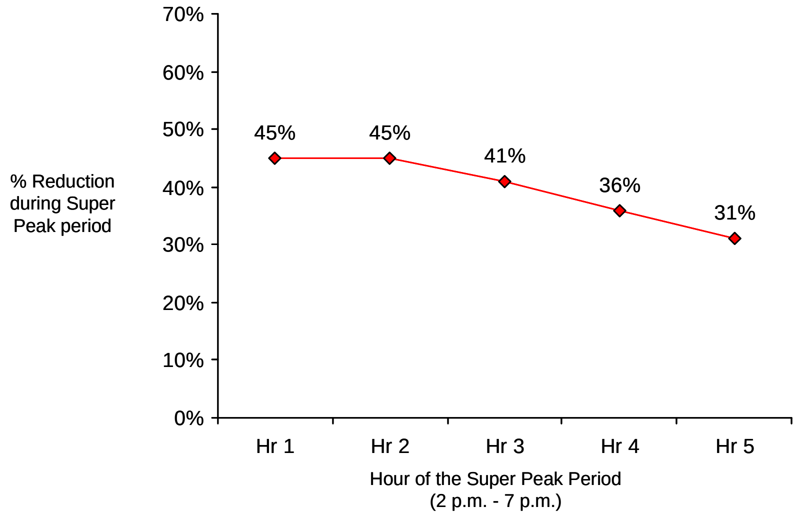


Figure 47 shows the hourly percentage savings of ADRS homes from control homes during the Super Peak period. The percentage reduction at 2 p.m. is 45% relative to control customers, but steadily decreases to 31% at 6 p.m. Referring to the load curves in Figure 43, ADRS load drops at the start of the Super Peak period then increases at the same rate as control load until about 4 p.m., when control load peaks, corresponding to outside temperatures. As control load begins to fall after 4 p.m. as outside temperatures also begin to cool, ADRS load continues to climb, as homes heat up to higher thermostat set points and begin to cycle back on. This results in progressively smaller ADRS savings over the latter hours of the Super Peak period. This behavior in the two groups explains the decline in ADRS load reductions relative to control homes across the Super Peak period.

Figure 48: Average ADRS reduction in Super Peak period load relative to control homes, PG&E high consumption homes

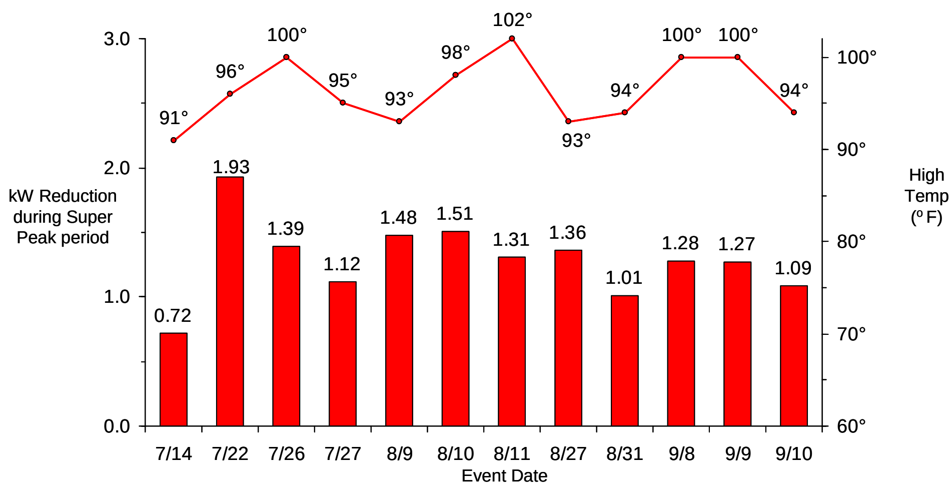


Figure 49: Average ADRS percent reduction in Super Peak period load relative to control homes, PG&E high consumption homes

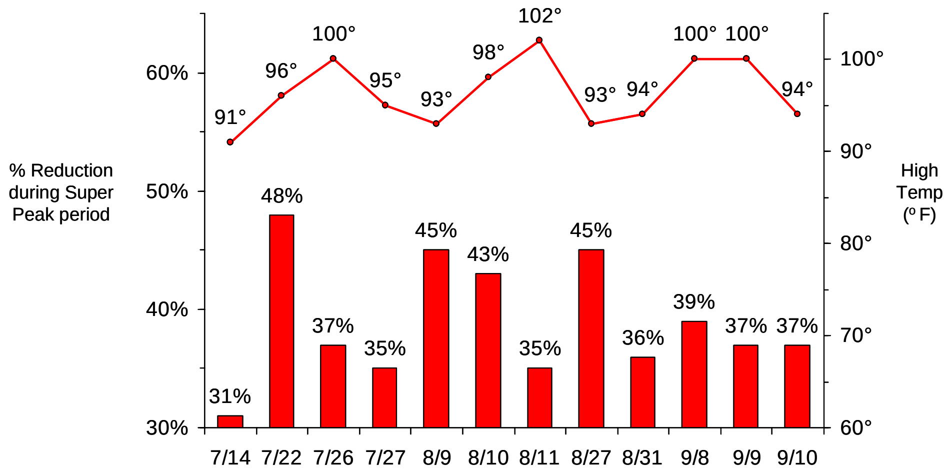


Figure 48 and Figure 49 plot the Super Peak period performance of high consumption ADRS homes in PG&E territory relative to control homes on each event day in the summer of 2004. Figure 48 represents the ADRS savings in kW and Figure 49 represents the savings as a percentage of the control Super Peak period consumption. Both figures plot the average ADRS peak temperature for each event day on a secondary axis.

On a kW basis, the smallest savings occur on the first event day, July 14th, which corresponds as the coolest of all event days at 91° F. The largest savings of 1.93 kW occur on July 22nd, the warmest of the non-consecutive event days of the summer. For the rest of summer 2004 events, the savings fall within a range of 1.1 kW savings and 1.5 kW with the temperature ranging between 93° F and 100° F.

On a percentage basis, PG&E high consumption ADRS load reductions varied across the event days. On most event day, ADRS savings ranged from 35% to 39% in load reduction relative to control homes. Although ADRS homes achieved 45% to 48% reduction on four event days in July and August, these four days were not the hottest days in the summer. The hottest event day in PG&E service territory occurred on August 11th, with peak temperatures reaching 102°F. August 11th was also the third day of consecutive event days in August. On that day, absolute ADRS load reduction relative to control homes was 1.31 kW, a very strong performance in light of the extremely hot weather.

ADRS savings over consecutive event days are displayed in Figure 50. Average maximum daily temperatures are also plotted on the secondary axis. Generally, consecutive event days all produce a small decrease in savings for high consumption ADRS homes in PG&E service territory.

With respect to temperature, there does not appear to be any consistent pattern with regards to consecutive event days. All three consecutive event day periods indicate a similar small decrease in savings in spite of increasing temperature over some days (August 9^{th} through 11^{th}) and decreasing temperature on others (July 26^{th}-27^{th} and September 8^{th} through 10^{th}).

Figure 50: Average ADRS percent reduction in Super Peak period load relative to control homes ("$A03^{aug}$") on consecutive event days, PG&E high consumption homes

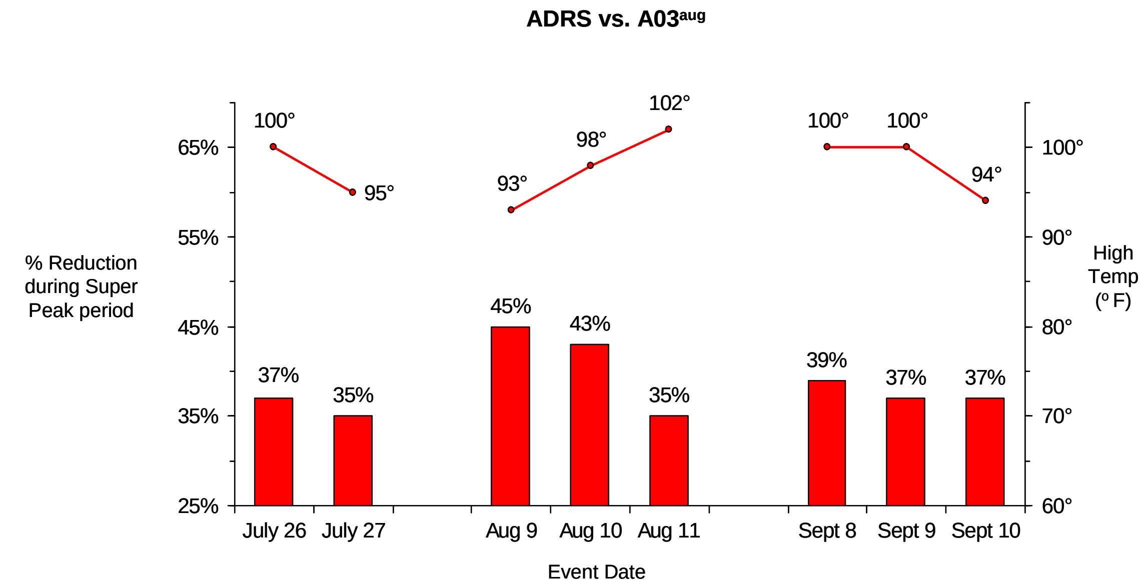


Figure 51: Average consumption, PG&E high consumption ADRS and control homes ("$A03^{aug}$"), event (left) and non-event (right) weekdays

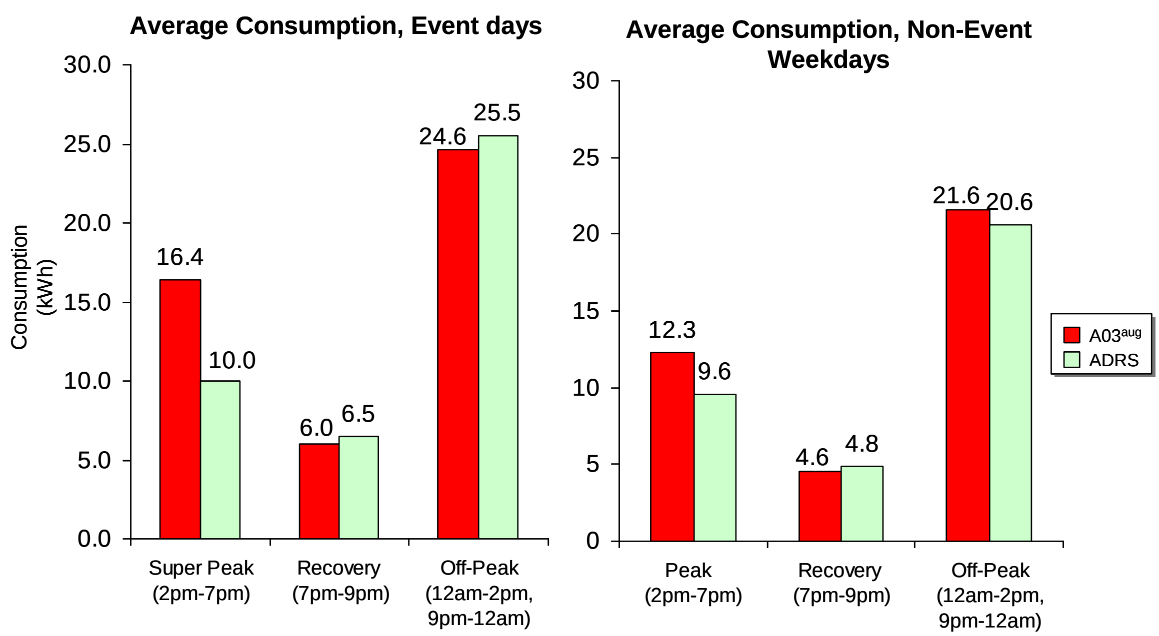


Figure 51 shows the average energy consumption for ADRS and control homes during peak, recovery, and off-peak periods on event and non-event days. On event days, ADRS homes consume 6.4 kWh less energy than control customers during the Super Peak periods. ADRS homes consume marginally more load (0.5 kWh or 8% of peak period savings) during the recovery period. This reversal of consumption patterns during the recovery period corresponds to the post-peak period rebound in consumption in the ADRS homes, which is exhibited in the increase in ADRS load at 7 p.m. At the end of the Super Peak period, the thermostats in ADRS homes are automatically reset from their warmer Super Peak setting to their cooler off-peak setting. This results in a sudden jump in load at 7 p.m. as all the air conditioners suddenly turn on to meet the new, cooler set point. ADRS homes consume marginally more energy than control homes (1 kWh) during the off-peak period, reflecting the similarity in off-peak loads.

Non-event weekday consumption for PG&E high consumption homes exhibit a similar pattern. ADRS homes' peak period consumption is substantially less than control homes (by 22%), while ADRS recovery consumption is slightly more than control homes'. Control homes consume marginally more than ADRS homes during off-peak periods (1 kWh), indicating similarity in loads during this period.

Figure 52:Average daily consumption, PG&E high consumption ADRS and control homes on event (left) and non-event (right) weekdays

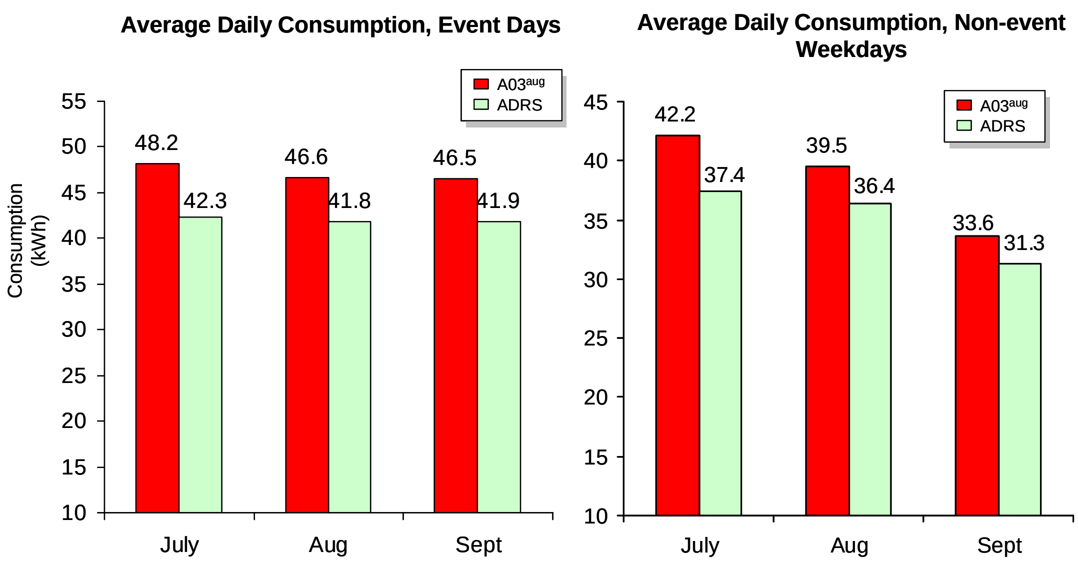


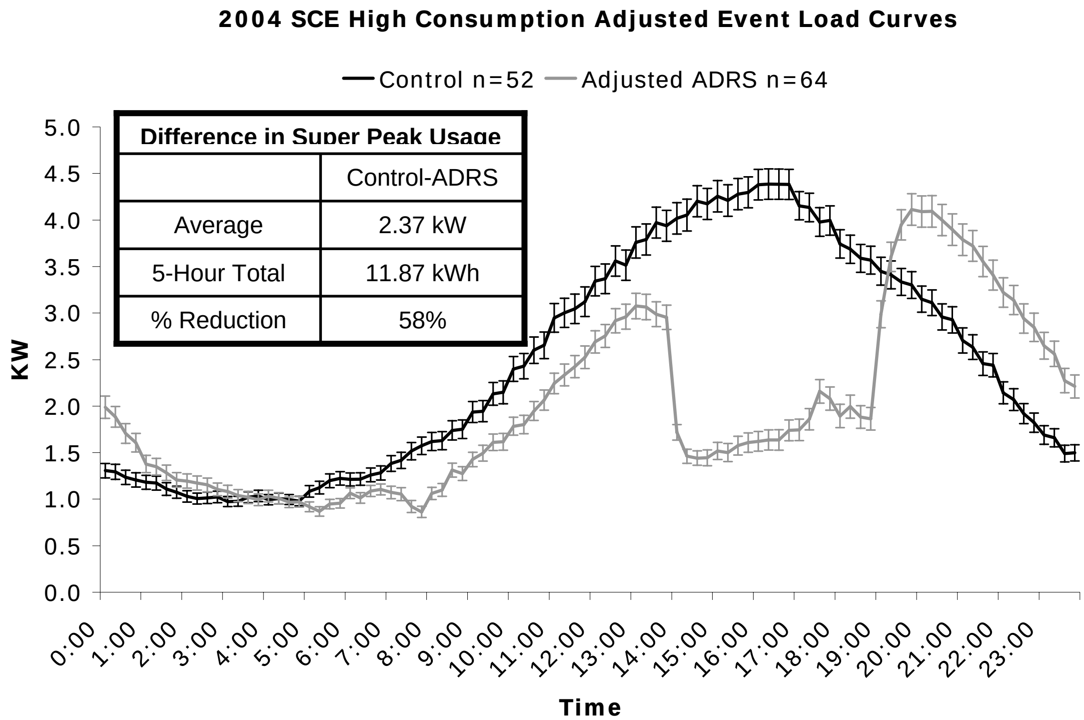
Figure 52 plots the average daily consumption by month for ADRS and control homes. Event days are shown on the left while non-event days are shown on the right. On event days, control homes consistently consume about 5-6 kWh more than ADRS homes. This difference in average daily consumption comes mainly from the ~6 kWh consumption difference between control and ADRS during the Super Peak period shown in Figure 51. The kWh difference in average daily usage on event days between ADRS and control customers varies little across summer months.

On non-event days, ADRS homes again consistently consume less than control homes. In July, ADRS homes consume an average of 4.8 kWh less than control homes, which declines to a difference of 2.3 kWh in September. Thus, the average difference in average daily consumption between ADRS and control homes is about 3 kWh.

2.3 SCE high consumption summer 2004 load impact analysis results

In Figure 53, SCE high consumption ADRS and control load curves are plotted, averaged across event days. ADRS homes in SCE territory reduce Super Peak consumption by an average of 11.87 kWh over the Super Peak period compared to control homes. This represents an average 2.37 kW or 58% reduction on event days. Ninety percent confidence intervals during the Super Peak period averaged ±0.16 kW for control homes and ±0.11 kW for ADRS homes[21].

Figure 53: 2004 SCE high consumption event day load curves



On non-event days, ADRS homes reduced load by an average of 1.12 kW compared to control customers (Figure 54). This corresponds to 38% savings, on average. Ninety percent confidence intervals during the peak period averaged ±0.07 kW for control homes and ±0.05 kW for ADRS homes[22].

[21] Super peak period fifteen-minute 90% confidence intervals ranged from ±0.15 kW to ±0.17 kW for control homes, and from ±0.08 kW to ±0.13 kW for ADRS homes.

[22] Non-event peak period fifteen-minute 90% confidence intervals ranged from ±0.06 kW to ±0.07 kW for control homes, and from ±0.04 kW to ±0.07 kW for ADRS homes.

Figure 54: SCE high consumption non-event day load curves

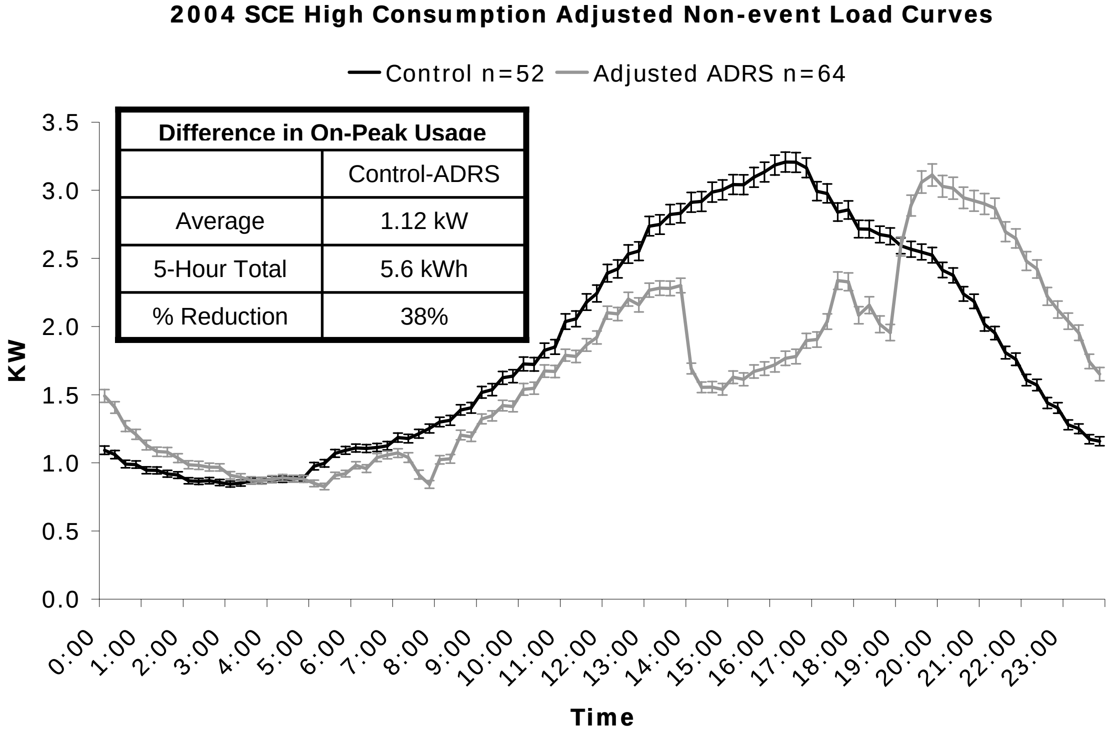
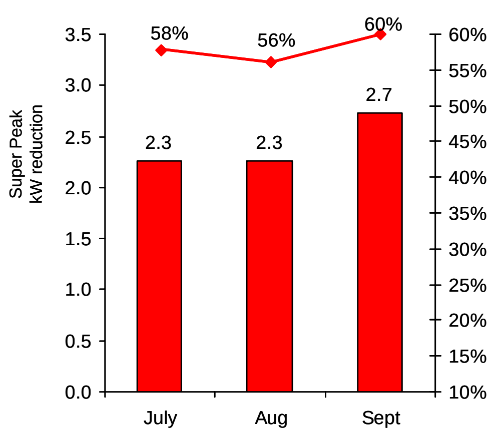
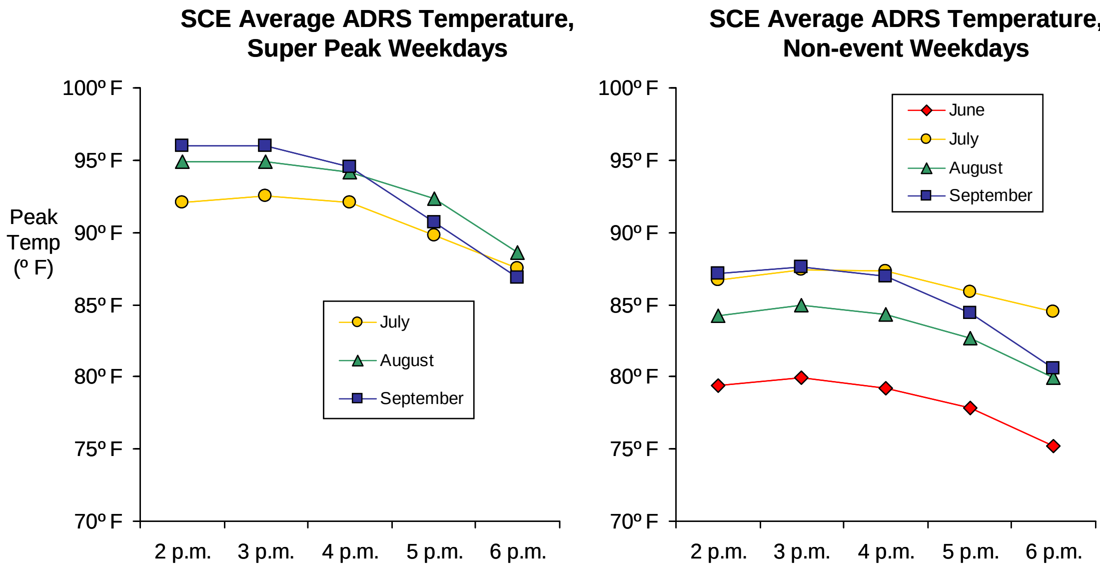


Figure 55:Average ADRS reduction in Super Peak period load, SCE high consumption homes on event days



Super Peak period savings for SCE high consumption ADRS homes are also consistent across the summer months (Figure 55). ADRS load reduction relative to control customers during July and August are the same (2.3 kW) and have roughly the same percentage savings (58% and 56% for July and August, respectively). SCE ADRS homes performance in September was the strongest, with Super Peak period savings of 2.7 kW or 60% relative to control homes.

Figure 56: Average SCE ADRS temperatures, non-event and event weekdays



Hourly temperatures for SCE ADRS homes during Super Peak periods (left chart in Figure 56) were generally hotter than peak period temperatures on non-event days. Super Peak period temperatures never dropped below 87°F while on non-event days, temperatures never exceeded 87°F, on average. Super Peak temperatures on event days followed a similar pattern across July, August, and September. Temperatures peaked at 3 p.m. and fell off substantially by 6 p.m. Super Peak period temperatures during September were both the hottest and the coolest that ADRS homes in SCE territory experienced, peaking at 96°F at 3 p.m. and falling to 86.9°F at 6 p.m., a ten-degree difference. July was the coolest month across Super Peak hours, varying from 92.5°F at 3 p.m. to 87.5°F at 6 p.m.

Non-event day peak period temperatures showed more variability between months than event days. June was the coolest month on average for peak period temperatures. June's average hourly temperature peaked at 80°F and declined to 75°F. August was the next coolest month for non-event peak period temperatures, varying from 85°F to 80°F. September and July featured some of the highest average peak period temperatures for non-event days. These ranged from 87.4°F to 84.5°F for July. September had similar peak temperatures to July's, but declined more steeply after 4 p.m. September's temperatures peaked at 87.6°F and cooled to 80.6°F by 6 p.m.

Figure 57: Average percent reduction in ADRS Super Peak period load for all summer events, SCE high consumption homes

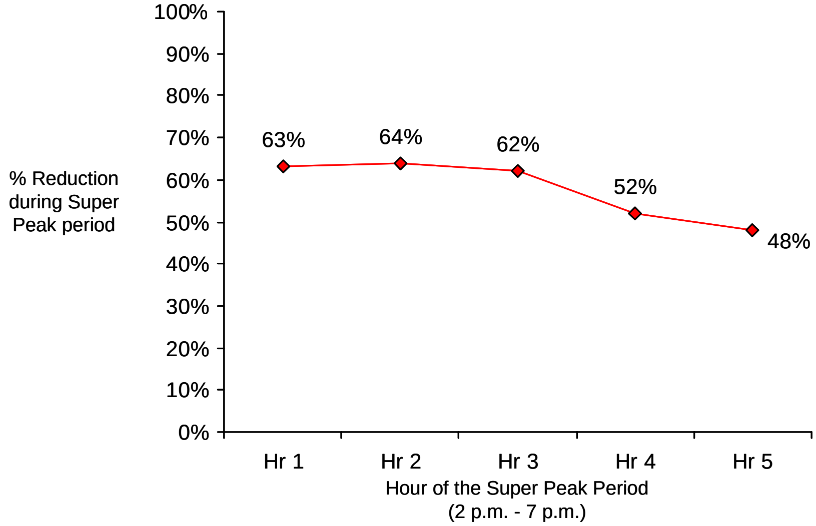


Figure 57 charts the average percent reduction of ADRS load relative to control customers for each hour during Super Peak periods. Savings were substantial and consistent during the first three hours of the Super Peak period, varying between 64% and 62% from 2 p.m. to 4 p.m. and declined slightly to 48% by the last hour. Lower savings during the last two hours of the Super Peak period can be explained by an examination of the event day load curves in Figure 53. Control load peaks at 5 p.m. while ADRS load rises steadily throughout the peak period after a large initial drop at 2 p.m. Thus, with control load declining and ADRS load still increasing after 5 p.m., ADRS savings relative to control customers decline.

Figure 58:Average ADRS reduction in Super Peak period load relative to control homes, SCE high consumption homes

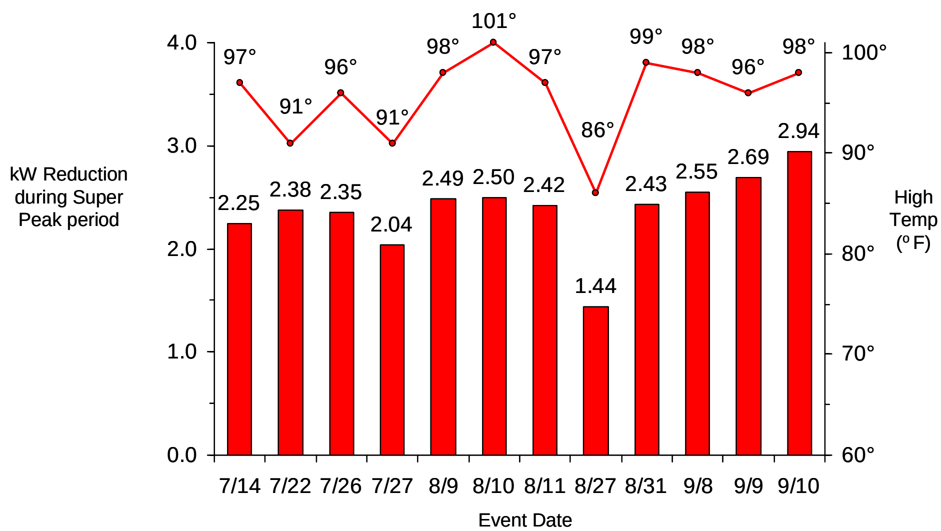


Figure 59:Average ADRS percent reduction in Super Peak period load relative to control homes, SCE high consumption homes

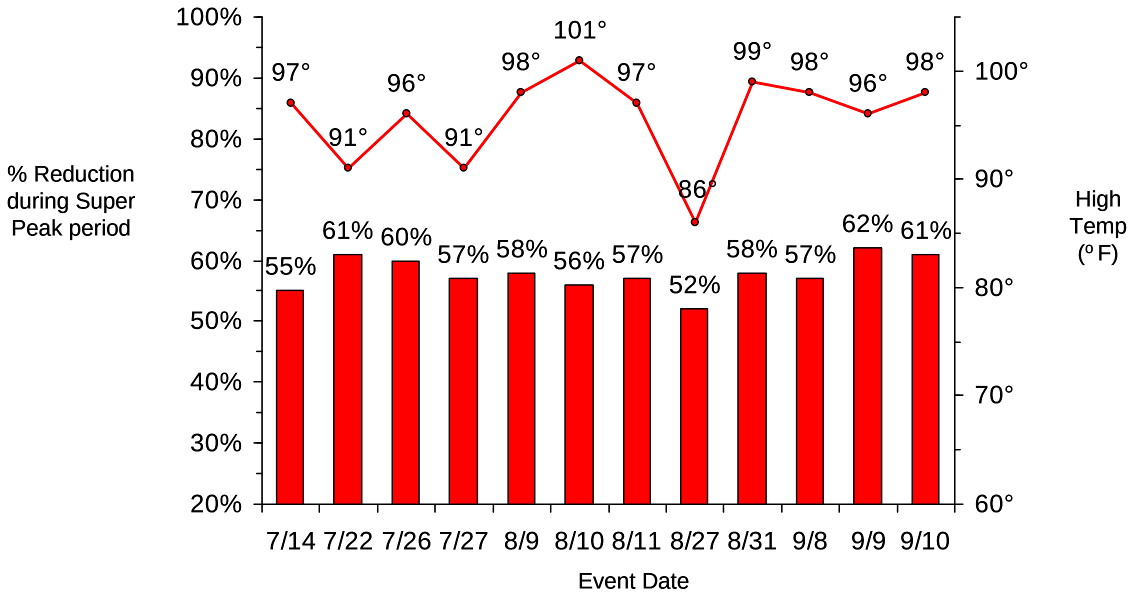


Figure 58 and Figure 59 graph Super Peak period performance of ADRS homes relative to control for each event day in 2004. Figure 58 shows the savings in terms of actual load drop and Figure 59 shows ADRS load reductions as a percentage of control customers' consumption. Average ADRS homes' peak temperature is plotted on the secondary axis for each in both figures.

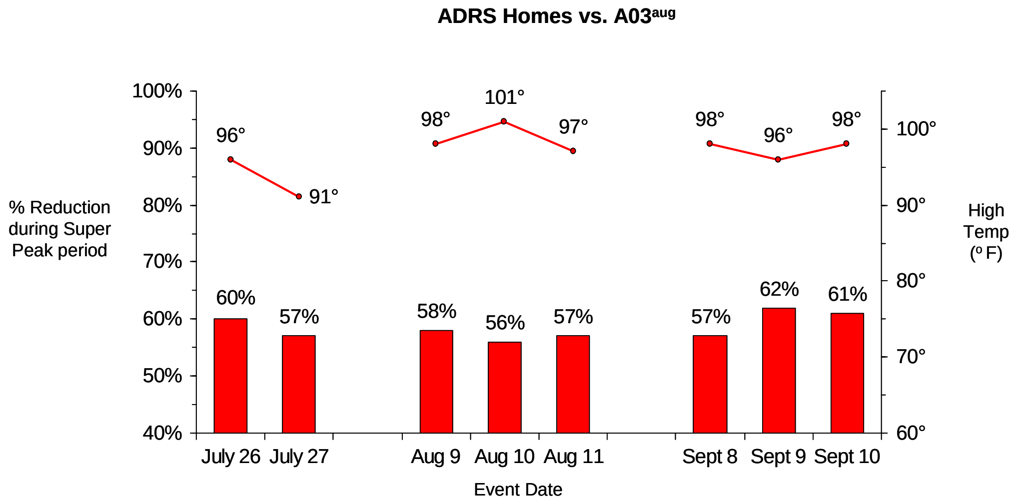
SCE ADRS high consumption customers consistently reduced load by more than 2 kW on almost all event days during summer 2004. One exception is Super Peak period savings on August 27th at 1.44 kW, which was also the coolest event day, with an average peak period temperature of 86°F in SCE territory. The highest savings of 2.94 kW occurred on September 10th. The high reduction is particularly remarkable in light of the fact that September 10th was the last event day of the summer, and the third consecutive event day. The hottest average peak temperature of 101° occurred on August 10th, which had a savings of 2.5 kW. The remaining event day savings fall within a range of 2.0 to 2.7 kW.

On a percent basis, SCE high consumption homes consistently reduced load by 55% to 62% on average during Super Peak periods. The lowest percent reduction occurred on August 27th at 52%. The highest percent reduction happened on September 9th at 62%, which is different than September 10th, the day with the highest absolute savings.

Figure 60 segregates percent performance of consecutive event days from the percent savings of ADRS homes on all event days. SCE high consumption ADRS customers maintained savings relative to control homes on consecutive event days. With the exception of July 26th and 27th, consecutive event day savings were the same or higher than the first day. The 58% savings on August 9th declined slightly to 56% on August 10th, and then rebounded slightly to 57% on

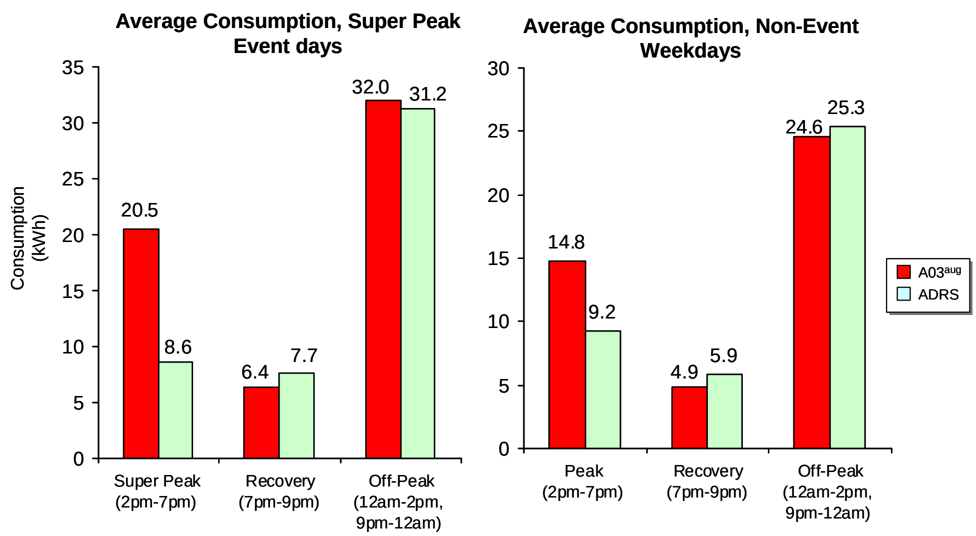
August 11th. The September consecutive days show a trend of increasing savings on consecutive days. September 8th's 57% savings increased to 62% on September 9th, which then declined slightly to 61% on September 10th. With the exception of July, there appears to be good correlation between average peak temperature and percent savings on consecutive event days. On hotter event days, control loads increase, causing ADRS load reductions as a percentage of control load to decrease.

Figure 60: Average ADRS percent reduction in Super Peak period load relative to control homes on consecutive event days, SCE high consumption homes



Average consumption of ADRS and control homes during peak, recovery, and off-peak hours is shown in Figure 61. Event days are illustrated in the left chart and non-event days are illustrated in the right chart.

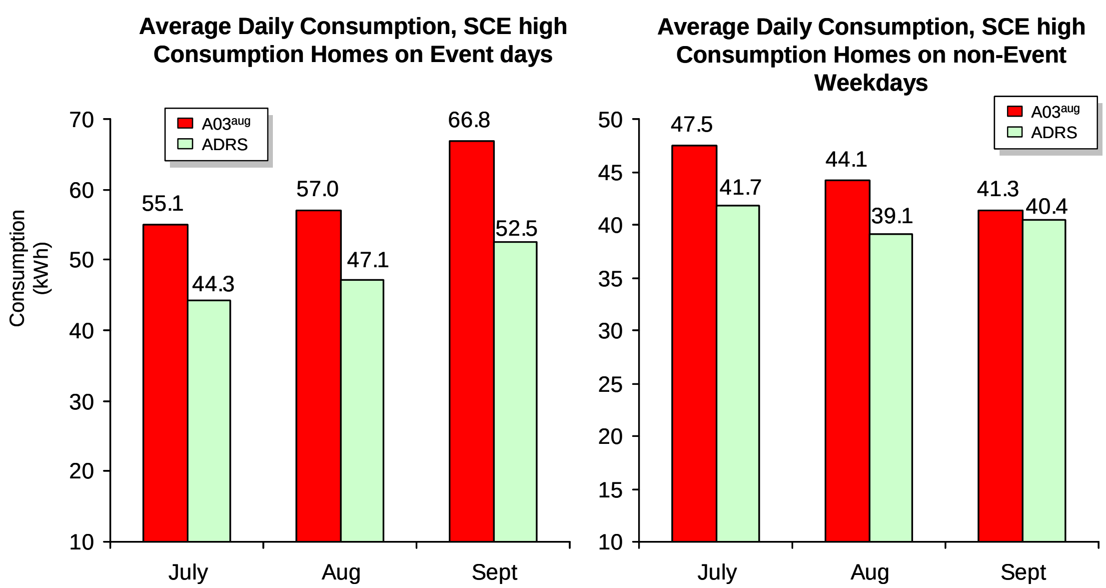
Figure 61:Average consumption, SCE high consumption ADRS and control homes on event (left) and non-event days (right)



Consumption difference during Super Peak period between control and ADRS customers is most striking. ADRS homes in SCE territory consume 12 kWh less or 42% as much energy as control homes during the Super Peak period. During the recovery period for event days, ADRS customers in SCE territory consume marginally more energy than control homes, by 1.3 kWh or 11% of peak period energy savings. This is likely explained by the automatic downward adjustment of ADRS thermostats to off-peak settings after the Super Peak period. Once the thermostats are reset at 7 p.m. to pre-Super Peak level, air conditioners in most ADRS homes turn on to meet the lower setpoint, resulting in a spike in load. Off-peak consumption for ADRS homes on event days is lower than control homes by 0.8 kWh, indicating similarity in loads during this period.

On non-event days, ADRS and control homes' relative energy consumption during peak, recovery, and off-peak periods are similar to that of corresponding periods on event days. ADRS homes consume substantially less load (38% less) than control homes during the peak period while control homes consume marginally less load during the recovery period.. ADRS consumption during the recovery period is 5.9 kWh, exceeding control consumption by 1 kWh. This reversal in consumption patterns for ADRS homes during the recovery period has the same explanation as for event days. Off-peak consumption on non-event days has ADRS consuming 25.3 kWh on average, marginally exceeding control's 24.6 kWh consumption, again indicating similarity in loads during this period.

Figure 62: Average daily consumption, SCE high consumption ADRS and control homes on event (left) and non-event (right) weekdays



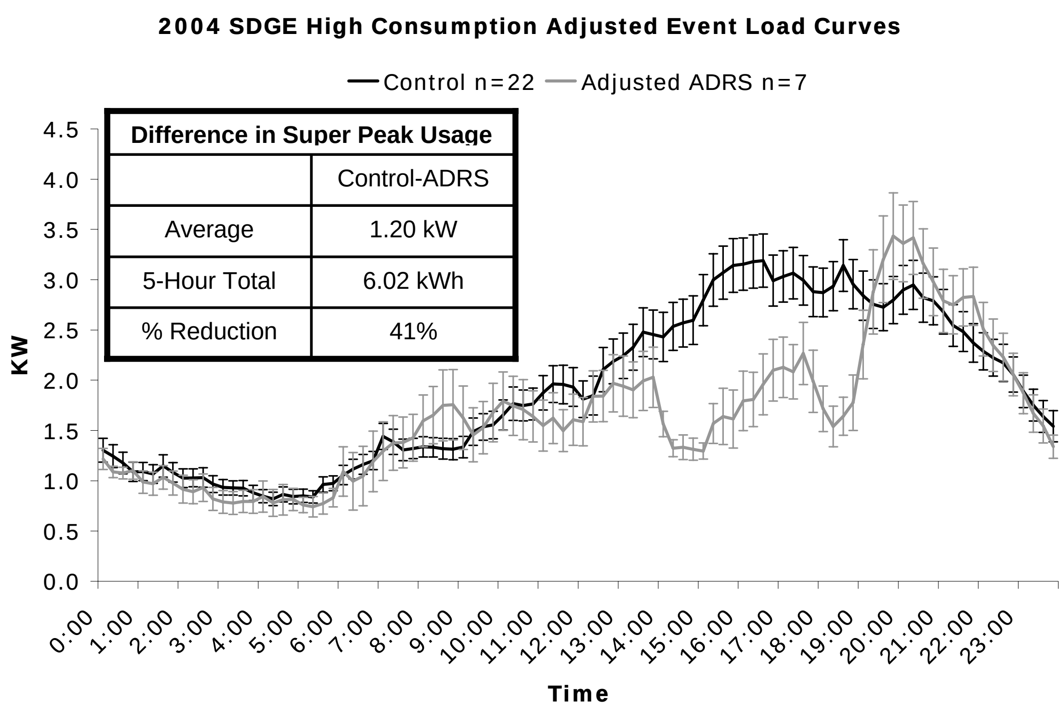
Average daily consumption for ADRS and control homes are plotted in Figure 62 by month for event days (left) and non-event days (right). For event days, ADRS high consumption homes in SCE territory consume less energy overall compared to control homes. The bulk of this reduction in average daily ADRS consumption on event days is from the Super Peak period, shown in Figure 61. July and August event days show ADRS homes consuming 10.7 and 9.9 kWh less energy than control homes, respectively. In September, the difference climbs to 14.3 kWh.

For non-event days, average ADRS daily consumption is also lower than control customers, though less dramatically than on event days. During July and August non-event days, ADRS daily consumption is lower than control customers' by 5.8 kWh and 5 kWh, respectively. In September, this difference falls to 0.9 kWh, indicating similarity in non-event day loads during this month.

2.4 SDG&E high consumption summer 2004 load impact analysis results

The average event day load curves for SDG&E high consumption ADRS and control homes are shown in Figure 63. ADRS homes reduced Super Peak period consumption by an average of 6.0 kWh on event days during the summer of 2004. This represents a 1.2 kW load drop, or 41% savings. Ninety percent confidence intervals during the Super Peak period averaged ±0.25 kW for control homes and ±0.23 kW for ADRS homes[23].

Figure 63: SDGE high consumption event day load curves



On non-event days, ADRS homes reduced Super Peak period consumption by an average of 1.87 kWh over the entire peak period (Figure 64). This corresponds with 0.37 kW, or 17% average reduction in load compared to control homes. Ninety percent confidence intervals during the peak period averaged ±0.11 kW for control homes and ±0.13 kW for ADRS homes[24].

[23] Super peak period 90% confidence intervals ranged from ±0.24 kW to ±0.27 kW for control homes, and from ±0.08 kW to ±0.31 kW for ADRS homes.
[24] Non-event peak period 90% confidence intervals ranged from ±0.10 kW to ±0.11 kW for control homes, and from ±0.10 kW to ±0.16 kW for ADRS homes.

Figure 64: SDG&E high consumption non-event day load curves

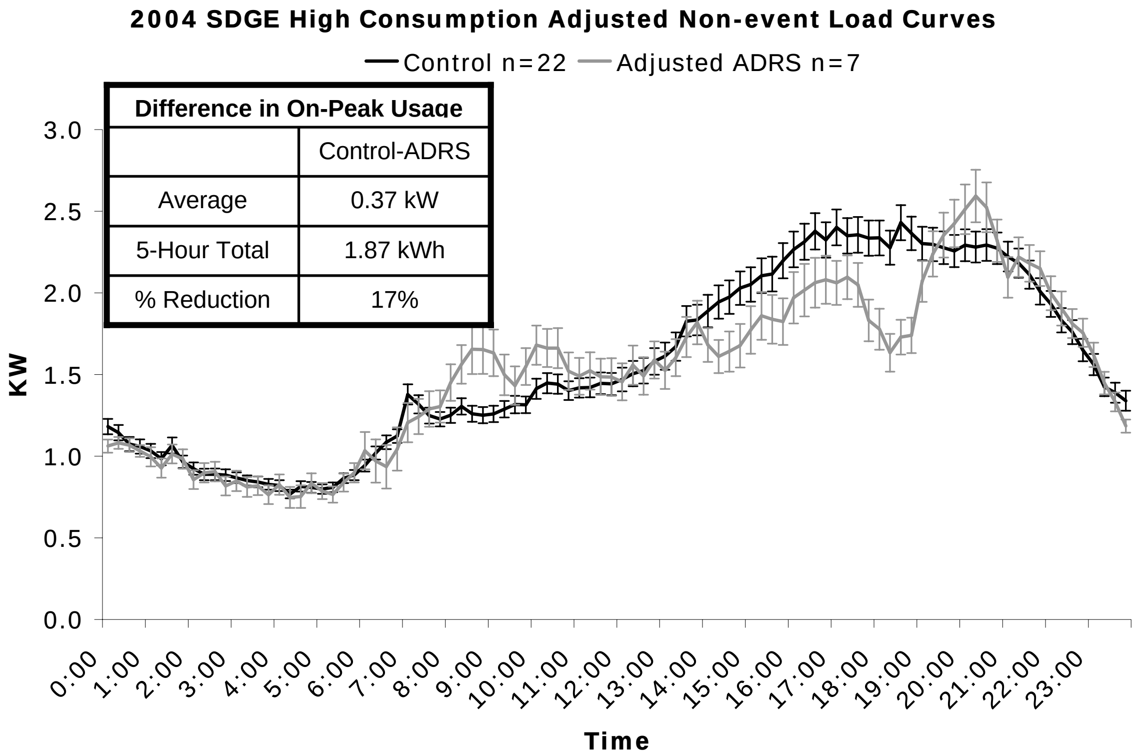


Figure 65: Average reduction in Super Peak period load, SDG&E high consumption homes

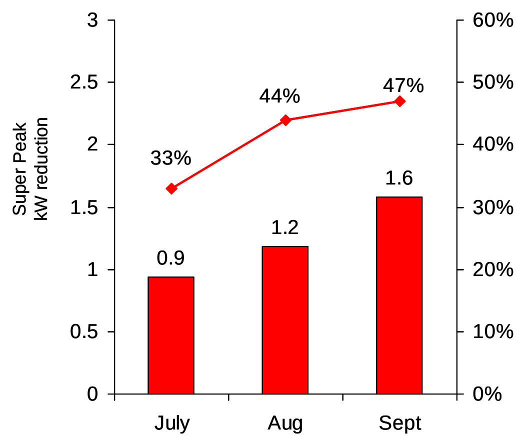
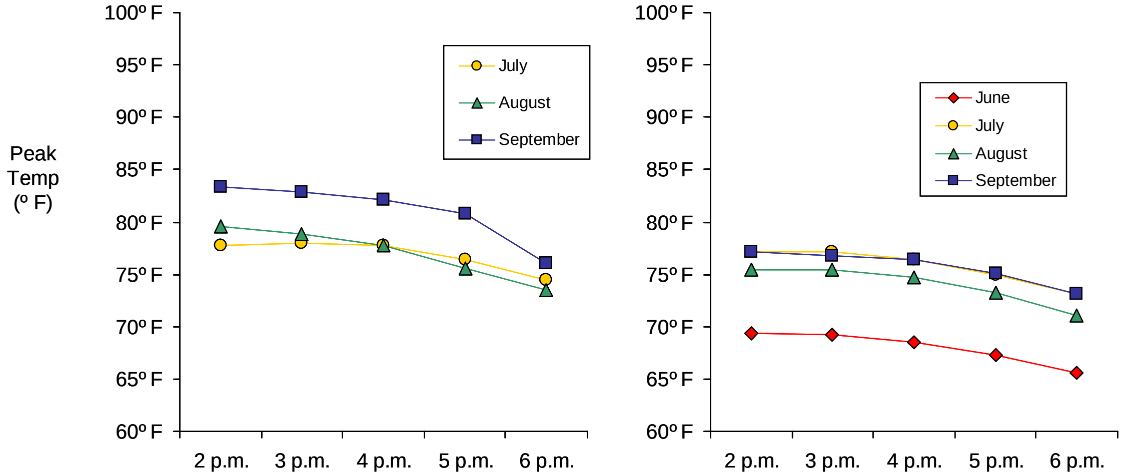


Figure 65 displays ADRS's event day peak period load reduction relative to control homes for each summer month. SDG&E ADRS savings steadily increased throughout the summer. In July, ADRS's Super Peak reduction was 0.9 kW, or 33%, and increased to 1.2 kW, or 44%, in August. ADRS load reduction in September was greatest of all, with 1.6 kW, or 47%, reduction relative to control homes.

Figure 66 charts the event and non-event day average hourly peak temperatures during the Super Peak and peak periods in SDG&E territory, respectively. The left chart displays the Super Peak period temperature averages for each summer month and the right chart displays the average peak period temperature for non-event days.

Figure 66: Average ADRS temperature, event (left) and non-event weekdays (right), SDG&E ADRS homes

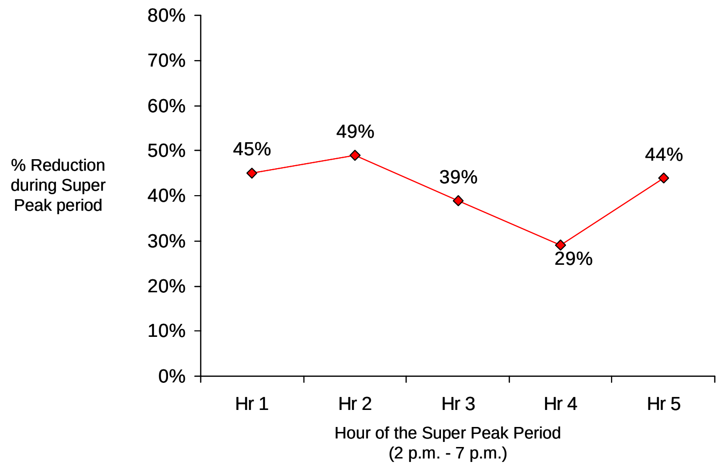


Event day temperatures in SDG&E territory were generally cool, with average peak temperatures reaching only into the low 80°F. Super Peak period temperatures generally peak at 3 p.m. and decline into the late afternoon. September event days were the hottest, averaging 83.3°F at 2 p.m. then declining to 76°F at 6 p.m. July was the coolest month, with temperatures on Super Peak days, peaking at 78°F at 3 p.m.

On non-event days, June had the lowest average afternoon temperature averages of the summer. Temperatures in July and September were warmest, and peak period temperatures were nearly identical. At 2 p.m., temperatures peaked at a mild 77°F and then declined to 73.1°F at 6 p.m. June non-event day temperatures were cool, averaging from 69.4°F to 64.6°F during the afternoon peak period.

Hourly percentage savings of ADRS homes during the Super Peak period are graphed in Figure 67. SDG&E high consumption ADRS load reductions were significant, ranging between 29% and 49% throughout the Super Peak period. There is no discernible pattern to SDG&E hourly Super Peak savings, and could be attributed to small sample size of SDG&E high consumption ADRS homes (n=7). This somewhat sporadic savings profile is also reflected in the erratic Super Peak period load profiles in Figure 63. The control load peaks at 4 p.m. then declines for the remainder of the Super Peak period. ADRS load continues to rise from 4 p.m. to 6 p.m. resulting in the decline in percent savings during the 3rd and 4th hours. At 6 p.m., ADRS load suddenly drops, resulting in a rebound in savings relative to control homes during the 5th Super Peak hour.

Figure 67:Average percent reduction in Super Peak period load, SDG&E high consumption ADRS homes



Event day Super Peak reductions for SDG&E high consumption ADRS homes are plotted in Figure 68 and Figure 69. Figure 68 represents the ADRS savings in kW and Figure 69 represents the savings as a percentage of the control load. Average maximum Super Peak day temperatures are plotted along a secondary axis above each bar chart.

Figure 68: Average reduction in Super Peak period ADRS load relative to control, SDG&E high consumption homes

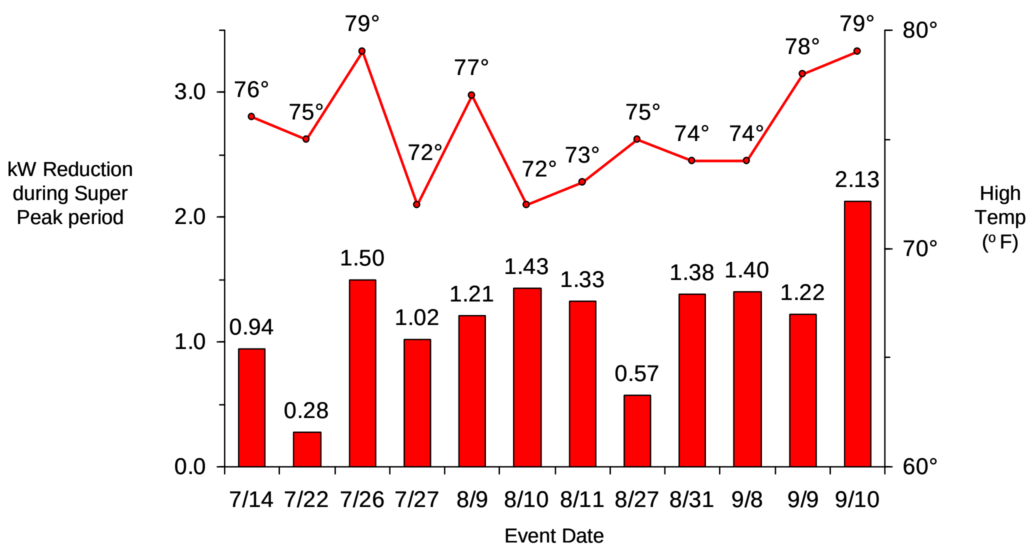
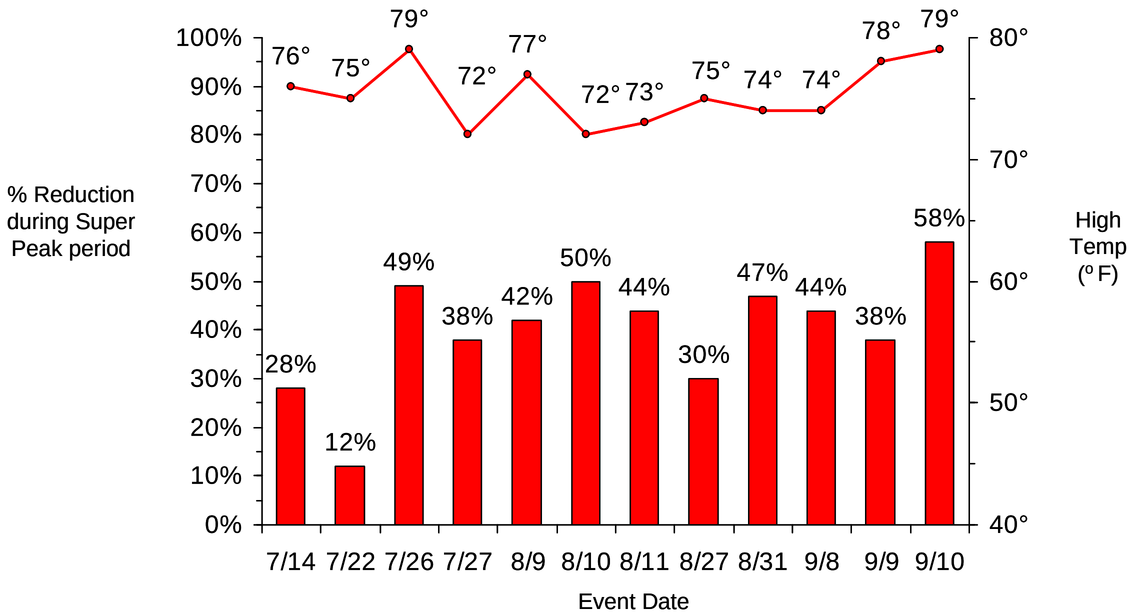


Figure 69: Average percent reduction in Super Peak period ADRS load relative to control, SDG&E high consumption homes



ADRS load reductions were inconsistent between event days on both absolute and percent bases. This was likely due to mild temperatures experienced in SDG&E territory on event days. On most event days, ADRS in SDG&E territory reduced loads relative to control by 1 kW to 1.5 kW. The smallest load reduction was on July 22nd at 0.28 kW, or 12% of control load. The maximum savings of 2.13 kW, or 58%, occurred on the last event day of the summer, September 10th, which also had the highest average peak temperature of all the event days at 79° F.

As a percentage, Super Peak period savings varied from 28% to 50%. Temperature variations do not appear to provide any insight into the variability of savings. For example, some of the largest event day savings, such as those of August 10th, 11th, and 31st, occurred in some of the mildest temperatures.

ADRS savings over consecutive event days are plotted in Figure 70. Average maximum daily temperatures are also plotted on the secondary axis. There is no consistent pattern to consecutive event day load reductions in SDG&E territory. Temperature variations do not provide any additional insight into the variability of savings on consecutive event days.

July 26th and 27th exhibit decreased savings on the second day. ADRS homes first increase then decrease load reductions on August 10th, and 11th compared to August 9th, as temperatures drop from 77°F to 72°F and 73°F on the second and third consecutive event days. In contrast to August event days, consecutive September days show the opposite pattern. September 8th savings of 44% drop to 38% on September 9th as the temperature increases from 74°F to 78°F. Then ADRS load reduction jumps to 58% on September 10th while average peak temperatures increase by only 1°F.

Figure 70: SDGE high consumption ADRS vs. A03aug

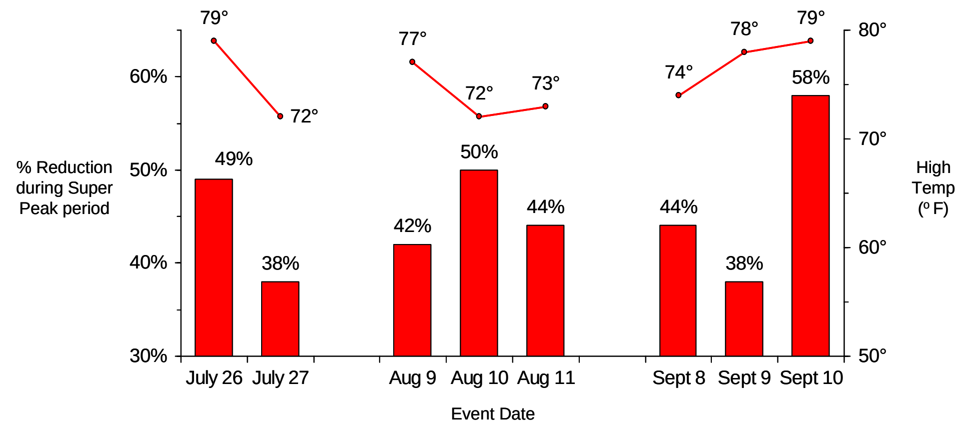
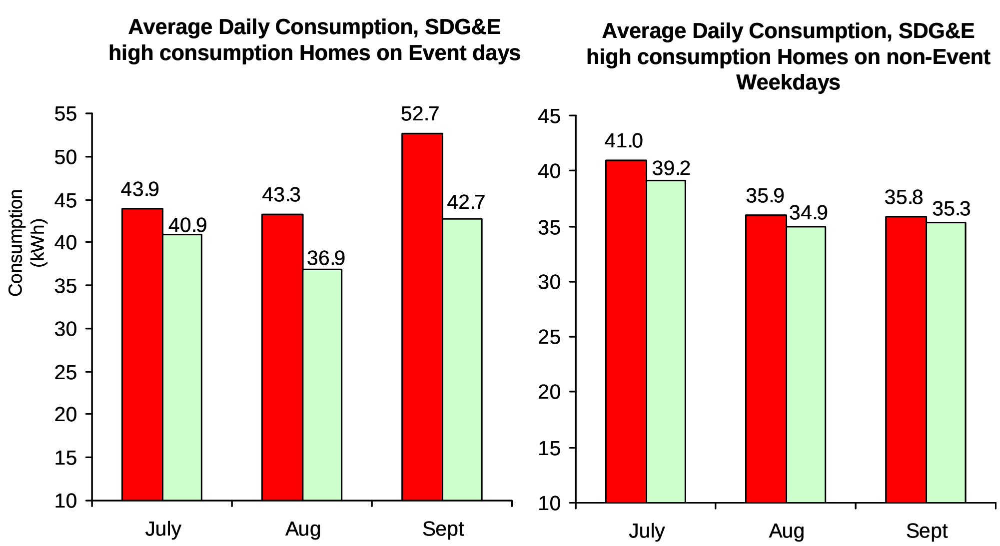


Figure 71 shows the average energy consumption for ADRS and control homes during peak, recovery, and off-peak periods on event and non-event days. On event days, ADRS homes consume 6 kWh less energy than control customers during Super Peak periods. ADRS homes consume marginally more load (0.6 kWh) during the recovery period. This reversal of consumption during the recovery period corresponds to the post-peak period rebound in consumption in the ADRS homes, which is exhibited in the spike in ADRS load at 7 p.m. This rebound is likely due to the latent air-conditioning demand in ADRS homes on event days. At the end of the Super Peak period, the thermostats in ADRS homes are suddenly reset from their warmer Super Peak setting to their cooler off-peak setting. This results in a sudden jump in load at 7 p.m. as all the air conditioners suddenly turn on to meet the new cooler setpoint. Control homes consume marginally more energy than ADRS homes (0.8 kWh) during the off-peak period, reflecting the similarity in off-peak loads.

Figure 71:Average consumption, SDG&E high consumption homes, event (left) and non-event (right) days



Non-event days consumption for PG&E high consumption homes exhibit a similar pattern. ADRS homes' peak period consumption is slightly less than control homes', while ADRS recovery consumption is slightly more than control homes'. Control homes consume marginally more than ADRS homes during off-peak periods (0.5 kWh), evincing similarity in loads during this period.

Figure 72:Average daily consumption, SDG&E high consumption homes on event (left) and non-event (right) weekdays

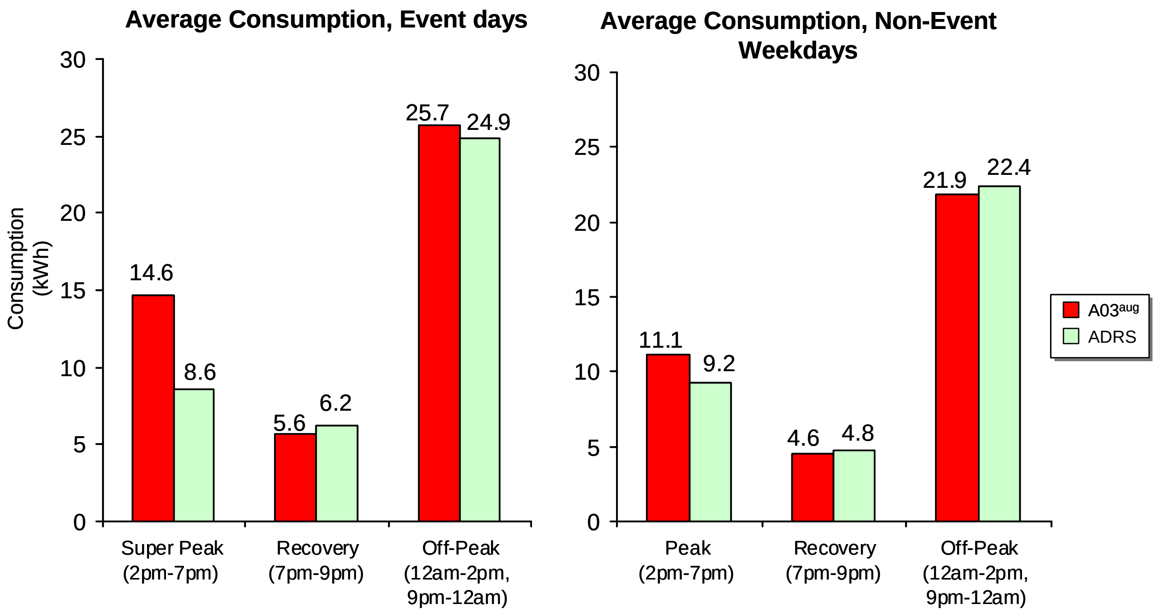


Figure 72 charts the average daily consumption by month for ADRS and control homes in the SDG&E territory. Event days are shown on the left and non-event days are shown on the right. On event days, the ADRS consumption relative to control homes decrease throughout the summer. In July, ADRS homes consume 3 kWh less than control homes. For August event days, this difference increases to 6.4 kWh. In September, high consumption ADRS homes consume 10 kWh less than control homes. From Figure 71, we observe that most of the difference in consumption comes from ADRS load reduction during the Super Peak period.

On non-event days, ADRS homes also consistently consume less energy than control homes, with the opposite monthly trend as the event days. In July, there is a 1.8 kWh difference in consumption. This diminishes to a 1 kWh difference in August and then to a 0.5 kWh difference in September.

2.5 Summary of ADRS 2004 load impact results

Following adjustments for selection bias of ADRS customers and addition of high consumption control homes, load impact results are stable and improved. Customers with ADRS technology and subject to CPP-F rates in climate zone 3 successfully achieved load reductions compared to control customers without ADRS technology on standard tiered rates in 2004. The load reductions are substantial and stable across a range of days and temperatures.

Compared to A07 homes statewide, which reduced their load with only the Super Peak rate stimulus on event days but without the assistance of ADRS technology, ADRS customers also achieved load reductions successfully across a range of days and temperatures. Following adjustments for selection bias of ADRS customers and adjusting for selection bias of A07 customers, RMI's reported results for A07 load reductions on event days matches the results reported by the CEC in 2004 and is similar to the results reported by CRA in 2004 on a percentage basis.

Load reduction performance for customers with ADRS technology and subject to CPP-F rates varied between utilities across the state, when compared to control customers. SCE high consumption ADRS customers achieved more than 2 kW reductions on event days across a range of temperatures. PG&E and SDG&E high consumption ADRS customers achieved substantial, but lower reductions, just over 1 kW on event days on average.

Homes with ADRS technology produced a consistent and predictable load profile during Super Peak and peak periods. Reductions were at their maximum at the start of the period, then gradually increased as homes warmed up and air conditioners pulsed on to maintain indoor temperatures at the higher set point. There was typically a dramatic recovery in load immediately following the Super Peak or peak periods, when thermostats in ADRS homes automatically reset from their warmer Super Peak or peak settings to their cooler off-peak setting.

In 2004, high consumption ADRS homes achieved some reduction in daily energy consumption in addition to shifting load from peak to off-peak periods. Most of the reduction in daily energy consumption was from load shifting during the Super Peak and peak periods, rather than additional energy reductions during the off-peak periods. This was true for ADRS customers from all three utility service territories.

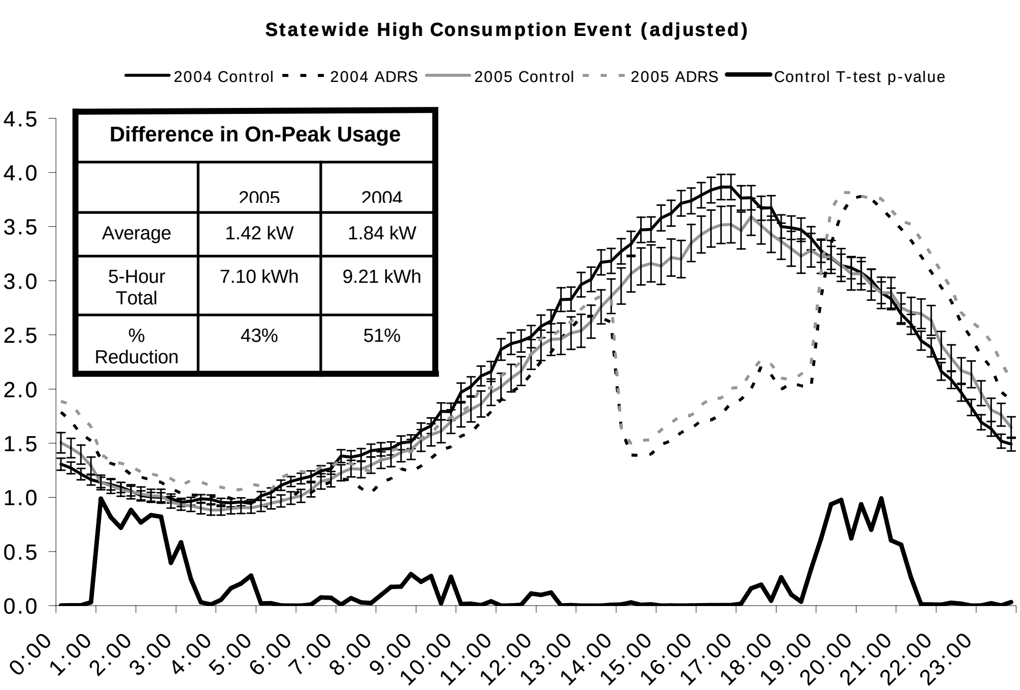
Chapter 3 Comparison of summer 2005 and summer 2004 ADRS load impact results

The following section compares the load reduction performance of customers participating in the ADRS pilot during the summer of 2005 to load reduction performance during the summer of 2004. ADRS participants are households with technology and subject to experimental CPP-F rate compared to homes without technology and subscribed to standard tiered rates. Load reductions are first reported on a statewide basis for high consumption homes, followed by results for high consumption ADRS participants in each utility service territory of PG&E, SCE, and SDG&E, respectively. A summary of results for low consumption ADRS homes is then provided on a statewide basis, then for each utility individually. All load impact results have been adjusted for selection bias of ADRS homes. Details of RMI's investigation into selection bias are presented in Appendix C.

3.1 Comparison of 2005 and 2004 high consumption ADRS load impact, statewide

Statewide high consumption average daily load curves are shown in Figure 73 and Figure 74 for both summer 2004 and summer 2005 event and non-event weekdays. Also drawn are ninety percent confidence intervals for each 15-minute period of control load as well as the t-test p-values evaluating the statistical similarity of control loads between years.

Figure 73: Statewide high consumption event load curves: 2004 and 2005

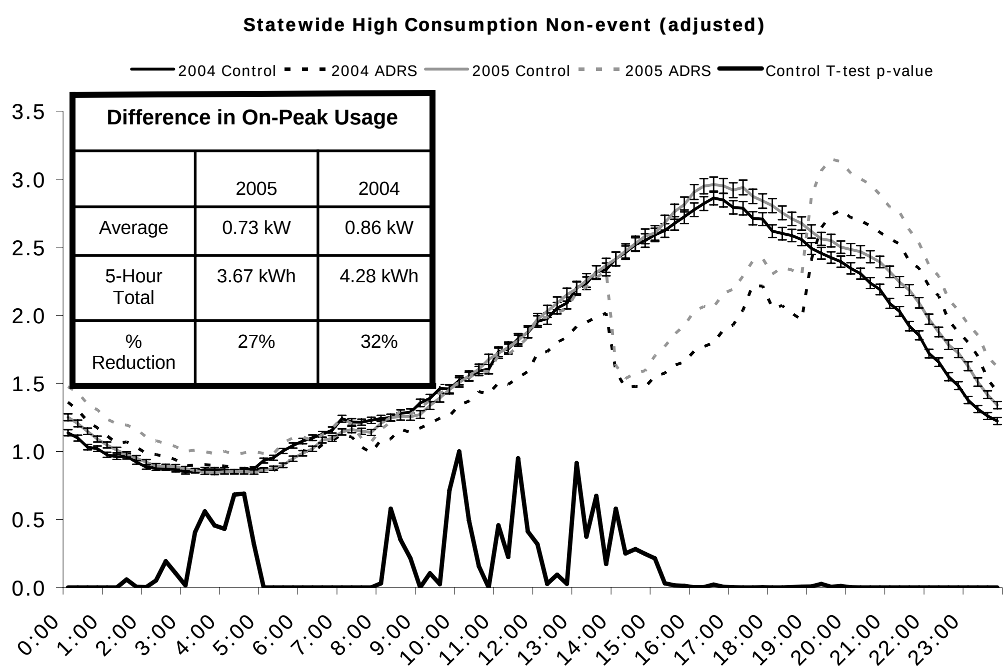


On event days, ADRS homes in 2005 show a 1.37 kW, or 42% reduction in Super Peak load compared to control. This result was less than in 2004, when ADRS load reductions were 1.81 kW, or 51% compared to control. Total energy reduction across the Super Peak period was 6.8 kWh in 2005 and 9.3 kWh in 2004. Nonetheless, ADRS load reductions during both years were substantial. The smaller load reduction in 2005 appears to be mostly a result of lower control load during the Super Peak period rather than the slight increase in ADRS load.

Examining the results in more detail, ADRS loads in 2005 and 2004 match closely, with ADRS load higher by 8% in 2005 than in 2004 load over the whole day, and 7% higher during the Super Peak period specifically. This makes sense, as average event day temperatures were slightly higher in 2005 (refer to Figure 75), so it is reasonable that 2005 loads were slightly higher.

Control loads in 2005 compared to 2004 show the opposite behavior. Event day control load in 2005 matches 2004 load closely through much of the morning off-peak period. During the Super Peak period, control load in 2005 was significantly less than load in 2004 by approximately 8%. The near zero p-values in Figure 73 from late morning through the Super Peak period mean that there is a near zero probability (low) that differences in control loads between the two years are due to random chance (see Appendix B for a review of statistical tools used in this report). This result is counterintuitive given that summer 2005 was hotter than summer 2004, on average. The 2005 control load, furthermore, represents the averages *after* the removal of anomalous control homes from the dataset[25]. We cannot explain this behavior of high consumption control homes with the available load data.

Figure 74: Statewide high consumption non-event load curves: 2004 and 2005



[25] Refer to Appendix A of this report, Data Collection and Load Impact Analysis Methodology for details of high consumption control homes data verification and removal of outliers in the 2005 load impact analysis.

On non-event days, ADRS load reductions compared to control averaged 0.73 kW or 3.7 kWh in 2005, compared to 0.86 kW or 4.3 kWh across the peak period in 2004 (Figure 74). On a percentage basis, high consumption ADRS homes reduced load by 27% in 2004 and 32% in 2005, respectively.

Non-event weekday control customers' load in 2005 compared to 2004 displayed a different pattern than event-day loads for the two years. Control customers' loads on non-event days were similar in 2005 and 2004 for much of the morning off-peak period through the first two hours of the peak period. After 4 p.m., however, 2005 control load exceeded 2004 control load for the remainder of the peak period. This is as expected due to higher average non-event weekday temperatures in 2005 (see Figure 75).

ADRS loads in 2005 also surpassed 2004 ADRS loads, especially during the peak and following recovery periods. However, note that the 2 p.m. ADRS load dropped further in 2005 than 2004, but recovered more quickly during the rest of the peak period, resulting in modestly reduced savings overall. This observation is consistent with the explanation that hotter summer weather causes the indoor temperatures to rise to the on-peak thermostat set point faster.

Figure 75 confirms that 2005 was a hotter year during the summer season. The figure displays the average peak temperatures by month over all the high consumption homes. With the exception of September non-event weekdays, 2005 featured higher average peak temperatures than 2004. Event day temperatures in 2005 were hot, ranging from 93°F to 96 °F on average during Super Peak period over the summer months. Corresponding event day peak temperatures in 2004 varied in the 87°F to 90°F range, about eight degrees lower than 2005 temperatures. Non-event day temperatures were not much cooler than event day temperatures in 2005, averaging at 91°F and 89°F, respectively, in July and August. Corresponding 2004 temperatures in July and August were much cooler on non-event days, averaging between 82°F and 84°F, about ten degrees lower than in 2005. September temperatures in 2005 averaged just one degree higher than in 2004, indicating similarity in climate between the two years during that month.

Figure 75: 2004 and 2005 average peak temperatures by month

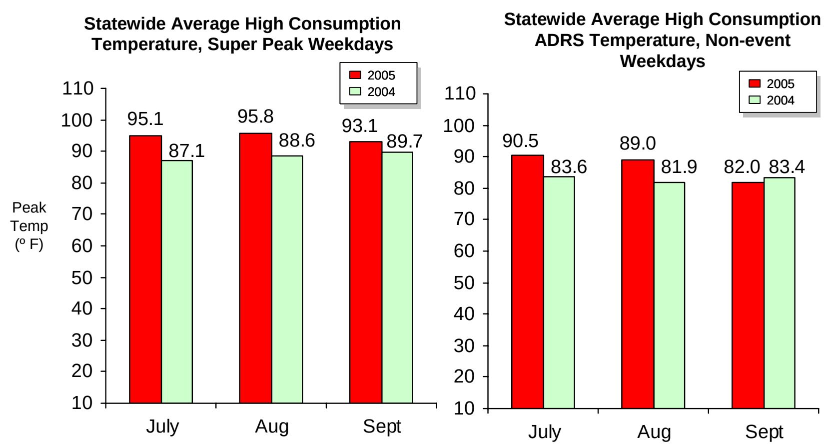


Figure 76 compares the 2004 and 2005 percent load reductions during Super Peak hours for high consumption homes statewide. Overall, Figure 76 demonstrates the constancy of strong ADRS performance over consecutive years. High consumption ADRS load reductions in 2005 and 2004 were at their maximum during the first Super Peak hours, and declined modestly on a percentage basis until the end of the Super Peak period. In 2005, hourly ADRS reductions compared to control homes declined from 50% to 35% over the peak period. Hourly Super Peak period reductions in 2004 were slightly higher, from 57% at 2 p.m. to 42% by 6 p.m. Thus, percent load reductions in 2004 were consistently 7-10% more than 2005. Recall that high consumption control loads were curiously higher in 2004 than 2005 in spite of the fact that 2004 was a cooler summer. Otherwise, both years feature about a 15% decline in load reduction performance over the five hour Super Peak period.

Figure 76: 2004 and 2005 statewide high consumption Super Peak hourly percent load reductions

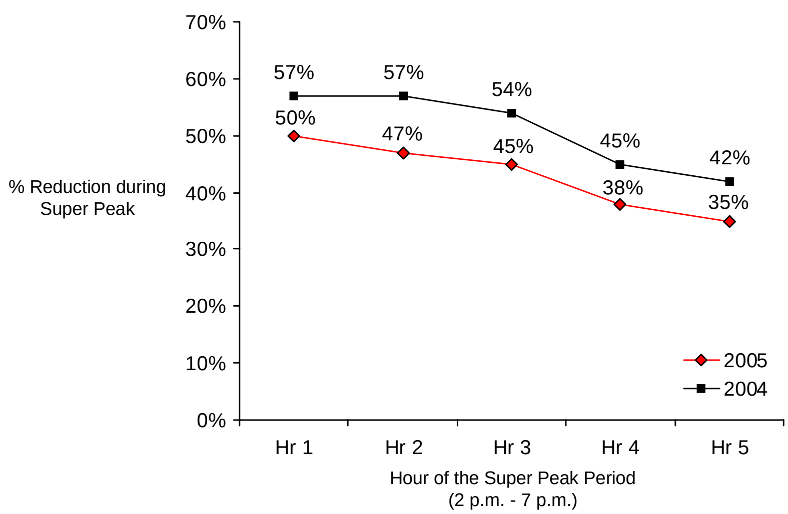


Figure 77 and Figure 78 plot the Super Peak period load reductions of high consumption ADRS homes statewide for 2005 and 2004, respectively. 2005 ADRS Super Peak reductions were consistently less than on 2004 event days, indicating the consistency of lower peak period control load over all 2005 events.

On a monthly basis for event days, only July can be used for intra-year comparison. Event days in July 2005 exhibited smaller ADRS load reductions compared to July 2004 events on average. There were five events called in August 2004 while only one event was called in August 2005. With only one data point for August 2005 event days, we cannot be certain event day performance was typical of Super Peak period ADRS load reduction for that month. September events in 2005 come at the end of the month, after the beginning of autumn. This likely accounts for their markedly reduced savings compared to the September 2004 events, which were called early in the month, just after Labor Day.

Figure 77: 2005 statewide high consumption Super Peak period load reductions by event day: in kW

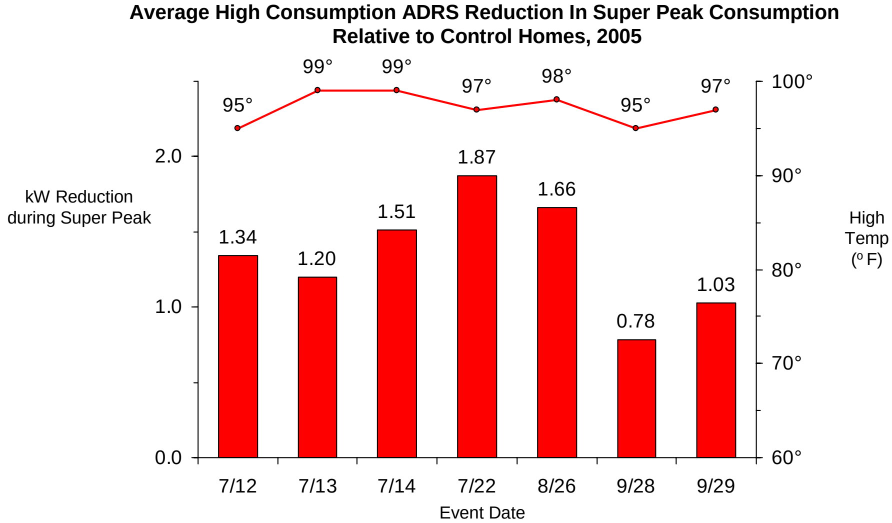
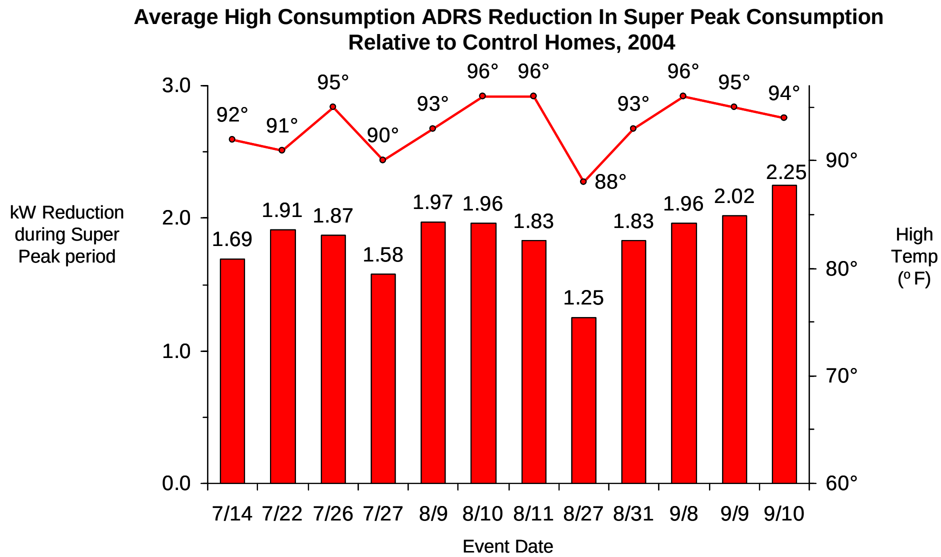


Figure 78: 2004 statewide high consumption Super Peak load reductions by event day: in kW



Event day load reductions on a percentage basis are graphed in Figure 79 and Figure 80 for 2005 and 2004 respectively. Again, only July is relevant for direct intra-year comparison. In general however, percent load reductions in 2005 were lower than in 2004. 2005 percent load reductions range from 34%-47% from July through September, while 2004 reductions vary from 47%-56%.

Figure 79: 2005 statewide high consumption Super Peak percent load reductions by event day

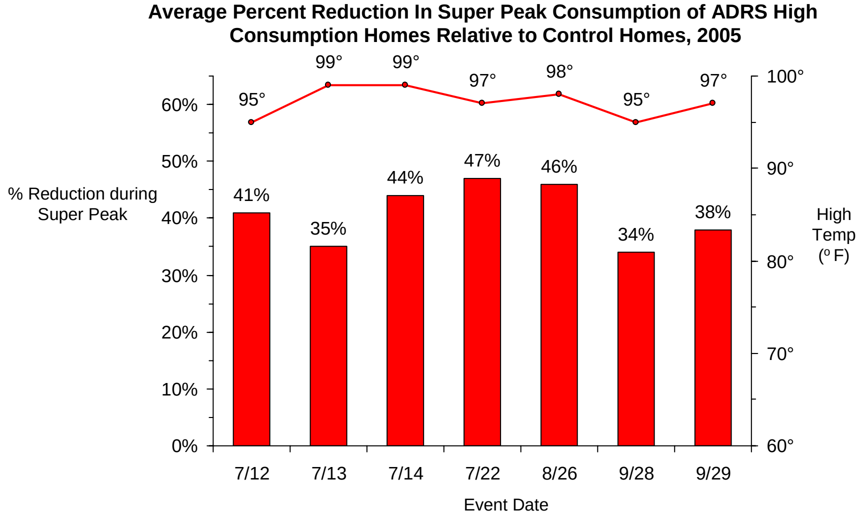


Figure 80: 2004 statewide high consumption Super Peak load percent reductions by event day

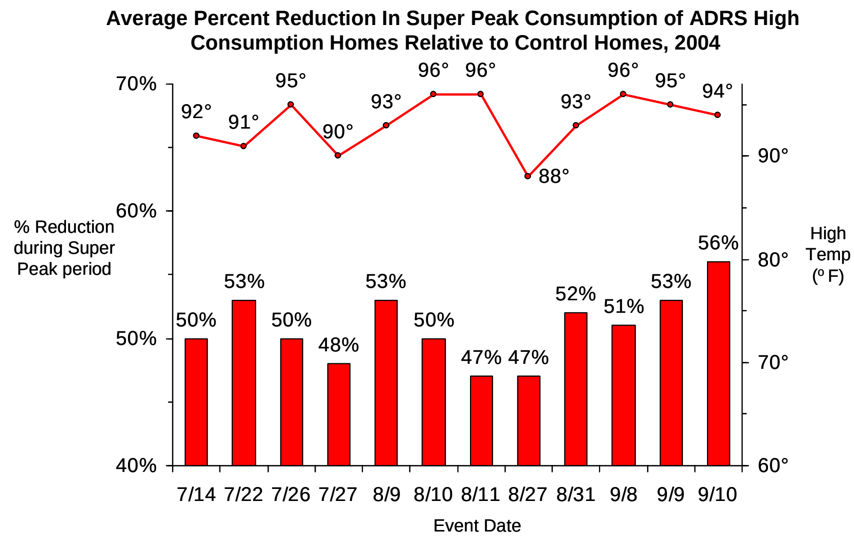


Figure 81 reports both statewide percent load reductions and corresponding average Super Peak temperatures over consecutive event days for 2005 (left) and 2004 (right). High consumption ADRS load reductions were consistent across consecutive event days, with reductions varying narrowly between 34% and 44% in 2005 and between 47% and 56% in 2004. The 2005 percent load reductions generally show higher variability over consecutive days compared to 2004. Consecutive events in July for both years show a second day drop in performance. Consecutive events in September for both years show a second day increase in performance. No consistent pattern is observed between changes in temperature and percent reductions over consecutive event days -- either within or between years.

Figure 81: statewide high consumption 2004 and 2005 consecutive event day Super Peak period load reductions: in percent

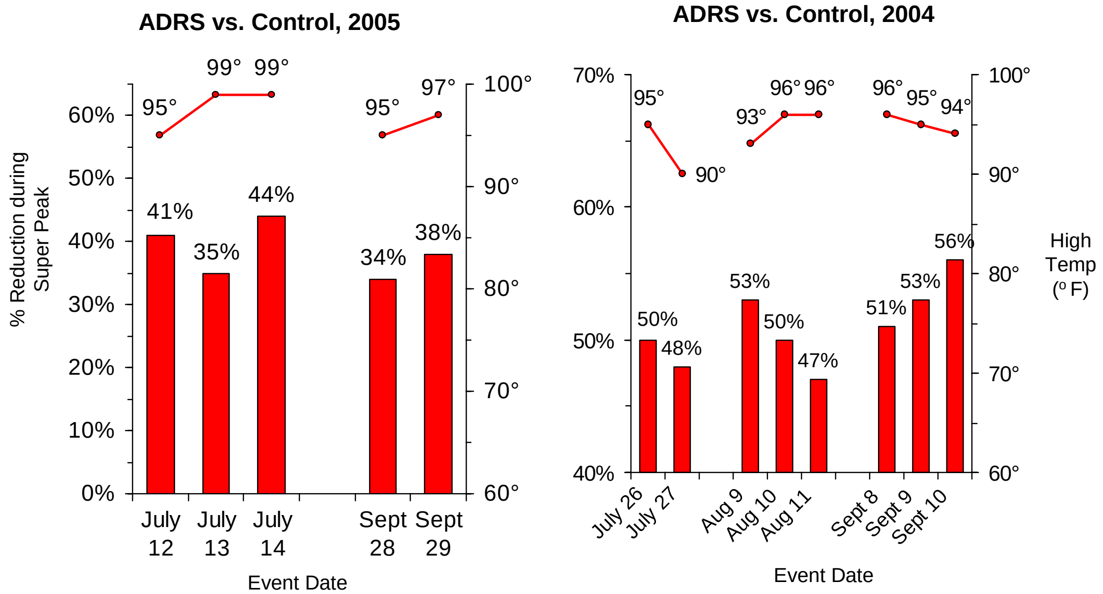


Figure 82 and Figure 83 segment average daily consumption of ADRS and control customer loads into peak, recovery, and off-peak periods for 2005 and 2004. In both figures, event day averages are shown on the left and non-event weekdays are shown on the right. Because of load reductions during Super Peak periods, ADRS high consumption homes consumed less energy than control homes during the period in both 2004 and 2005. In 2005, ADRS homes reduced energy consumption by 7 kWh compared to control homes. In 2004, ADRS customers consumed 9.2 kWh less energy relative to control customer during Super Peak periods.

Figure 82: 2005 statewide high consumption homes, usage by period

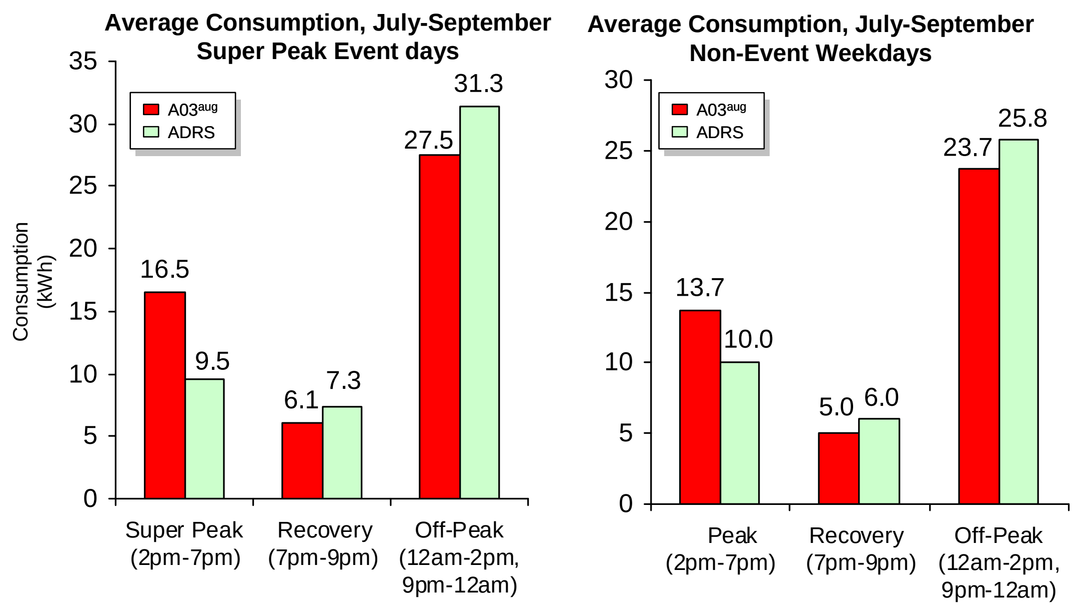
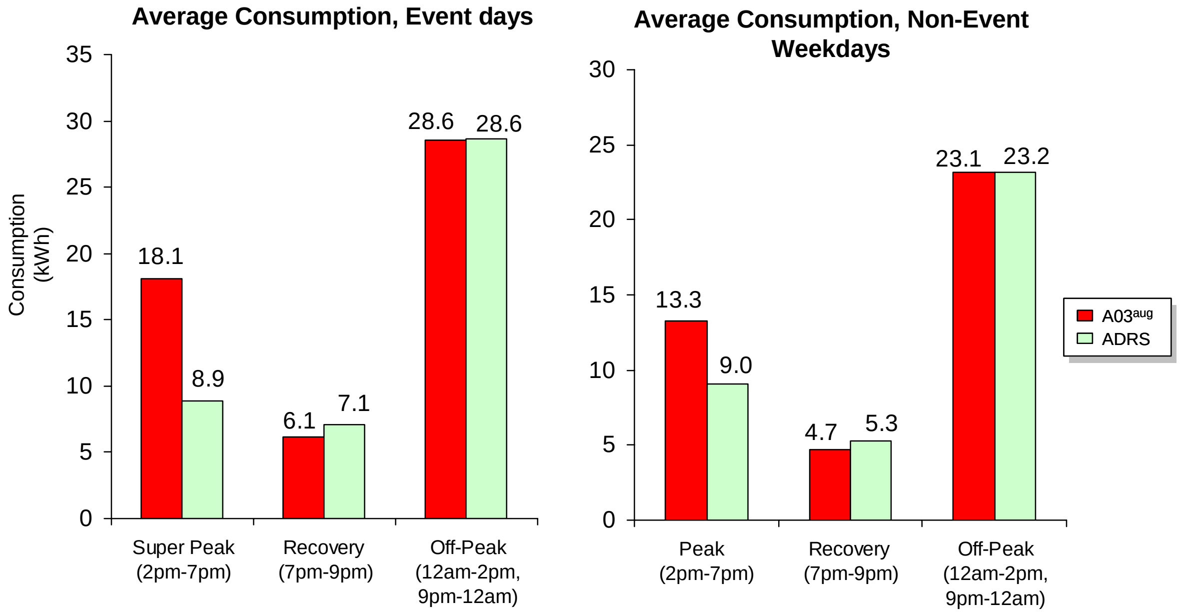


Figure 83: 2004 statewide high consumption homes, usage by period



During the recovery period from 7 p.m. to 9 p.m. on event days, ADRS customer consumption rebounded to exceed control consumption by 1.2 kWh in 2005 and by 1.0 kWh in 2004 as ADRS thermostats were reset to off-peak period set points. ADRS homes also consumed more than control homes in the off-peak periods on event days in 2005, by 3.7 kWh. Off-peak period consumption on event days between ADRS and control customers was the same in 2004. The load-shifting away from the Super Peak in ADRS homes is apparent in the relatively higher ADRS consumption in recovery and off-peak periods in 2005 and 2004.

Non-event day consumption patterns in 2005 and 2004 show the same trends as event days, though differences between ADRS and control customers were more modest in 2005. ADRS homes reduced peak period consumption by 3.7 kWh in 2005. These energy reductions compared to control customers were nearly cancelled out by the greater ADRS consumption during the recovery period and off-peak hours, when ADRS homes consumed 1.0 kWh more and 2.1 kWh more than control homes in 2005 and 2004, respectively. Hence, the non-event day peak period reductions represent load shifting to off-peak periods rather than overall reduction in energy consumption over the whole day.

Non-event weekday consumption reflects this same pattern in 2004. ADRS homes achieved peak period savings of 4.3 kWh with a recovery rebound of only 0.6 kWh relative to control. Off-peak consumption was nearly equivalent between ADRS and control homes in 2004. Hence, both load shifting and energy conservation were present during 2004 non-event weekdays as well.

Figure 84 charts the 2005 average daily energy consumption for high consumption ADRS and control homes on event (left) and non-event weekdays (right), statewide. Figure 85 plots the average daily consumption for ADRS and control groups on event and non-event days in 2004. Comparing across years, ADRS homes exhibited conservation behavior on event days in both years. On non-event days, however, ADRS homes exhibited conservation in 2004, but virtually no conservation in 2005.ADRS homes consistently consumed less average daily energy than control homes over all summer months on both event and non-event days in both 2004 and 2005.

Figure 84: 2005 statewide high consumption homes, average daily usage by month

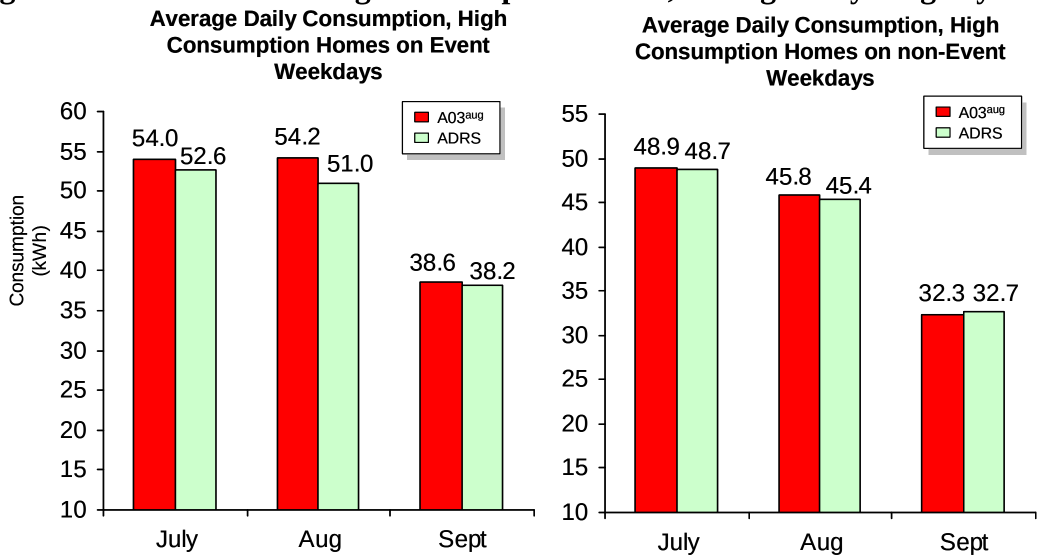
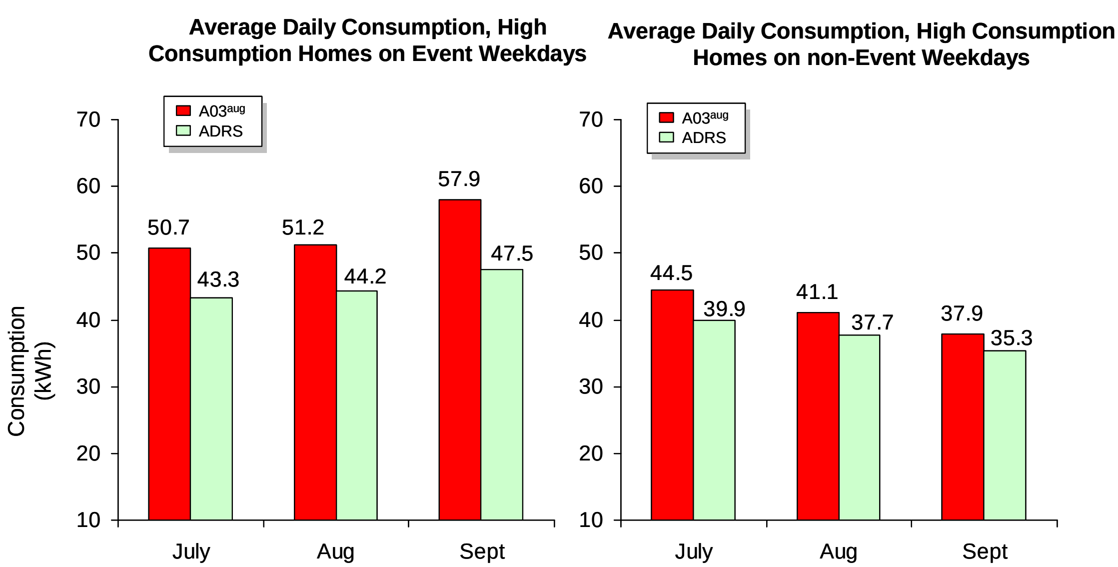


Figure 85: 2004 statewide high consumption homes, average daily usage by month



Comparing between years, average daily energy consumption of both ADRS and control customers were considerably greater in 2005 than in 2004 on both event and non-event days, with the exception of September. Event days and non-event weekdays in September 2005 featured substantially reduced overall consumption compared to other months. In contrast, September event and non-event days in 2004 featured similar ADRS and control consumption compared to other months. This corroborates the notion that the September event days in 2005, which were called at the end of the month, reflect a transition to autumn climate and different consumption behavior.

On event days in 2005, ADRS homes consumed 2.5 kWh and 3.2 kWh less than control homes in July and August, respectively. On September event days in 2005, the difference in ADRS and control customer energy consumption was only 0.4 kWh, demonstrating only a small conservation effect. On event days in 2004, ADRS customers generated greater energy savings than in 2005, between 7-10 kWh less than control customers' consumption from July through September. From Figure 82 and Figure 83, we see that most of this reduction in ADRS consumption on event days comes from the Super Peak period.

On non-event days in 2005, average daily energy consumption in ADRS and control groups was virtually the same from July through September, indicating that ADRS customers used the technology mostly to shift load to off-peak hours without any net conservation effect. This may also be due in part to lower control customer loads in 2005. On non-event days in 2004, on the other hand, ADRS customers consistently consumed marginally less energy than control customers across all summer months.

3.2 Comparison of 2005 and 2004 high consumption ADRS load impact, PG&E

Figure 86 superimposes high consumption control and ADRS customer loads in PG&E service territory for both 2004 and 2005 summers. Ninety percent confidence intervals are drawn around control loads for each 15-minute period. The black line along the bottom of the chart displays the t-test p-value for each 15-minute period, which evaluates the probability that control home load differences between 2004 and 2005 were due to random chance.

ADRS loads correspond closely with each other between summer 2005 and summer 2004, especially during the Super Peak period. ADRS load during the Super Peak Period in 2005 was negligibly higher than in 2004, by only 0.3 kWh or 3%. However, average control customer load in 2005 was significantly less than in 2004 during the Super Peak period and subsequent recovery period, as indicated by the near zero p-values. Super Peak period control customer load in 2004 was 12% or 0.4 kW on average lower than in 2005. During the morning and late evening off-peak periods, both ADRS and control homes had similar loads in both years.

Due mostly to the downward shift in 2005 control load during the Super Peak period, ADRS load reduction relative to control homes was less in 2005 than in 2004. ADRS homes in 2005 reduced Super Peak period load by an average of 0.83 kW or 4.2 kWh, compared to 1.29 kW or 6.4 kWh in 2004. On a percent basis, 2005 ADRS homes saved 29% of 2005 control load, compared to 39% in 2004. Notwithstanding changes in control customer load between years, high consumption ADRS homes in PG&E territory achieved consistent and significant Super Peak load reductions on event days.

Figure 86: PG&E high consumption 2004 and 2005 event day load curves

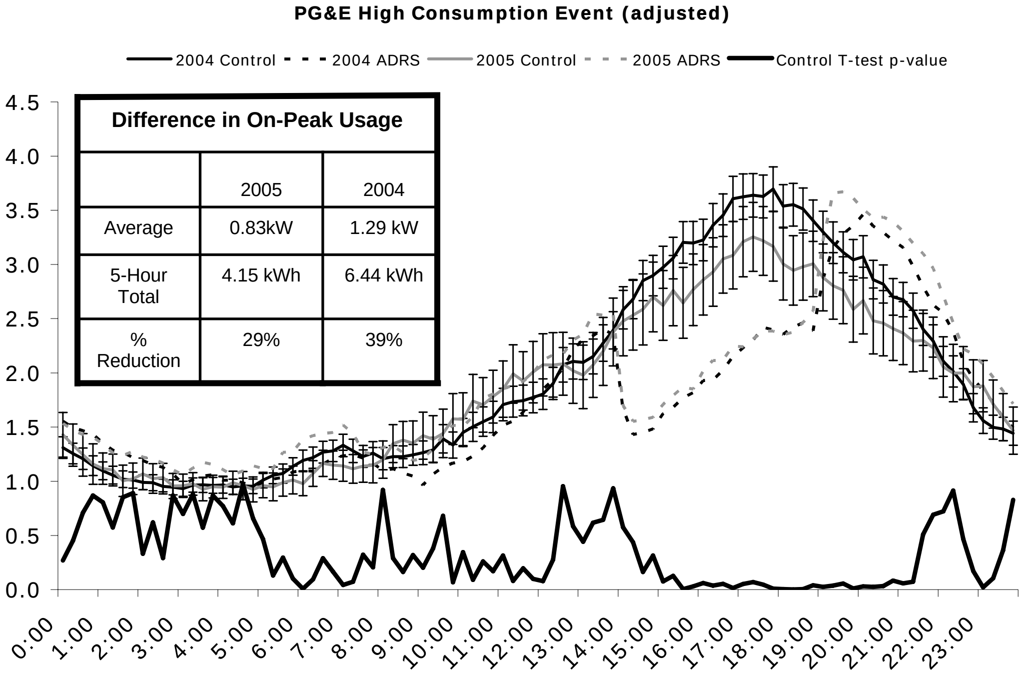


Figure 87 charts the average daily load curves for high consumption ADRS and control on non-event weekdays for both 2004 and 2005 summers in PG&E territory. Ninety percent confidence intervals were calculated and plotted around average load curves for control homes for each 15-minute period. The black line along the bottom of the chart displays the t-test p-value for each 15-minute period, which evaluates the probability that control home load differences between 2004 and 2005 were due to random chance.

Comparing peak period load reduction performance between years, high consumption ADRS homes reduced slightly less load compared to control during summer 2005 than in summer 2004, on non-event days. PG&E high consumption ADRS homes in 2005 reduced peak period load by an average 0.47 kW (18%) in 2005, compared to a 0.55 kW (22%) reduction in 2004. We deduce that the decrease in ADRS peak period load reduction in 2005 is because ADRS loads during the peak period increased in 2005 more than control home loads increased. The increase in both ADRS and control loads in 2005 is reasonable due to the hotter temperatures in the 2005 summer relative to the 2004 summer.

From the average daily load curves for ADRS and control homes shown in Figure 87, we observe that ADRS high consumption loads in 2005 were consistently higher than in 2004. The magnitudes of the ADRS load differences, however, varied by time of day. During off-peak periods, the difference in ADRS load between years was generally negligible. However the differences between years during peak and recovery period loads were more substantial, at 0.3 kW and 0.6 kW, respectively.

Similarly, control loads match each other fairly closely for the majority of off-peak hours between years. During the morning off-peak hours and early peak period, however, control load in 2005 is significantly greater than in 2004 on non-event weekdays. The average difference in control loads between years is 0.23 kW, or 16% greater than 2004 control load, from 9 a.m. to 1:45 p.m., and 0.19 kW, or 8%, greater during the peak period.

Figure 87: PG&E high consumption 2004 and 2005 non-event load curves

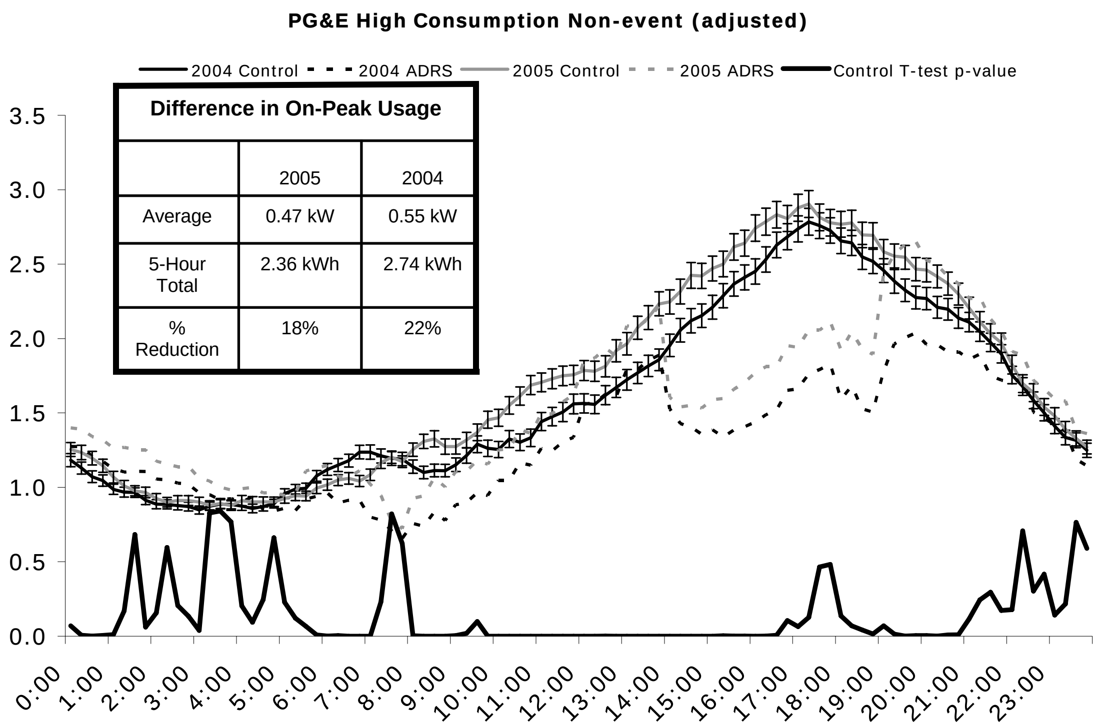
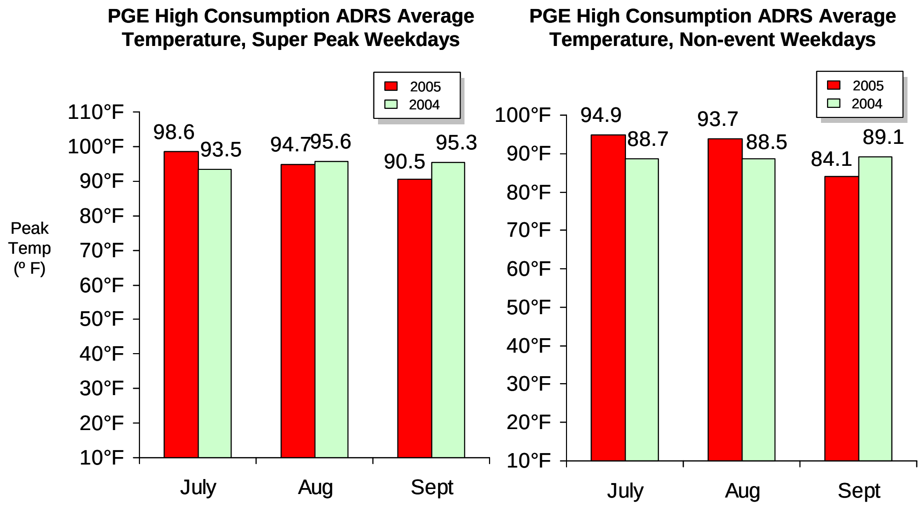


Figure 88 compares the average peak temperatures on event and non-event weekdays for 2004 and 2005. In PG&E service territory, September 2005 was a cooler month on both event and non-event days compared to 2004, while both July and August were hotter on average in 2005 than in 2004. On the other hand, while average temperatures were higher in 2005 for July on event days, they were same in August between the two years.

Specifically on event days, Super Peak period temperatures were high during all three summer months in both years. Average monthly event temperatures in 2005 declined from 98.6°F in July to 94.7°F in August and even further to 90.5°F in September. Corresponding 2004 monthly temperatures were less variable, maintaining averages between 93.5°F and 95.3°F from July through September. On event days, July temperatures were hotter in 2005 than in 2004. In August and September, however, event day temperatures were warmer in 2004.

Figure 88: Average Super Peak and peak period temperatures for 2004 and 2005 by month, PG&E



July and August 2005 non-event weekday average temperatures were almost as hot as the corresponding event days, averaging 94.9^{o}F and 93.7^{o}F, respectively. In September 2005, non-event weekday averages cooled by about 10^{o}F relative to July and August, to 84.1^{o}F. Non-event day peak period temperatures in July and August 2004 were cooler than corresponding months in 2005, but more consistent, varying between 88.7^{o}F and 88.5^{o}F between the two months. September non-event days in 2004 were 5^{o}F higher than in September 2005.

Comparing against statewide average temperatures summarized in Figure 75, PG&E monthly temperatures were hotter than the statewide average in 2004, on both event and non-event days. In 2005, however, PG&E average temperatures were hotter than statewide average temperatures on non-event days, but experienced similar and also cooler temperatures than the statewide average on event days, in August and September, respectively. This suggests that the event days called statewide in August and September were not the hottest days experienced by PG&E customers in 2005, with possible adverse results on ADRS load reduction performance.

Figure 89 compares the percentage load reductions during each hour of the Super Peak period between 2004 and 2005 of high consumption ADRS customers compared to control customers in PG&E service territory. Percentage reductions are consistently less in 2005 than in 2004. As noted before, this is mostly due to a lower relative 2005 control load during the peak period, resulting in lower savings in 2005. Nevertheless, Super Peak performance in high consumption ADRS homes in PG&E territory is reliable over consecutive years. Both years show the same downward trend in load reduction over the duration of the Super Peak period. In 2005, ADRS load reductions fell more substantially between the first and last hours of the Super Peak period than in 2004. In 2005, ADRS load reductions dropped 20% between the first and last hours of the Super Peak period compared to a 14% drop in 2004. This is again due to a curiously lower control customer load in 2005 compared to 2004.

Figure 89: PG&E high consumption 2004 and 2005 Super Peak hourly load reductions: in percent

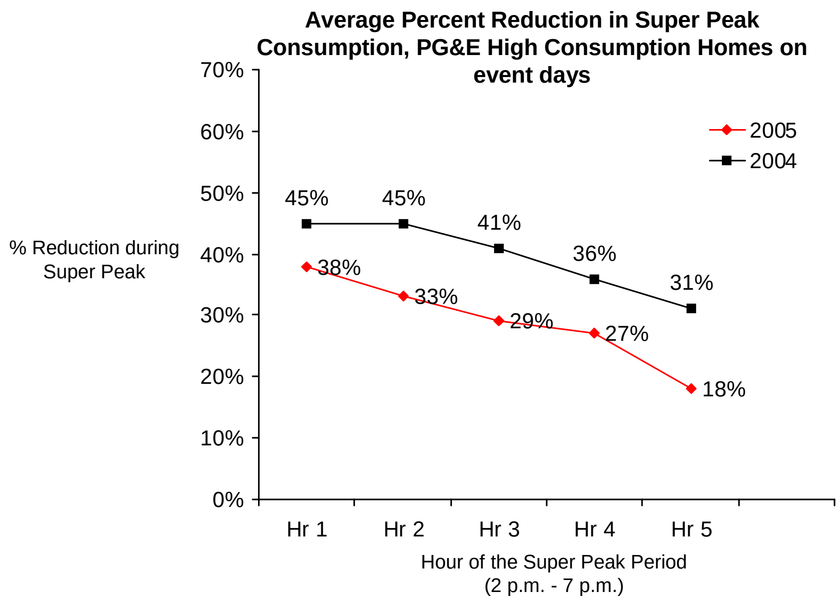


Figure 90: PG&E high consumption ADRS homes, 2005 event day Super Peak period kW reductions

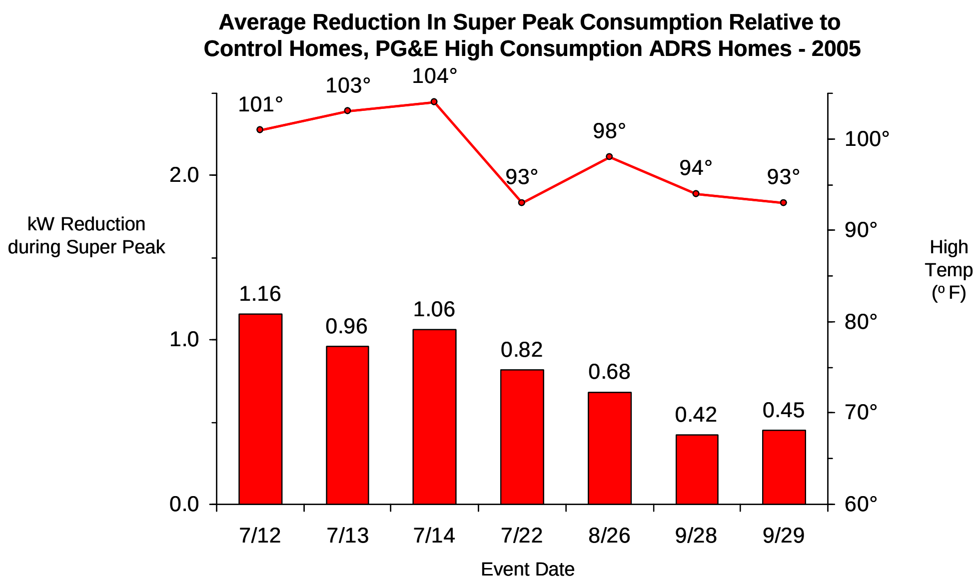


Figure 90 summarizes the 2005 ADRS load reductions for each event day along with the corresponding average peak temperatures for each event day in PG&E service territory. Super Peak period load reductions steadily declined over the course of the summer in 2005. The maximum savings of 1.16 kW occurred on the first event and the weakest performance of 0.42 kW reduction happened on the penultimate event day in September. The downward trend in performance also appears to correspond with the downward trend in average peak temperature. September 2005 event days are also suspect given they were called late in the month when the season was transitioning into autumn and likely changes in ADRS customer consumption behavior.

Figure 91 shows the ADRS load reductions for each event day in 2004 along with the corresponding average peak temperatures for each event day. Super Peak reductions were greater in 2004 than in 2005, compared to control home loads. The July 14 and July 22 event days elicited both the maximum and minimum performance of ADRS homes for summer 2004, at 1.93 kW and 0.72 kW reduction from control homes, respectively. The remaining event days in 2004 exhibited a smaller range of ADRS load reductions, between 1 kW and 1.5 kW.

Figure 91: PG&E high consumption ADRS homes 2004 event day Super Peak period kW reductions

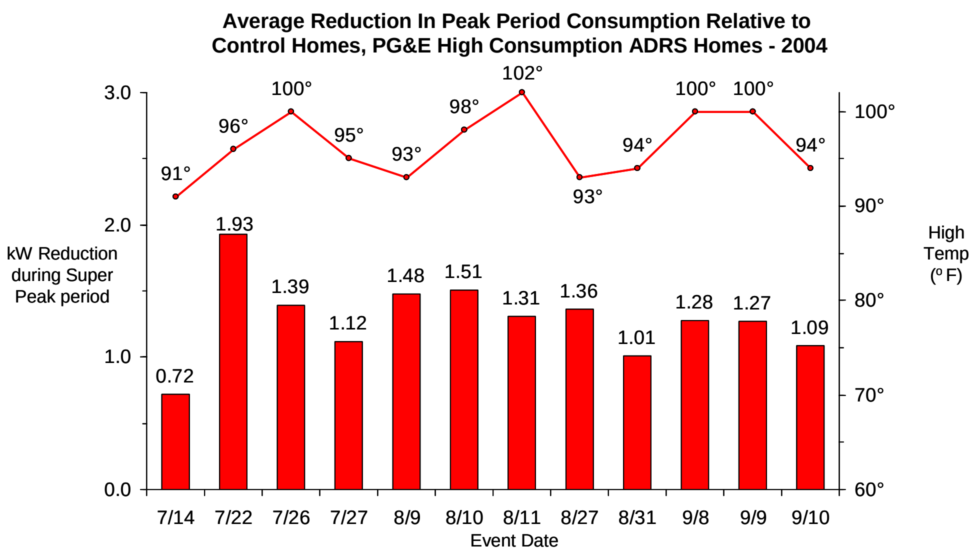


Figure 92 and Figure 93 calculate the 2005 and 2004 ADRS high consumption Super Peak period load reductions on each event day as a percentage of average control home load in PG&E service territory. Average peak temperature on each event day is also plotted, on a secondary axis. Percent load reductions are fairly consistent over all event days in 2005 and 2004. ADRS load reductions in 2005 as a percent of control home loads fell within an 11% range: between 22% and 33%. With the exception of July 14 event day in 2004, Super Peak period load reductions fell within a 13% range: between 35% and 48%.

To examine the relationship between average peak temperature and kW load reduction, we performed a correlation analysis using combined data for both 2004 and 2005 in Figure 90 through Figure 93. The resulting coefficient of correlation was 0.30, indicating a low correlation between temperature and ADRS load reduction.

Since the correlation between average peak temperature and ADRS Super Peak period load reduction was low, we decided to test the correlation between average ADRS load at 1:45 p.m. for each event day and the corresponding average Super Peak load reduction. After combining both 2004 and 2005 event day data, we calculated a coefficient of correlation of 0.36. Thus, for PG&E high consumption ADRS homes, there was also a low correlation between 1:45 p.m. load and average Super Peak load reductions.

Figure 92: PG&E high consumption ADRS homes 2005 event day Super Peak period percent reductions

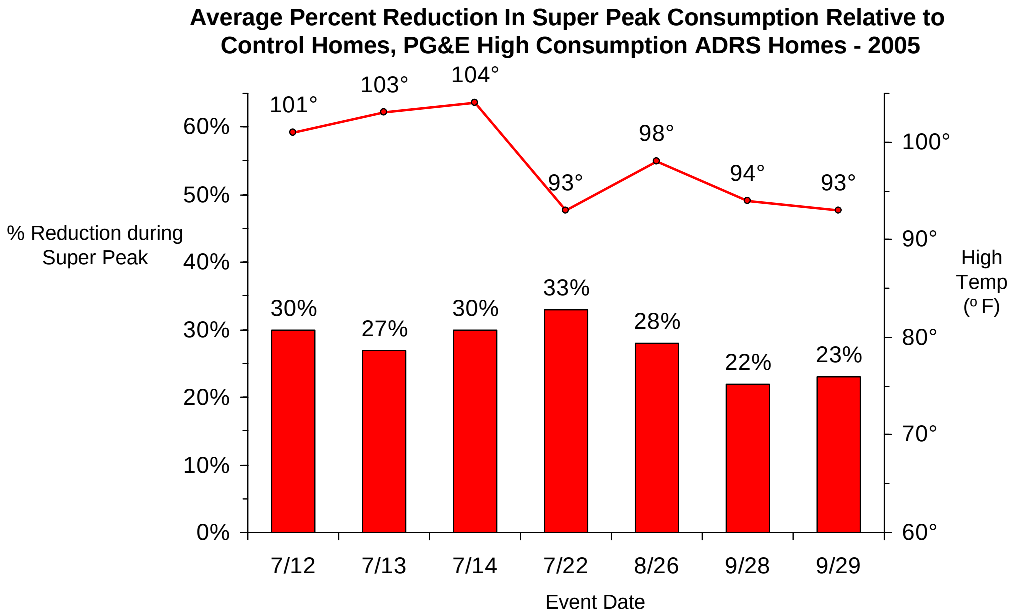


Figure 93: PG&E high consumption ADRS homes 2004 event day Super Peak period percent reductions

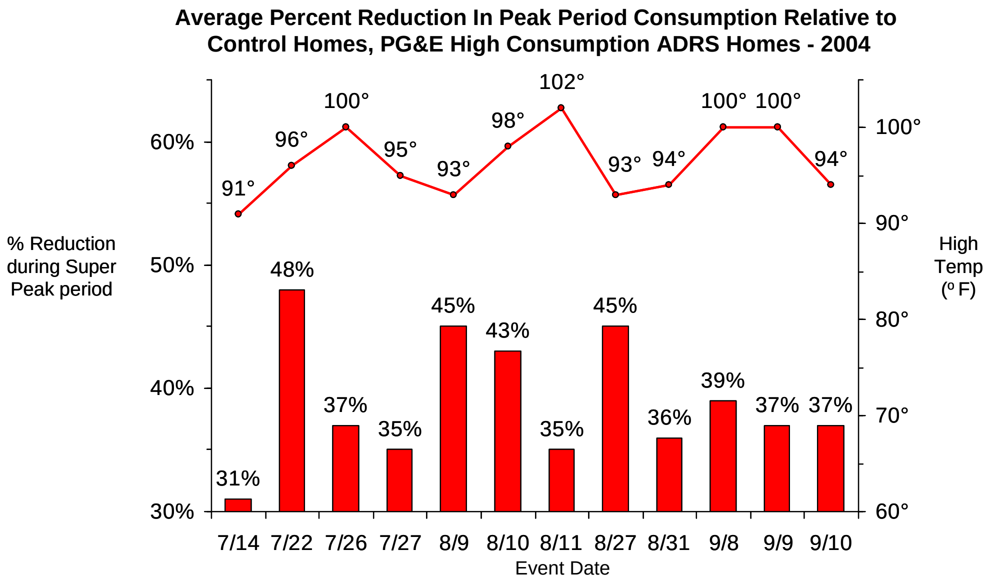


Figure 94 shows ADRS percent reductions compared to control homes over consecutive event days. 2005 event days are on the left and 2004 event days are on the right. In 2005, high consumption ADRS homes in PG&E service territory had consistent percent reductions across consecutive event days throughout the summer. For example in 2005, the three consecutive July event day load reductions varied by only 3% and September event day load reductions varied by only 1%. Event days in 2004 varied slightly more over consecutive days, especially on the August events. Load reductions shrunk 10% from August 9th to August 11th in 2004. Looking across both years, there does not seem to be any consistent relationship between temperature and consecutive day percent reduction.

Figure 94: PG&E high consumption 2004 and 2005 consecutive event days: Super Peak period percent reductions

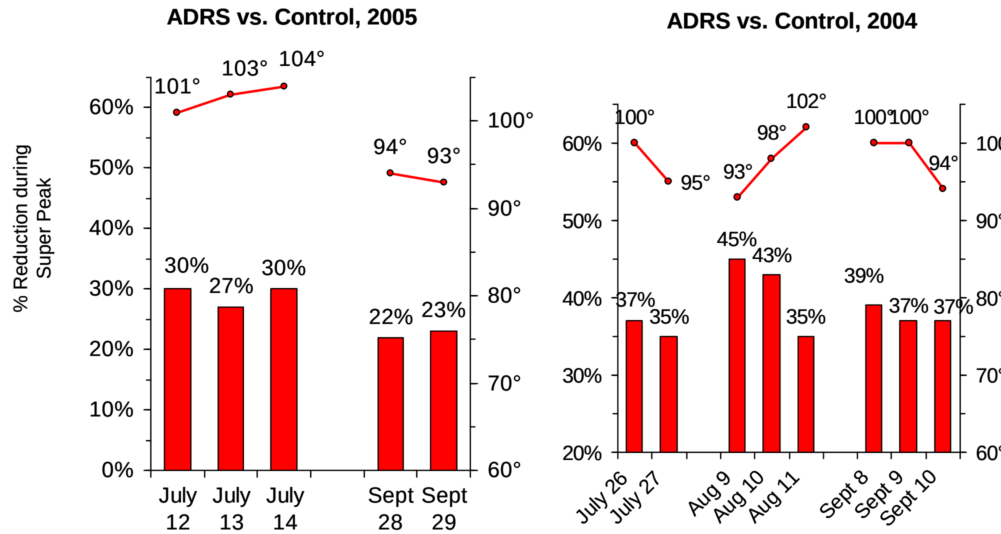


Figure 95 and Figure 96 plot the 2005 and 2004 event and non-event average consumption by peak, off-peak and recovery periods for ADRS and control groups. Comparing daily consumption patterns between years, the primary observable trend in these charts is the reduction of net energy conservation in ADRS homes and the increasing effect of shifting load into off-peak periods, from 2004 to 2005. On both event and non-event days for both years, ADRS high consumption homes consumed less energy than control homes during the peak period, and more energy than control homes in the recovery and off-peak periods. These differences in consumption are more pronounced on event days compared to non-event days, and more pronounced in 2004 compared to 2005. This indicates that ADRS homes were mostly engaged in shifting load from peak periods to off-peak periods in 2005, compared to 2004.

Figure 95: 2005 PG&E high consumption homes energy usage by period on event and non-event days

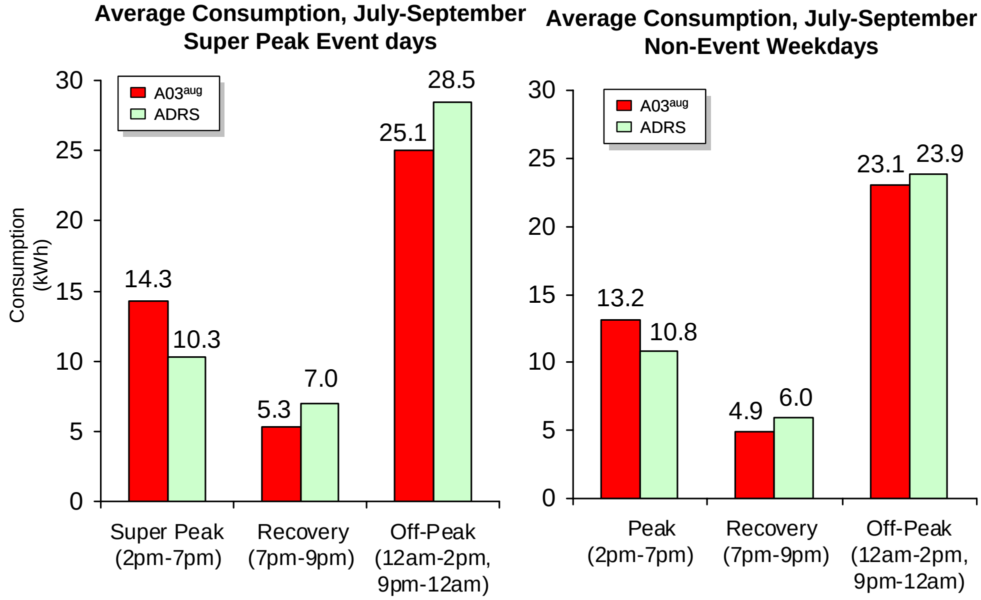
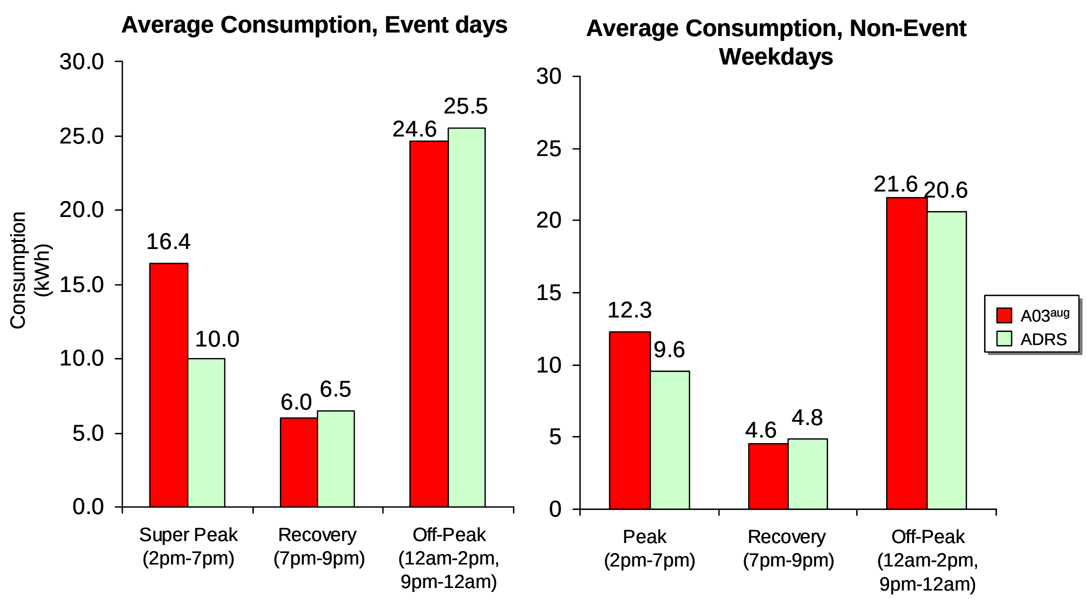


Figure 96: 2004 PG&E high consumption homes energy usage by period on event and non-event days



On event days, ADRS homes greatly reduced energy consumption relative to control during the Super Peak period by 4 kWh in 2005 and by 6.4 kWh in 2004. ADRS consumption increased marginally relative to control homes during the recovery and off-peak periods, by 1.7 kWh and 3.4 kWh, respectively, in 2005 and by 0.5 kWh and 0.9 kWh, respectively, in 2004.

On non-event days, ADRS homes showed a smaller peak period reduction relative to control compared to event days for both years. Peak period ADRS load reductions were 2.4 kWh and 2.7 kWh in 2005 and 2004, respectively. ADRS consumption during the recovery period was 1.1 kWh higher than control homes consumption in 2005 and was virtually the same in 2004. Finally on non-event days, ADRS homes consumed about as much energy in 2005 and by 1 kWh less than control homes in 2004 during the off-peak period.

Figure 97 and Figure 98 compare ADRS and control's average daily usage by month for event and non-event weekdays in 2005 and in 2004. Comparing average daily usage between 2004 and 2005, the trend is an increase in overall ADRS consumption in 2005, suggesting a movement away from conservation towards shifting load into off-peak periods.

Figure 97: 2005 PG&E high consumption homes average daily usage by month

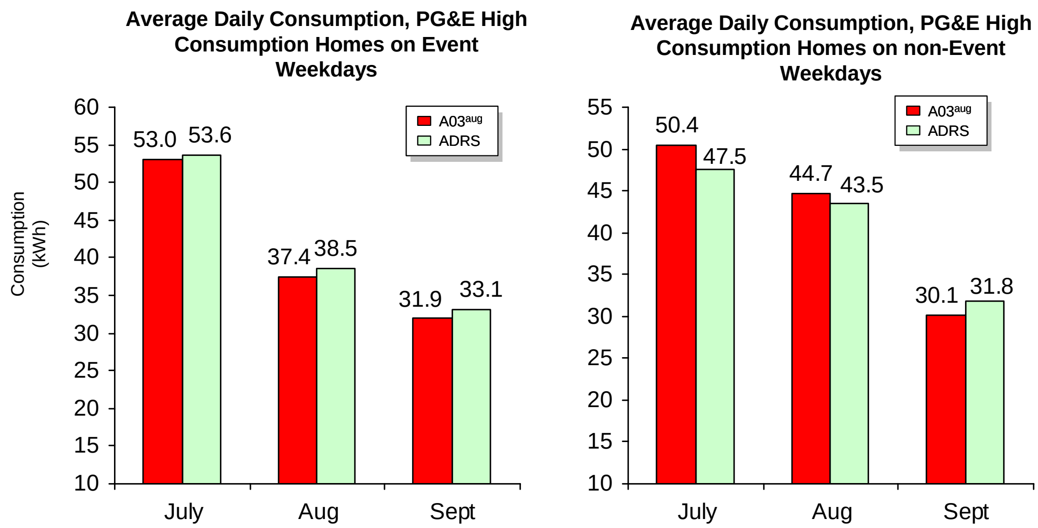
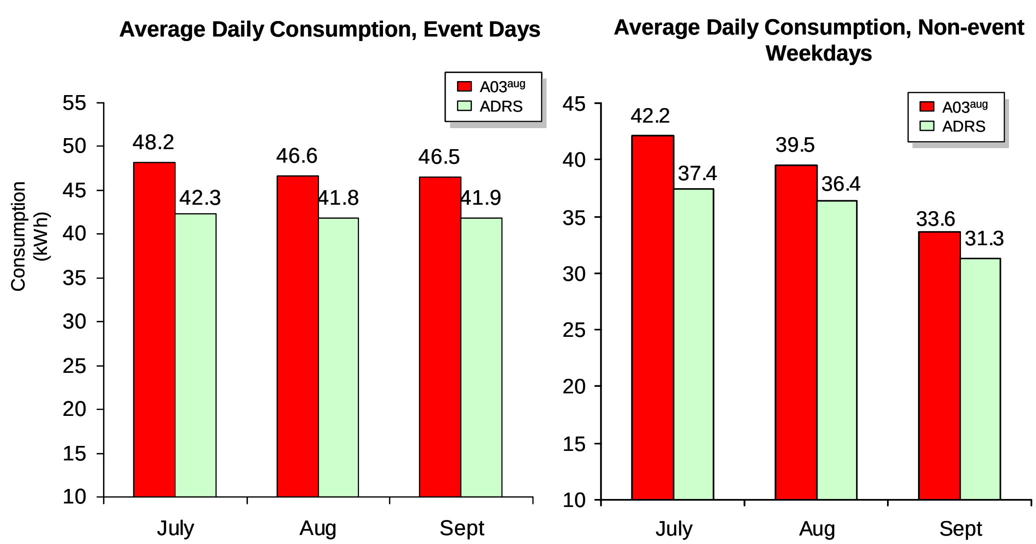


Figure 98: 2004 PG&E high consumption homes average daily usage by month



On event days in 2005, ADRS overall consumption was greater than control's for all summer months. This discrepancy is small, however, ranging from a 0.6 to 1.2 kWh difference in consumption. The relative parity in consumption supports the notion that the ADRS technology has a load-shifting benefit with no conservation benefit on 2005 event days. In contrast, high consumption ADRS homes in PG&E territory consumed significantly less energy than control homes on all summer days in 2004. On event days in 2004, ADRS homes consumed 5.6 to 5.9 kWh less energy than control homes from July through September.

On non-event days in July and August 2005, ADRS homes consumed less energy than control by 2.9 kWh and 1.2 kWh, respectively, while in September, ADRS homes consumed 1 kWh more energy than control homes. On non-event days in 2004, ADRS homes reduced more energy overall compared to 2005, by 2.3 to 5.8 kWh between July and September. Thus, for the majority of the summer, overall consumption patterns indicate both load shifting and conservation at work in ADRS homes on non-event days in 2005. In contrast, ADRS homes used technology to achieve a modest amount of energy conservation in 2004.

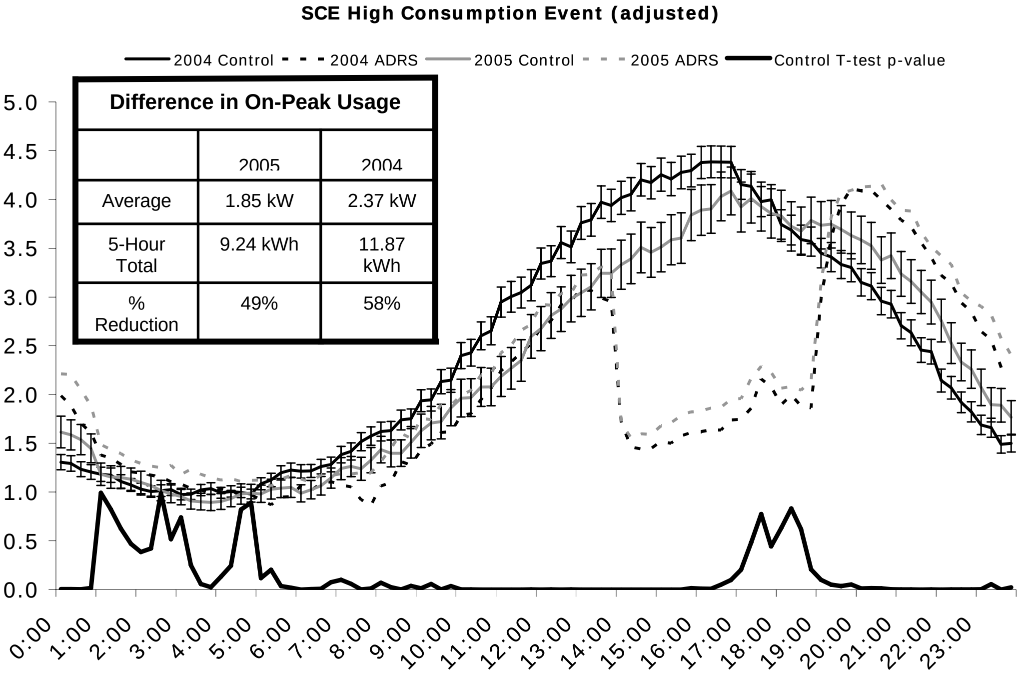
Event days in September 2005 featured substantially reduced overall consumption compared to other months. In contrast, September event days in 2004 featured similar ADRS and control consumption compared to other months. In PG&E service territory, non-event days in September were also substantially lower than the other months, for both 2005 and 2004. This corroborates the notion that the September event days in 2005, which were called at the end of the month, reflect a transition to autumn climate and different consumption behavior. This possibly explains the diminished reductions in both load and energy consumption observed in the above graphs in PG&E service territory.

3.3 Comparison of 2005 with 2004 high consumption ADRS load Impact, SCE

Figure 99 charts the 2004 and 2005 average event day load curves for ADRS and control groups. Figure 100 plots the 2004 and 2005 load curves for ADRS and control groups for non-event weekdays. Control customer load curves in both figures have ninety percent confidence intervals calculated for each 15-minute period as well as a statistical t-test p-value evaluating the similarity in control loads between years.

On event days in 2005, high consumption homes in SCE territory reduced load by 1.9 kW or 9.2 kWh during the Super Peak period. Super Peak period reductions were slightly higher in 2004, at 2.4 kW or 11.9 kWh on event days. On a percentage basis, ADRS customers reduced load by almost 50% relative to control homes in 2005 and by almost 60% in 2004. The downward shift in 2005 control load results in the small reduction in savings in 2005 compared to 2004. In contrast, ADRS loads were nearly the same between years. For ADRS homes, average Super Peak period load in 2005 was slightly higher on event days than in 2004, by 0.17 kW on average.

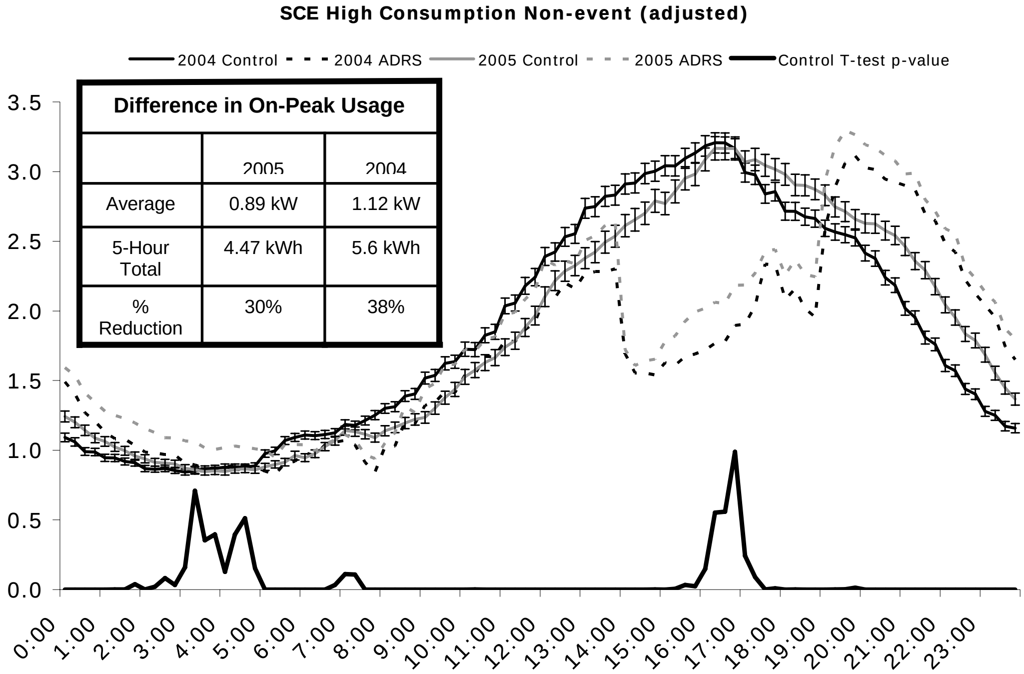
Figure 99: 2004 and 2005 SCE high consumption load curves



In addition to consuming less electricity in 2005 compared to 2004, high consumption control homes in SCE territory appear to shift load away from Super Peak period on event days. From Figure 99, we observe that control home load in 2005 rebounded noticeably between 7 p.m. and 9 p.m. in a manner that is very similar to ADRS load following the Super Peak period on event days. It appears from this observation that control homes on SCE territory might have become aware of announcements of event days and attempted to conserve energy on those days. Control homes loads during off-peak period between 12 a.m. and 7 a.m. were statistically similar, as indicated by the high t-test p-values. After 7 a.m., however, average control home loads between 2004 and 2005 began to diverge, with 2005 control homes consuming less than in 2004 through the rest of the morning and the majority of the Super Peak period.

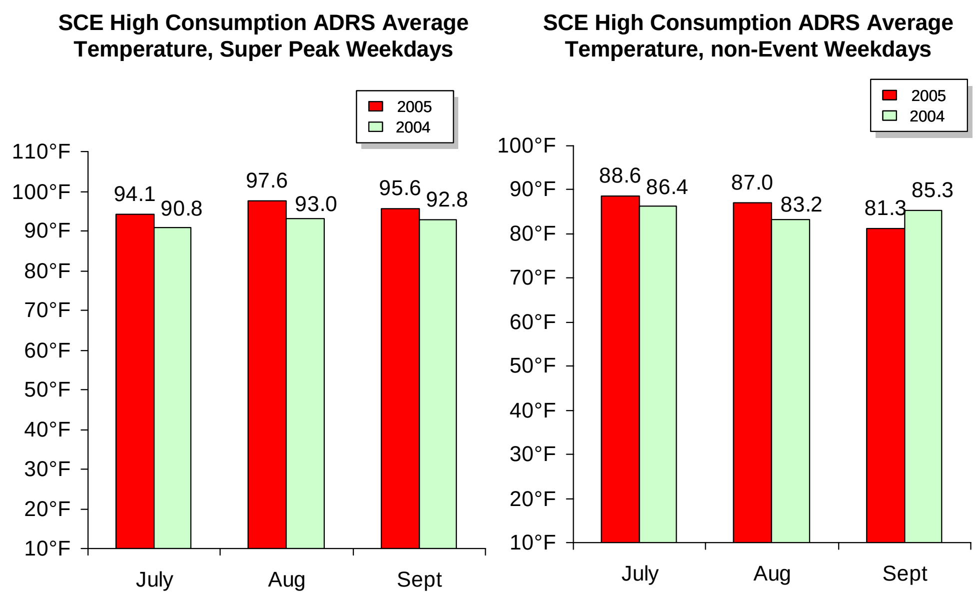
Differences in 2004 and 2005 non-event day control and ADRS average daily loads show similar trends described for event days (Figure 100). For ADRS homes, average load in 2005 was slightly higher on event days than in 2004, by approximately 0.2 kW during the peak period. Otherwise, ADRS loads have very similar profiles between years. Non-event day loads for control homes between 2005 and 2004 match up more closely than for event days. Control loads for the early morning off-peak period are similar but diverge around 7 a.m. As with event day loads, control homes consume less load in 2005 than in 2004 until the latter half of the peak period. Then, 2005 load exceeds 2004 load for the remainder of the day. There does not appear to be load shifting behavior in the high consumption control homes population on non-event days in 2005. However, the lower control homes consumption in 2005 at least during the first half of the peak period, despite hotter weather, suggests some degree of energy conserving behavior that was not observed in the control population in 2004.

Figure 100: 2004 and 2005 SCE high consumption load curves



According to the average peak temperatures in SCE territory shown in Figure 101 for 2004 and 2005 event and non-event days, 2005 was a hotter summer. Event days in 2005 averaged between 94.1°F to 97.6°F over 2005 summer months. The corresponding 2004 monthly averages ranged from 90.8°F to 93°F. Therefore, for event days, 2005 was 2.8°F to 5.6°F hotter than 2004 in SCE service territory.

Figure 101: 2005 and 2004 SCE high consumption average peak temperatures by month



Non-event days were consistently cooler (but still quite warm) on average than event days for both 2004 and 2005. Non-event average peak temperatures ranged from 81^oF to 89^oF, with July 2005 averaging the hottest out of any month in both years. The average August 2005 temperature of 87^oF exceeded the average temperature in August 2004 by 3.8^oF. On non-event days in September, the pattern is reversed, as 2005 was 5^oF cooler than the corresponding temperature in September 2004.

Comparing the average monthly temperatures in SCE territory to the statewide averages in Figure 75, temperatures were cooler than the statewide averages on both event and non-event days in 2005 with the exception of August. In 2004, average temperatures in SCE territory were slightly warmer than the statewide average on both event and non-event days.

Figure 102: 2004 and 2005 SCE high consumption Super Peak hourly percent reductions

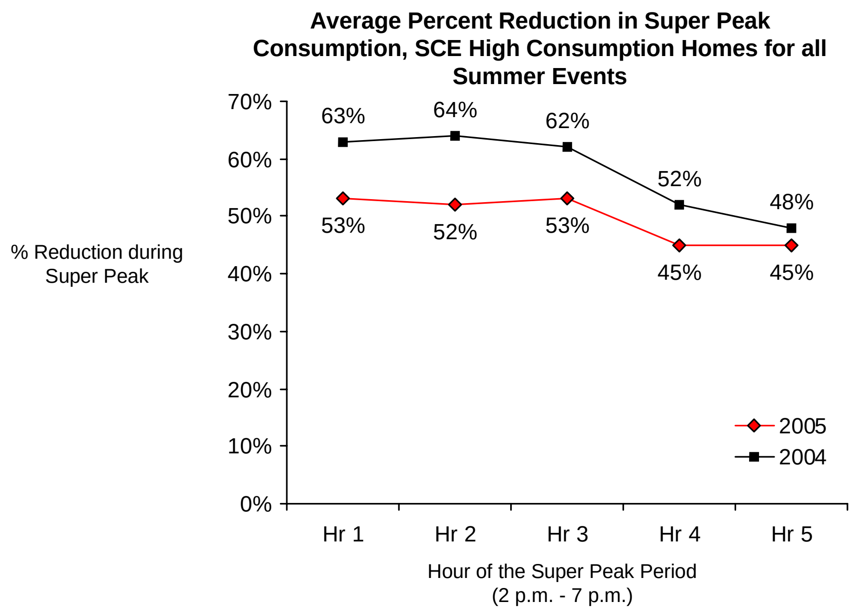
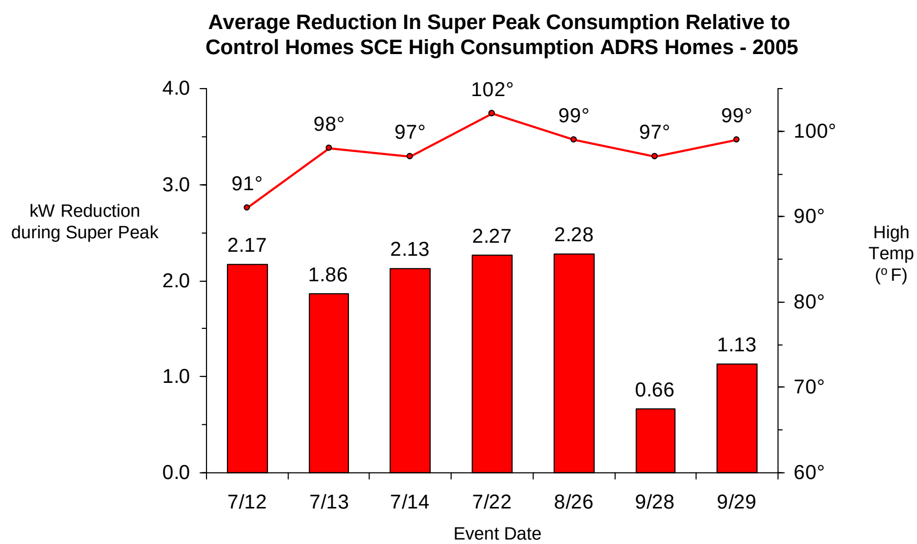


Figure 102 compares the 2005 and 2004 ADRS load reductions during each hour of the Super Peak period in SCE territory. Overall, hourly percent reductions are lower in 2005 than in 2004. Each year shows a similar downward trend of otherwise large percent reductions over the duration of the Super Peak period. Hourly percent reductions in 2004 show a slightly steeper decline than 2005 percent reductions, beginning at 4 p.m. On the other hand, ADRS load reductions compared to control customers are stable and sustained during the first three hours of the Super Peak period in both 2005 and 2004. ADRS load reductions in 2004 drop 15% over the Super Peak period compared to an 8% drop in 2005.

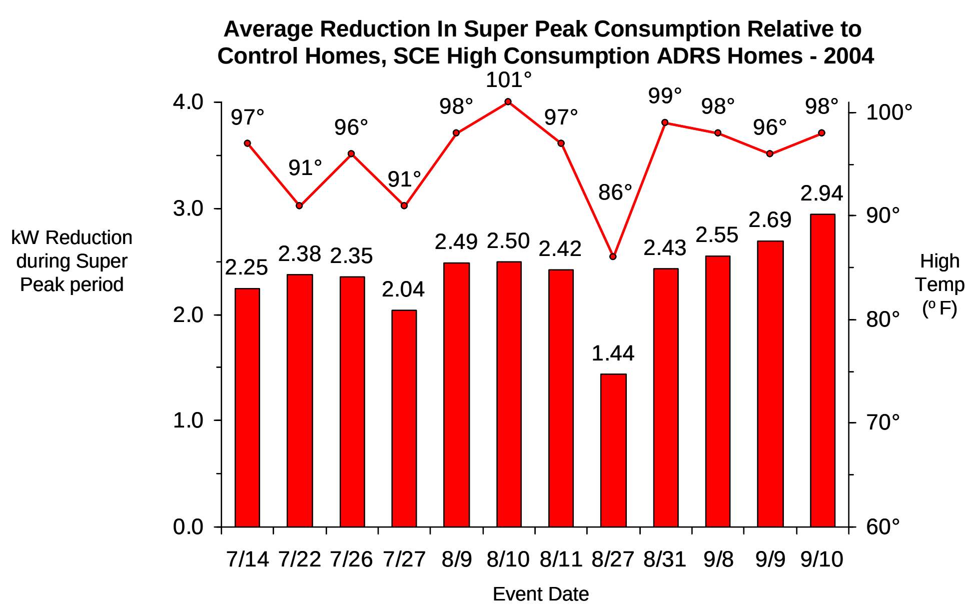
Figure 103 displays the 2005 ADRS load reductions for each event day along with the average Super Peak temperature on that day. ADRS load reductions compared to control group were very strong in July and August 2005, ranging from 1.86 kW to 2.28 kW. September event days in 2005 had markedly lower load reductions of 0.66 and 1.13 kW. This may be due in part to the timing of the event days at the end of September with associated changes in ADRS consumption behavior in anticipation of autumn. The dramatically lower Super Peak reductions in September contributed to lower average summer 2005 load impact of SCE's high consumption ADRS homes.

Figure 103: 2005 SCE high consumption event day Super Peak period load reductions: in kW



Load reductions for 2004 event days were even stronger than 2005 event day load reductions, shown in Figure 104. With the exception of a cool August 27th event, reductions in 2004 ranged from 2.0 kW to nearly 3 kW on average over the Super Peak period. Unlike summer 2005, September load reductions for SCE ADRS customers were the greatest compared to July and August, with average reductions between 2.6 kW and 2.9 kW.

Figure 104: 2004 SCE high consumption event day Super Peak period load reductions: in kW



The 2005 and event day load reductions as a percentage, drawn in Figure 105 and Figure 106, indicate a slight downward trend. With the exception of September 2005 event days, percent reductions were substantial, ranging from 47% to 59%. Super Peak load reductions in September 2005 were still admirable, at almost 30% and 37% compared to control homes. Maximum percent reduction occurred on the first event day and the lowest percent reductions happened on the last two event days in 2005. The percentage reductions for 2004 indicated more consistent savings than the 2004 load reductions represented in Figure 104. Reductions fell consistently within a 10% range between 52% and 62%. These percent reductions were also consistent across a variety of temperatures.

Figure 105: 2005 SCE high consumption event day Super Peak period percent load reductions

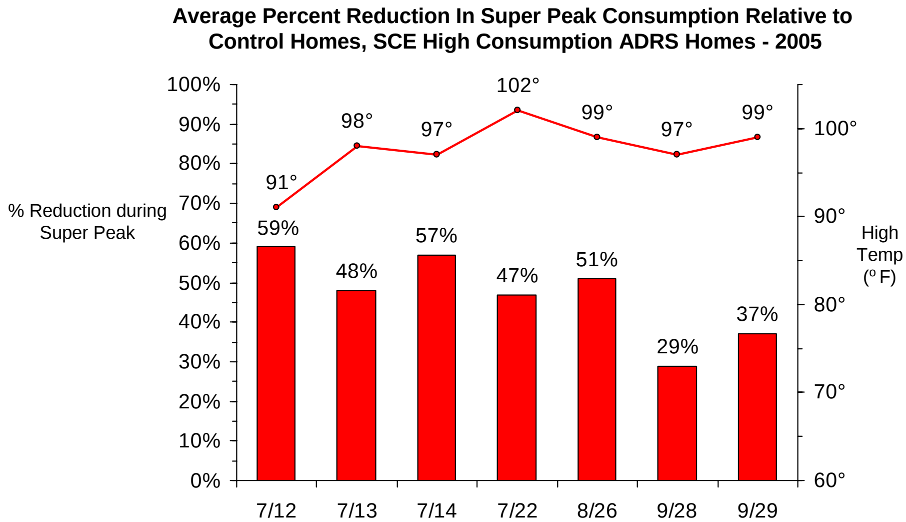
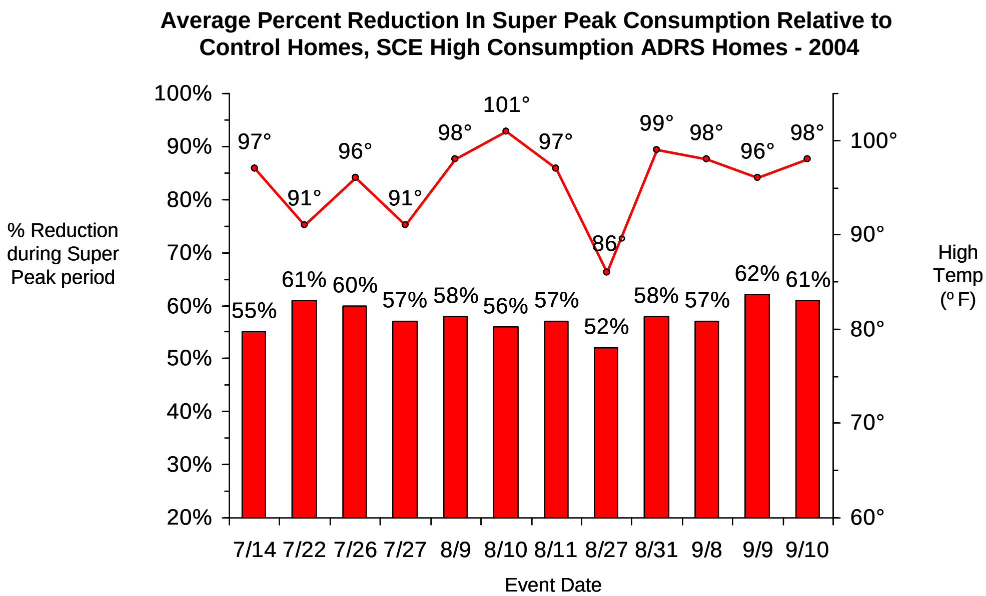


Figure 106: 2004 SCE high consumption event day Super Peak period percent load reductions



To examine the relationship between average peak temperature and kW load reduction, we combined the data in Figure 103 and Figure 104 and performed a correlation analysis. The resulting coefficient of correlation of 0.22 indicated a low correlation between these two factors.

Since the correlation between average peak temperature and ADRS Super Peak period load reduction was low, we decided to test the correlation between average ADRS load at 1:45 p.m. for each event day and the corresponding average Super Peak load reduction. After combining both 2004 and 2005 event day data, we calculated a coefficient of correlation of 0.49. Thus, for SCE high consumption ADRS homes, there was a moderate correlation between 1:45 p.m. load and average Super Peak load reductions.

Figure 107 juxtaposes percent load reductions over consecutive event days for 2004 (right) and 2005 (left). High consumption ADRS Super Peak period load reductions compared to control homes in SCE territory were consistent across consecutive event days, though 2005 displayed wider variability over consecutive days than in 2004. Consecutive event days in July 2005 varied by 11% while the maximum variability in 2004 consecutive event days was only 5%. July 2005 reductions were comparable with 2004 July reductions. However, September reductions in 2005 were roughly half September 2004 reductions. Temperature appeared to correspond well with percent reduction on consecutive days in either year.

Figure 107: 2004 and 2005 SCE high consumption Super Peak period percent load reduction on consecutive event days

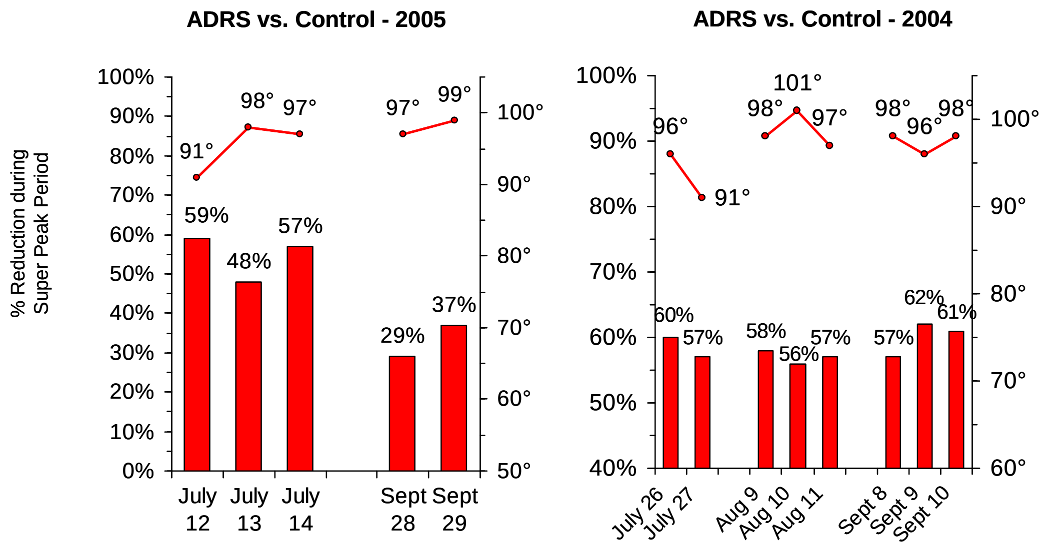


Figure 108 and Figure 109 chart average energy consumption by peak, off-peak and recovery periods for ADRS and control groups in 2005 and 2004 in SCE territory. The recovery and off-peak energy consumption of ADRS homes in excess of control homes energy consumption indicates that ADRS homes were mostly engaged in significant load shifting from peak to off-peak periods for both summer 2005 and summer 2004. During summer 2005, there was further reduction in net energy conservation of ADRS customers towards load shifting to off-peak periods compared to summer 2004.

On both event and non-event days in both 2005 and 2004, ADRS customers consumed less energy than control customers during the Super Peak and peak periods, and more energy in the recovery and off-peak periods. ADRS energy reduction relative to control customers was lower during the Super Peak period in 2005 than in 2004, by 9 kWh and 12 kWh, respectively.

ADRS and control customer consumption during the recovery period was similar on event days in 2005 and 2004, where both groups consumed between 6.4 and 7.9 kWh during the period. On non-event days, ADRS and control customers' consumption during the recovery period was also similar, at almost 5 kWh and 6.3 kWh during this period. On the other hand, ADRS customers consistently consumed 1 kWh more than control customers on both event and non-event days, and for both 2005 and 2004 pilot years. An exception is recovery period energy consumption averaged across event days in 2005, when the difference in consumption between ADRS and control customers was a marginal 0.7 kWh.

ADRS and control customer consumption during the off-peak period were similar on event days in 2005 and 2004, where both groups consumed between 30 kWh and 34 kWh during the period. On non-event days, ADRS and control customers consumption during the recovery period were also similar, between 24 kWh and 27 kWh during this period. However, differences between ADRS and control customer consumption during the off-peak period were greater in 2005 than in 2004, supporting our view that ADRS homes were engaged in more significant load shifting in summer 2005 than in summer 2004.

Figure 108: 2005 SCE high consumption homes energy usage by period on event and non-event days

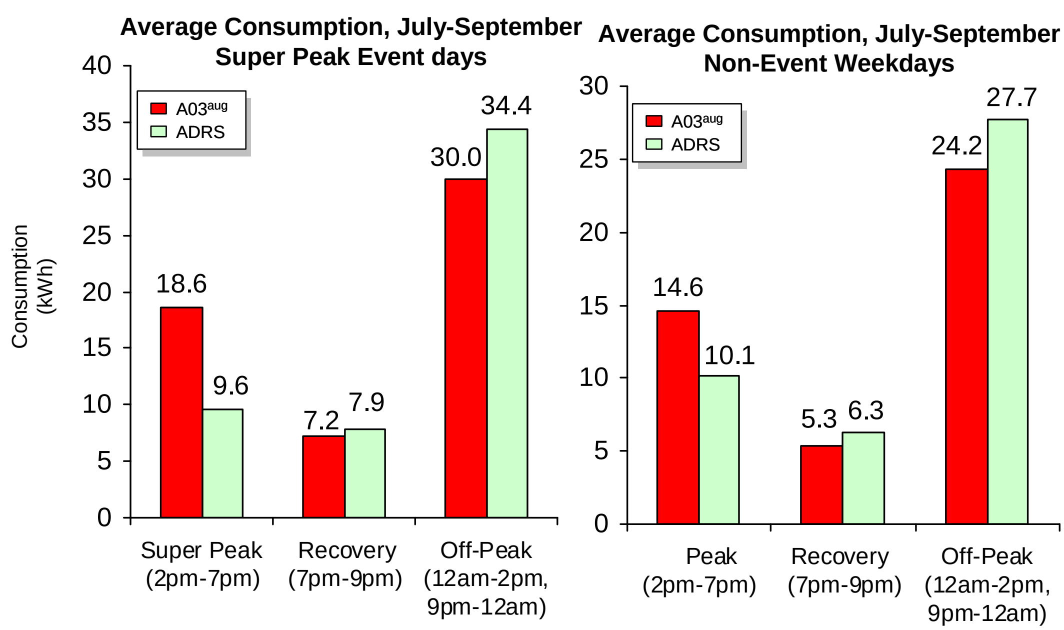


Figure 109: 2004 SCE high consumption homes energy usage by period on event and non-event days

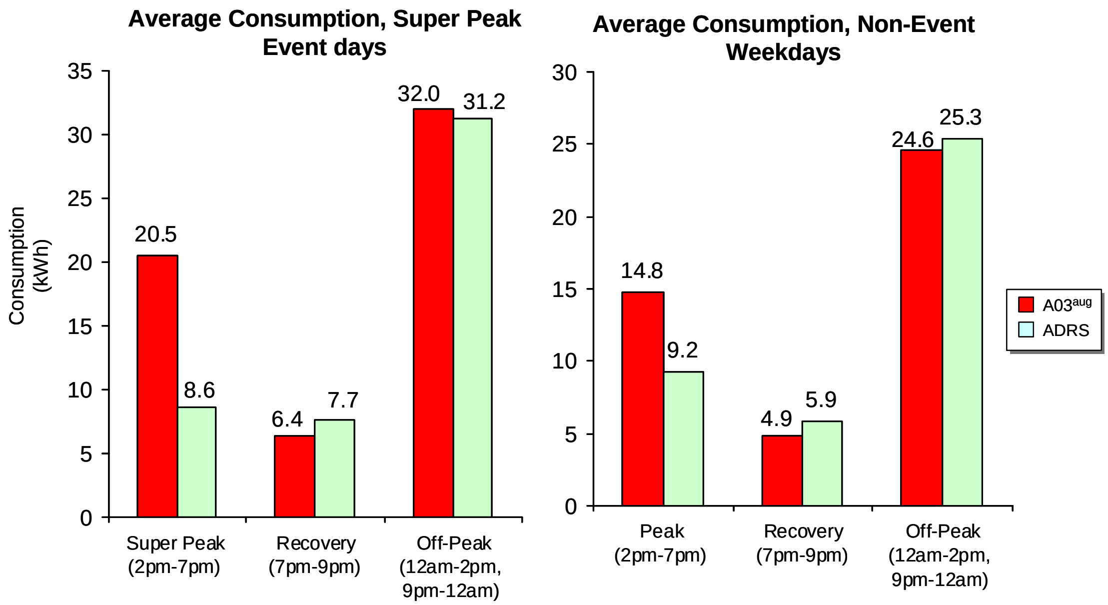


Figure 110 and Figure 111 compare average daily usage of high consumption ADRS and control customers in SCE territory by month for event and non-event weekdays in 2005. In 2004, ADRS high consumption customers consistently consumed less energy than control customers throughout the summer months, on both event and non-event days. Note that most of this reduction in average daily usage results from load reductions during Super Peak and peak periods. Thus, ADRS technology proves to be conserving a modest amount of energy on all days in 2004. On the other hand, ADRS high consumption customers consistently consumed as much or more energy on a daily basis compared to control customers in 2005, with the exception of event days in July and August. These observations support our view that ADRS customers moved away from conservation towards more aggressively shifting load from peak period to off-peak periods in 2005.

For event days in 2005, ADRS overall consumption was less than control's for July and August. This discrepancy in July and August event day consumption was significant, ranging from 4.1 kWh to 5.9 kWh. ADRS event day energy consumption was 1.2 kWh greater than control homes in September, signifying ADRS load shifting behavior from Super Peak to off-peak hours. Average daily usage on non-event days in 2005 show that ADRS homes consumed about the same amount of energy daily as control homes. Thus in 2005, ADRS homes on non-event days seem to be exclusively shifting load from peak period to off-peak hours.

On all summer days in 2004, ADRS homes consumed 9.9 kWh to 14.3 kWh less energy than control homes. On non-event days, ADRS customers achieved more modest savings from control consumption between 0.9 kWh to 5.8 kWh lower average daily usage.

Figure 110: 2005 SCE high consumption homes: average daily usage on event and non-event weekdays by month

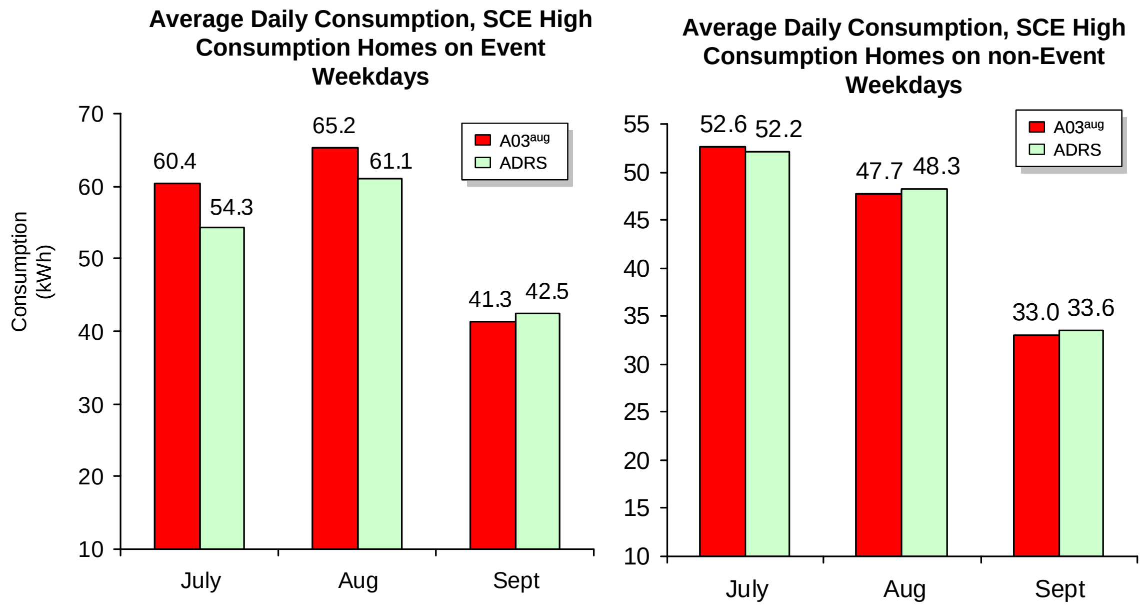
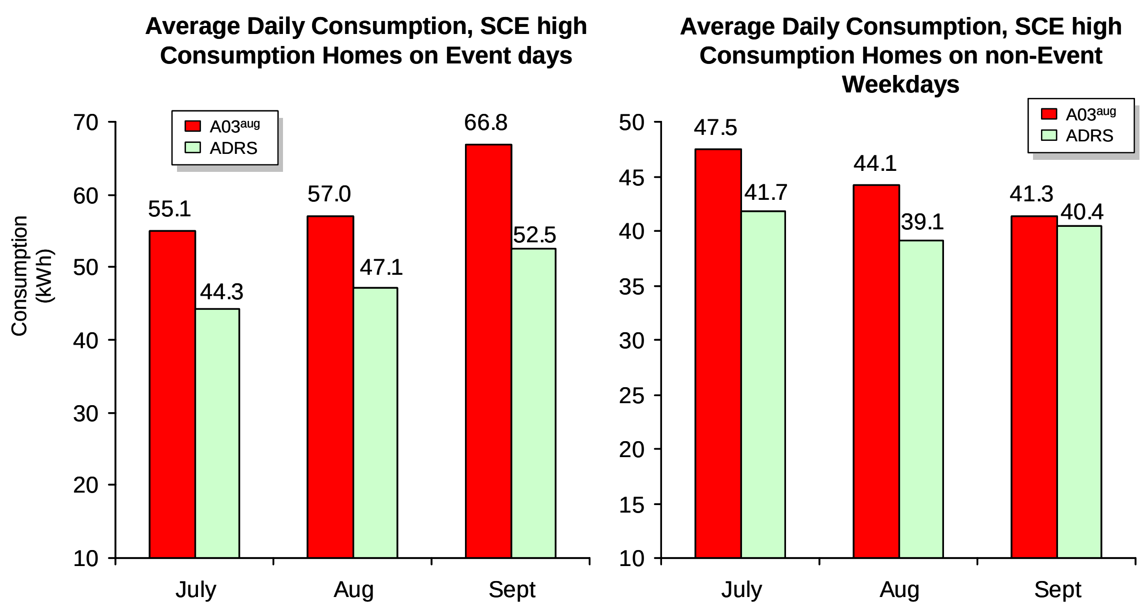


Figure 111: 2004 SCE high consumption homes: average daily usage on event and non-event weekdays by month



Event days and non-event weekdays in September 2005 featured substantially reduced overall consumption compared to other months in SCE service territory. In contrast, September event and non-event days in 2004 featured similar ADRS and control consumption compared to other months. This corroborates the notion that the September event days in 2005, which were called at the end of the month, reflect a transition to autumn climate and different consumption behavior. This possibly explains the diminished reductions in both load and energy consumption in September observed in the above graphs in SCE service territory.

3.4 Comparison of 2005 and 2004 high consumption ADRS load impact, SDG&E

The SDG&E event day load curves for 2004 and 2005 are plotted in Figure 112. Ninety percent confidence intervals were drawn above and below the control curves for each 15-minute period and the t-test p-value evaluating similarity in control loads is plotted beneath the curves. It should be noted that there are only six existing high consumption ADRS homes in SDG&E territory. This small sample size does not usually yield statistically significant or meaningful results.

Super Peak period savings exhibited virtually no change between years. In both years, ADRS homes reduced load by 1.20 kW in 2004 and 1.17 kW in 2005 compared to control homes. As a percentage, however, these reductions translated to 38% and 41% for 2005 and 2004, respectively.

ADRS loads during Super Peak period in 2005 surpassed 2004 ADRS load from 5 p.m. to 7 p.m. Overall, 2005 ADRS Super Peak load was higher by 10% compared to 2004. Control loads, on the other hand, were statistically the same for a majority of the day, as indicated by the near unity t-test p-values, suggesting a high probability that differences in control home loads between to two years are due to random chance. The 2005 average control homes loads are slightly higher than average control homes loads in 2004, by 5% during the Super Peak period.

Figure 112: SDG&E high consumption 2004 and 2005 event day load curves

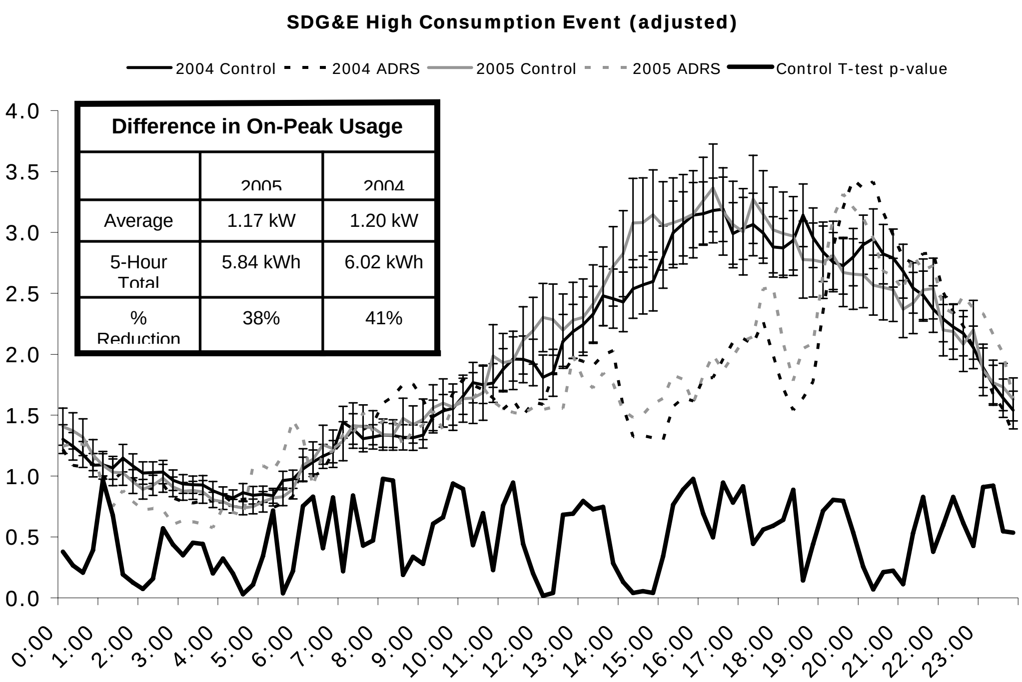


Figure 113 plots the summer 2004 and 2005 average daily load curves for ADRS and control homes for non-event weekdays. Control homes load curves have ninety percent confidence intervals plotted above and below the average value for each 15-minute period. T-test p-values measuring the similarity of control loads between years are also plotted at the bottom of the figure.

High consumption ADRS homes in SDG&E service territory achieved greater peak period load reductions in 2005 compared to 2004. ADRS homes reduced peak period load by an average of 0.7 kW on non-event weekdays in 2005, compared to 0.4 kW in 2004. As a percentage, ADRS Super Peak period load reduction in 2005 was 27% compared to 17% in 2004. The increase in ADRS load reduction in 2005 was due to the increase in 2005 control home load relative to 2004 during the peak period.

ADRS load curves plotted for 2005 and 2004 in Figure 113 match each other closely. ADRS load consumption differences during the peak period were negligible at 0.1% between 2004 and 2005. Control loads match between years for a majority of off-peak hours. Around 10 a.m., 2005 control load diverges above 2004 load until the end of the peak period. Over the peak period, control load in 2005 was 14% higher than control load in 2004.

Figure 113: SDG&E high consumption 2004 and 2005 non-event load curves

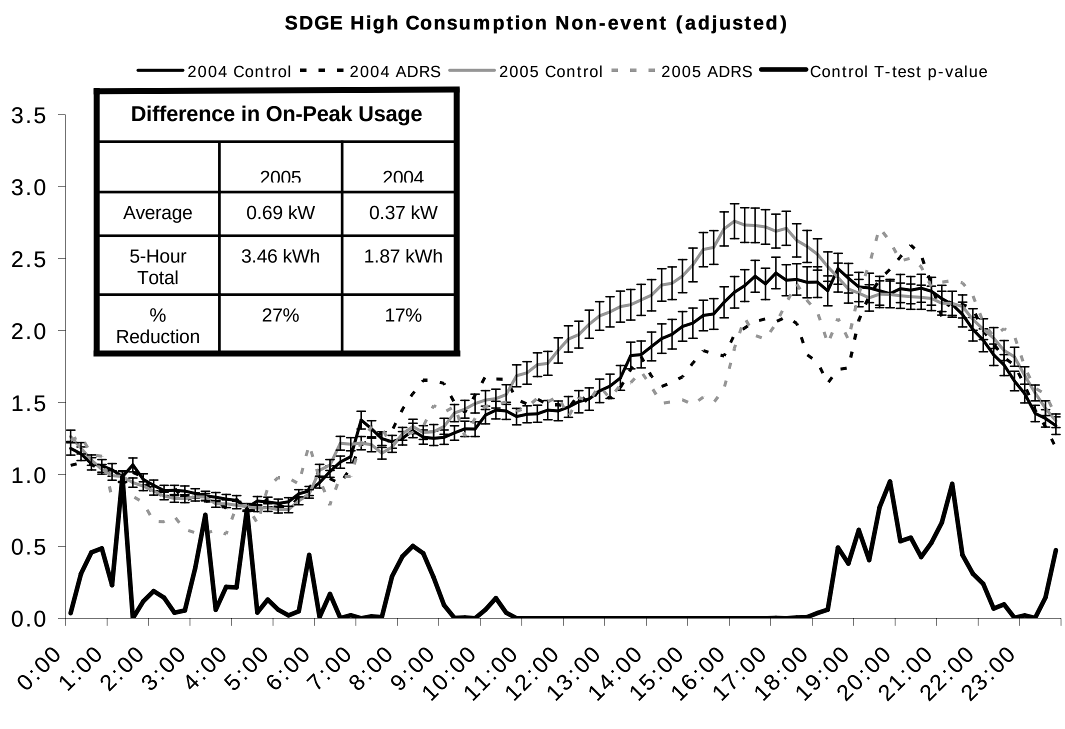
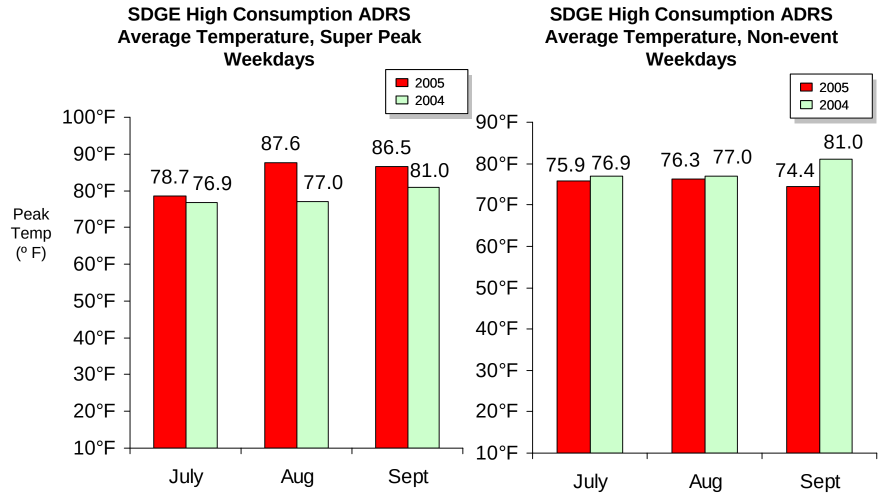


Figure 114 illustrates the average Super Peak and peak period temperatures on event and non-event days, respectively, for high consumption control and ADRS homes in SDG&E service territory. Event day temperatures were hotter in 2005 than in 2004 for all summer months. Average temperatures in SDG&E territory became warmer as the summer progressed in both 2005 and 2004.

Figure 114: SDG&E 2004 and 2005 average peak temperatures for event and non-event weekdays



On non-event days, average temperatures between summer 2005 and summer 2004 were reversed: 2004 was slightly hotter than 2005 during July and August and considerably hotter in September. Monthly average temperatures on non-event days in 2005 also appeared to get warmer as the summer progressed, while average temperatures remained fairly consistent across the summer months in 2004. Temperatures in SDG&E territory were consistently cooler than the statewide average temperatures on event and non-event days, by at least 10°F in both 2005 and 2004.

Figure 115: SDG&E 2004 and 2005 Super Peak period percent load reductions

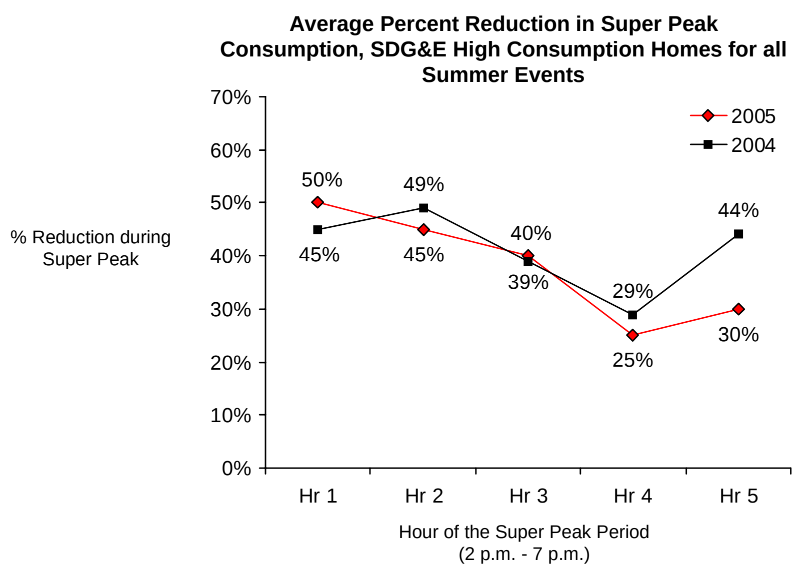


Figure 115 graphs the average hourly percent load reductions during the Super Peak period for high consumption ADRS customers during summer 2004 and summer 2005. Both years show the same downward trend for the first four Super Peak hours with recovery in performance during the fifth hour. For the first four hours, hourly percent reductions in 2005 are quite similar compared to 2004, with differences of only 5% on average. Overall, SDG&E ADRS customers achieved consistently strong load reductions during both 2004 and 2005.

Figure 116 displays the high consumption ADRS Super Peak period load reductions on each event day during summer 2005 and plots the average peak temperature on a secondary axis. Figure 117 presents the same information for summer 2004. Event days in 2005 showed a wide range of load reductions, varying from 0.5 kW to 1.74 kW. There was also a noticeable increase in savings with the steady increase in temperature. High consumption ADRS load reductions in 2004 show a similar variability as in 2005, with a nearly 2 kW spread between event days. The 2004 load reductions showed the same variability in spite of much more consistent and mild average peak temperatures.

Combining both years of event day temperature and kW load reduction data from Figure 116 and Figure 117, we performed a correlation analysis to evaluate the relationship between the two sets of data. The resulting coefficient was calculated as 0.30, indicating low correlation between temperature and kW savings. In a subsequent analysis, we examined the correlation between average ADRS load at 1:45 p.m. for all event days and the corresponding average Super Peak period ADRS load reductions. This resulting coefficient of correlation was 0.65, indicating a moderately strong relationship for SDG&E high consumption homes.

Figure 116: 2005 SDG&E high consumption event day Super Peak period kW reductions

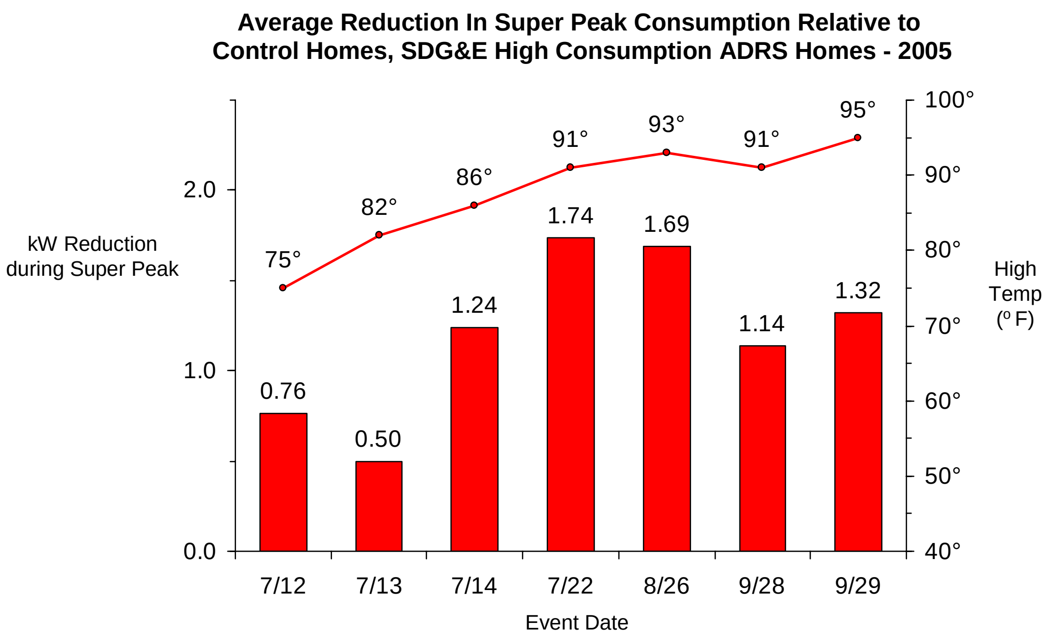


Figure 117: 2004 SDG&E high consumption event day Super Peak period kW reductions

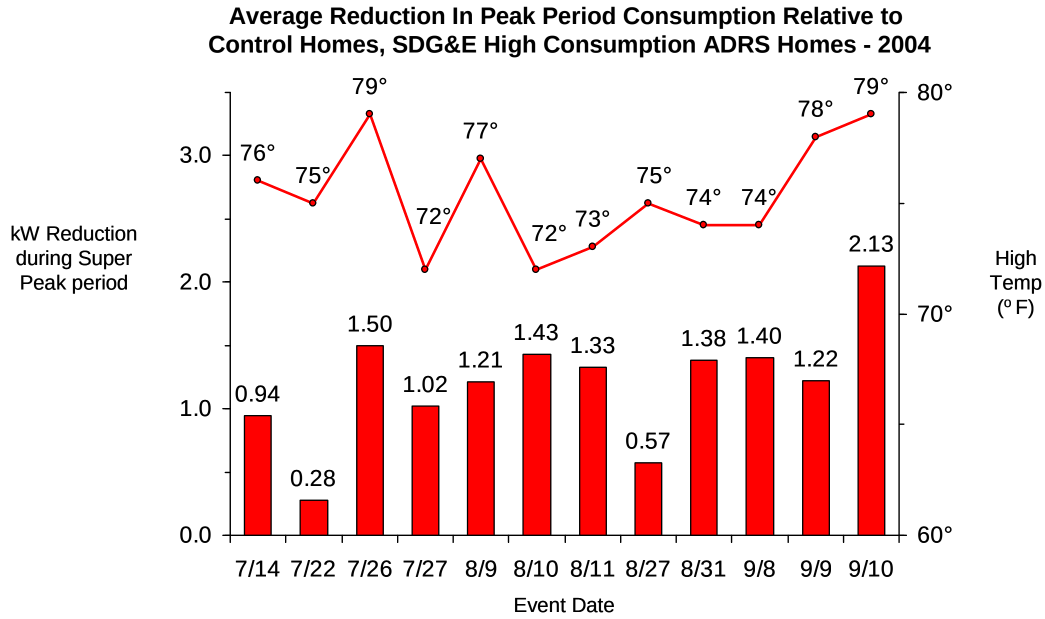


Figure 118 and Figure 119 summarize the Super Peak period load reductions as a percentage of control customer load in 2005 and 2004, respectively. Corresponding event day temperatures are plotted along a secondary axis in both figures. High consumption ADRS Super Peak period load reductions were consistent across event days in both years. Performance was strong from mid-July through September, when the average peak temperatures were above 85° F, percent reductions fall within 40% and 45%. Percent load reductions in 2004 were often substantial, but also show great variability compared to 2005. Savings in 2004 ranged from 12% to 58% between July and September.

Figure 118: 2005 SDG&E high consumption event day Super Peak period % reductions

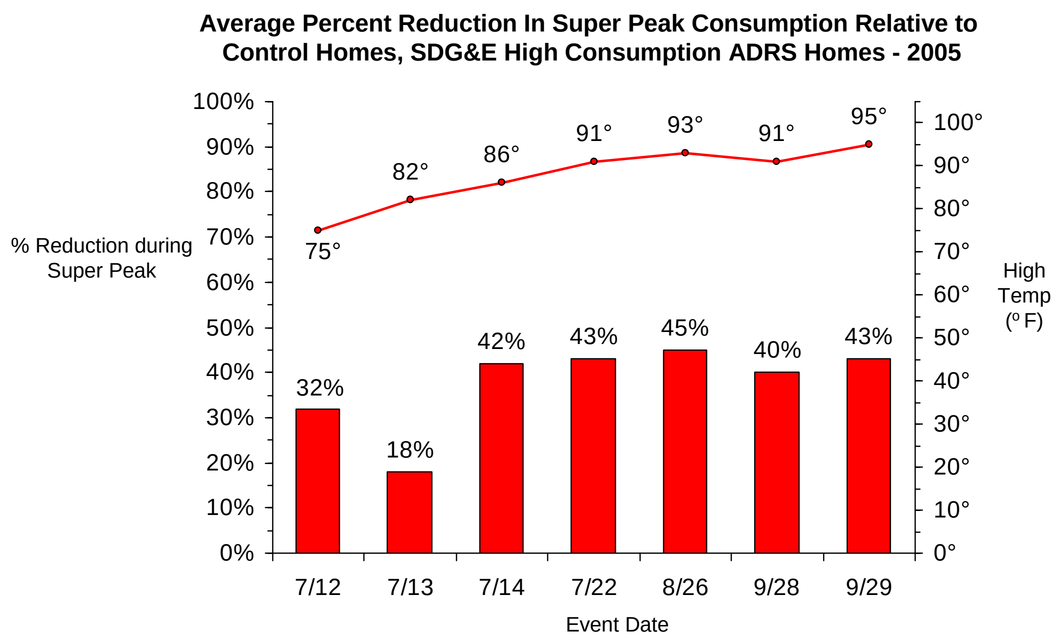


Figure 119: 2004 SDG&E high consumption event day Super Peak period percent reductions

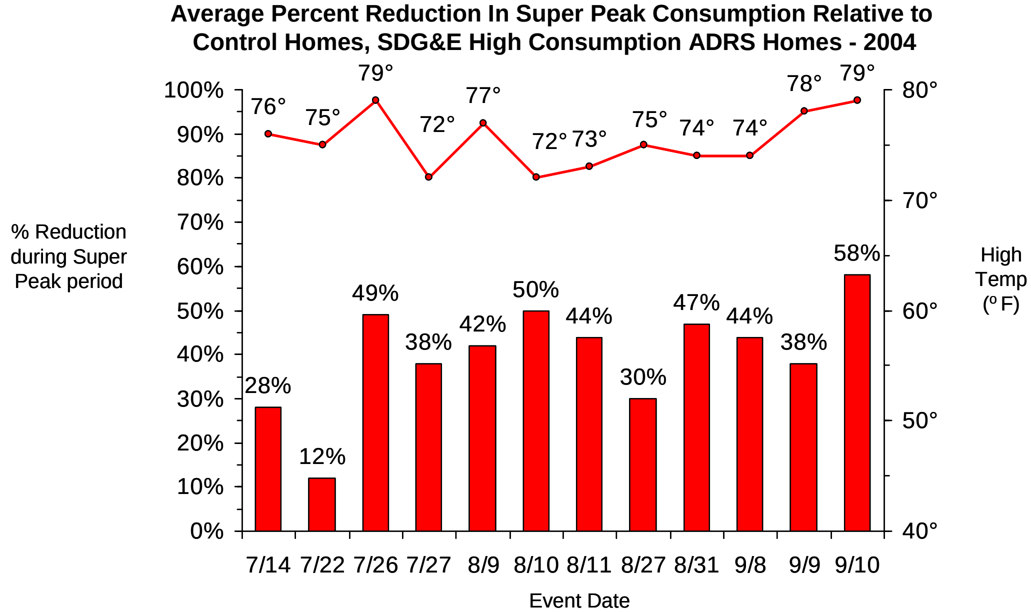


Figure 120 juxtaposes percent load reductions over consecutive event days for 2004 (right) and 2005 (left). Consecutive event days in 2004 and 2005 in SDG&E territory showed similar percent reductions and variability between ADRS load reductions compared to control, with the exception of the July 13, 2005 event day. Looking across both years, there does not appear to be any particular trend in consecutive day percent reductions, nor a particularly strong relationship with average peak temperature on corresponding event days.

Figure 120: SDG&E high consumption 2004 and 2005 consecutive event day Super Peak period percent reductions

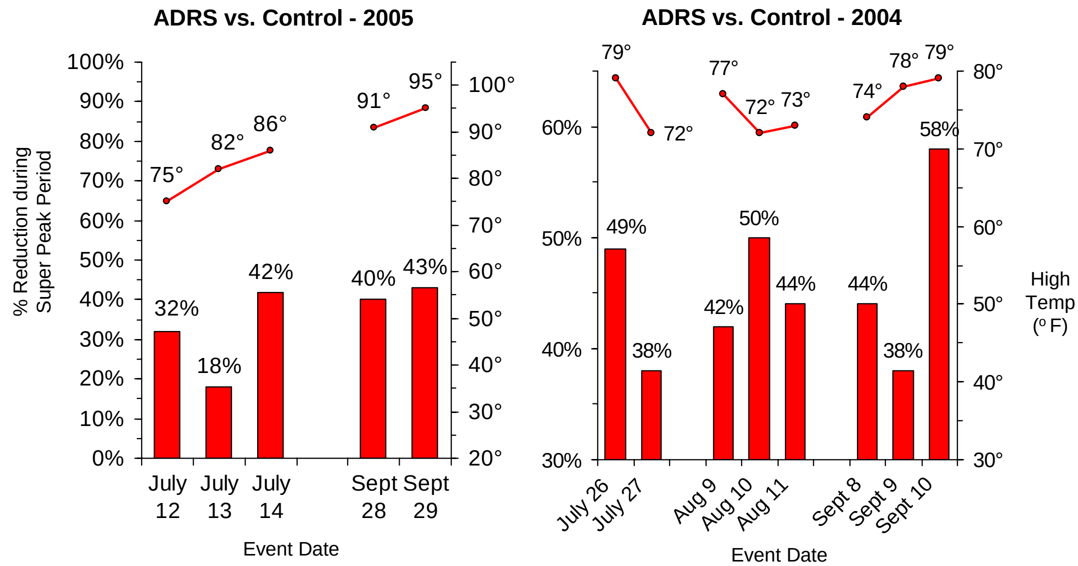


Figure 121 and Figure 122 chart the average energy usage by Super Peak, peak, recovery, and off-peak periods for ADRS and control groups during summer 2005 and 2004. The results should be interpreted with caution given that SDG&E has only six high consumption ADRS homes, indications are that these ADRS homes were primarily engaged in energy conservation as opposed to load shifting on event and non-event days. With the exception of the off-peak period in 2004, ADRS homes consumed less energy than control homes on event and non-event days. During the off-peak period, the difference between ADRS and control home consumption was 0.5 kWh, indicating similarity in usage. ADRS consumed marginally more energy than control homes during the recovery period during both summer 2005 and 2004.

Figure 121: 2005 SDG&E high consumption event and non-event usage by period

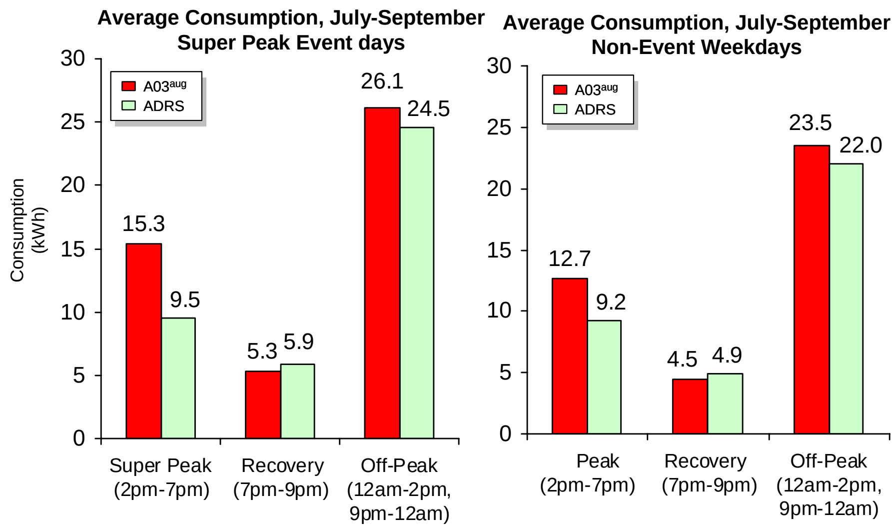


Figure 122: 2004 SDG&E high consumption event and non-event usage by period

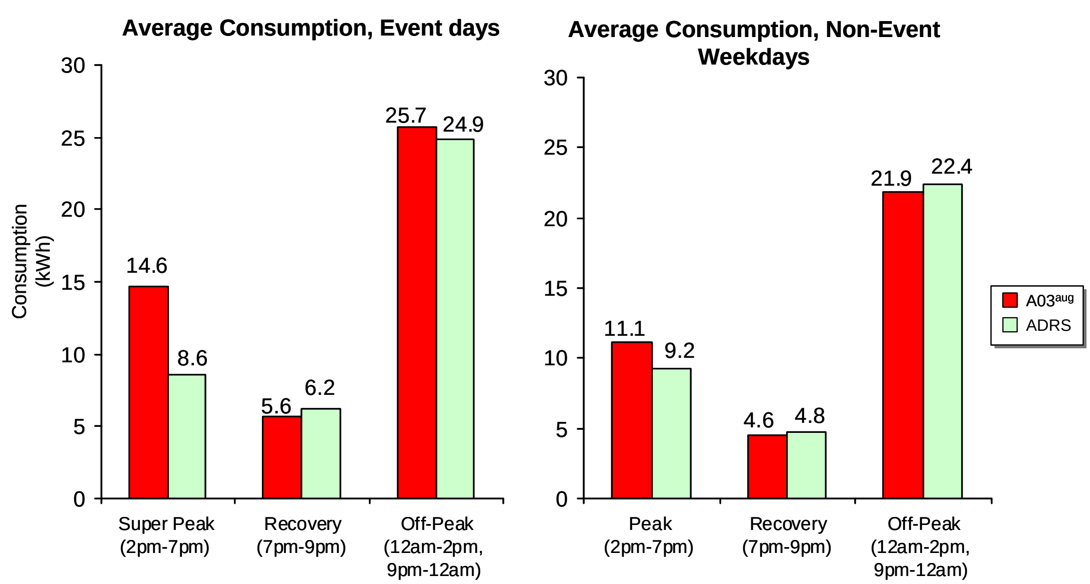


Figure 123 and Figure 124 compare the average daily usage for high consumption ADRS and control homes on event and non-event days during summer 2005 and 2004, respectively. With the exception of non-event days in September 2005, ADRS homes consumed less energy than control homes for all months on both event and non-event days, for both 2004 and 2005. This observation is supported by Figure 121 and Figure 122, where ADRS homes consumed less energy than control homes during Super Peak and peak periods in both 2005 and 2004. These results suggest that high consumption ADRS homes in SDG&E territory were using technology primarily to conserve energy as opposed to load shifting on event and non-event days.

Figure 123: 2005 SDG&E high consumption average daily usage on event and non-event weekdays by month

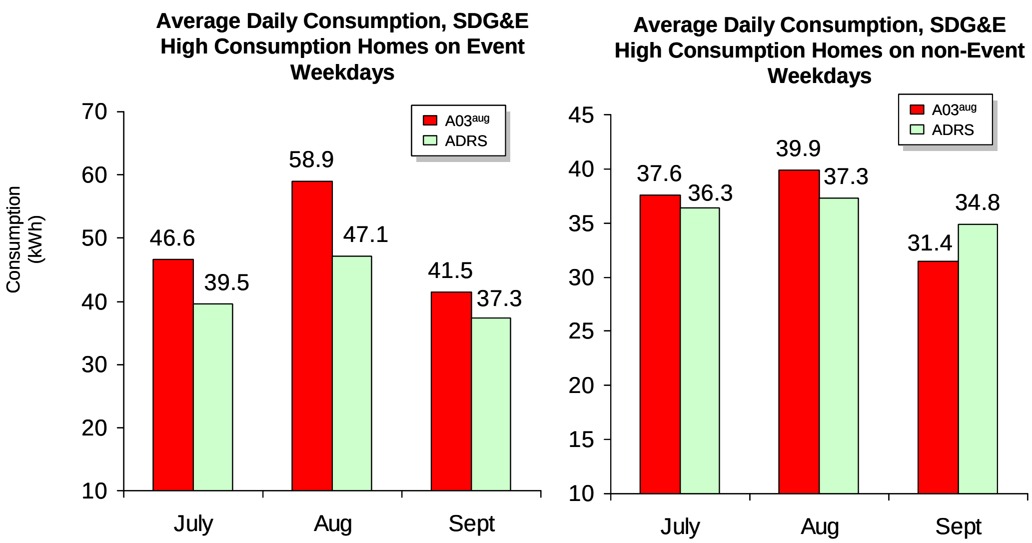
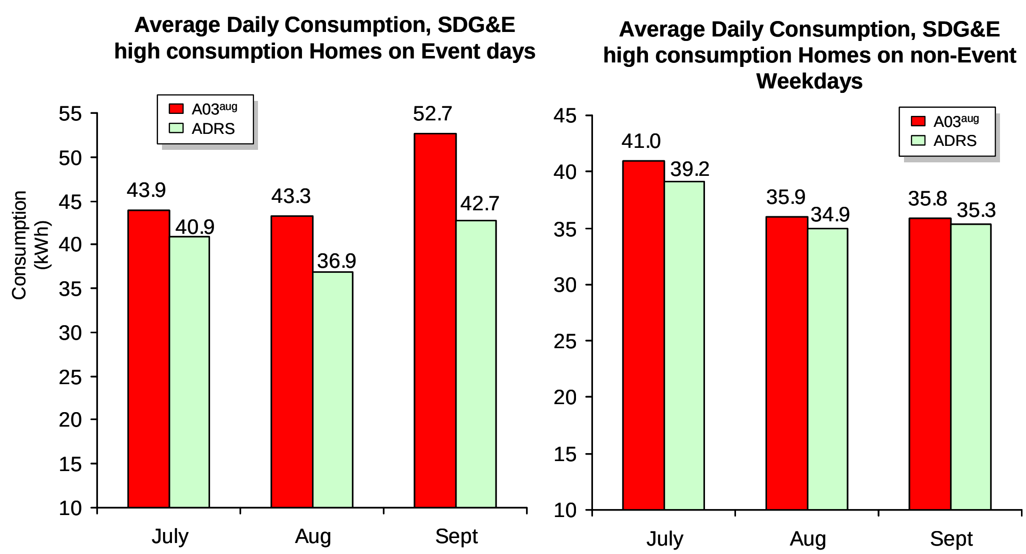


Figure 124: 2004 SDG&E high consumption average daily usage on event and non-event weekdays by month



On event days in 2005 and 2004, differences between ADRS and control homes consumption were similar from July through September, ranging from 4.2 kWh to 11.8 kWh in 2005 and from 3 kWh to 10 kWh in 2004. On non-event weekdays in 2005, absolute consumption as well as differences in ADRS and control consumption were more moderate compared to event days. These differences varied from 1.3 to 3.4 kWh between July and September. Non-event weekday consumption differences between control and ADRS homes in 2004 were also more moderate than event day consumption. Differences were small, varying from 1 kWh to 1.8 kWh across 2004 summer months.

3.5 Comparison of 2005 and 2004 load impact results, low consumption homes

Load impact results for low consumption homes during summer 2005 compared to summer 2004 are reported here for completeness but it should be noted that the numbers are not meaningful due to small sample size of both the control and ADRS homes in both years. Figures and tables corresponding to comparison of 2005 to 2004 load impact results for low consumption homes reported in this section are provided for reference in Appendix D to this report, Low Consumption ADRS 2005 and 2004 Load Impact Results Charts.

Statewide, low consumption ADRS homes reduced less load during Super Peak period in 2005 compared to summer 2004. In 2004, the Super Peak period reductions were 0.54 kW, or 28%, double the reductions in 2005. On non-event days, low consumption ADRS homes also reduced less load in 2005 compared to 2004. ADRS homes reduced peak period load by 0.02 kW (1%) in 2004, which declines to -0.25 kW (-20%) in 2005. The 90% confidence interval around the average peak period load reduction, however, indicates that reductions were essentially zero in 2004.

On a utility-specific basis, low consumption ADRS homes in PG&E service territory reduced more Super Peak period load during 2004 than in 2005. In 2004 ADRS homes reduced Super Peak period load by 0.74 kW or 30% while in 2005, ADRS homes consumed more load than control homes. On non-event days, low consumption ADRS homes consumed more load than control homes both in 2005 and in 2004. Taking into consideration the 90% confidence interval around the average peak period load reductions, however, PG&E low consumption ADRS customers' reductions were essentially zero on event days in 2005 and on non-event days in 2004.

Low consumption ADRS homes in SCE service territory reduced less load in 2005 than in 2004 during the Super Peak period. In 2004, ADRS homes reduced load by 1.0 kW or 49%, while in 2005 ADRS homes reduced load by 0.6 kW or 30% compared to low consumption control homes. On non-event days, ADRS homes again reduced more load in 2004 than in 2005, by 0.4 kW or 28% in 2004 compared to 0.2 kW or 14% in 2005 across the peak period.

In SDG&E service territory, low consumption ADRS homes reduced Super Peak period load by 0.2 kW or 14% in 2005. This was greater than Super Peak period reductions in 2004, when ADRS homes consumed slightly more load than low consumption control homes on average. On non-event days, ADRS homes consumed more load than control homes in both 2005 and 2004. Taking into consideration the 90% confidence interval around the average peak period load reductions, however, SDG&E low consumption ADRS customers reductions essentially produced zero on event days in 2005 and in 2004.

3.6 Summary of comparison of summer 2005 and summer 2004 ADRS results

Customers with ADRS technology and subject to CPP-F rates in climate zone 3 successfully achieve load reductions compared to control customers without ADRS technology on standard tiered rates in both 2005 and 2004. The load reductions were substantial and stable across a range of days and temperatures. Technology appears to be an important driver in reducing load, especially Super Peak load, for high-consumption homes.

High consumption ADRS load reductions in 2004 were slightly greater than load reductions in 2005. In 2005, performance was strongest in July statewide and for PG&E and SCE high consumption ADRS homes. In 2004, performance was strongest in September statewide and for PG&E and SCE high consumption ADRS homes. For SDG&E high consumption ADRS homes, performance was strongest in September in both 2004 and 2005.

Part of the reason why 2005 ADRS load reductions were lower than in 2004 was due to curiously lower control home load on event days in 2005 in spite of the fact that 2005 was a hotter summer on average. Furthermore, high consumption control homes in SCE service territory in particular seemed to display load shifting behavior in the manner of ADRS homes. Superimposing 2005 high consumption control home load curve with control home load curve in 2004, we observed that SCE control homes in 2005 consumed less load during Super Peak period, followed by a noticeable increase in load between the hours of 7 p.m. and 9 p.m. that was similar to the recovery in load of ADRS homes on event days. It is unclear whether and how control homes in SCE territory were aware of event day announcements. However, given that summer 2005 was hotter than in 2004, and given that energy issues were prominent in the news in 2005 with record high oil prices, perhaps control customers combined various energy marketing messages and attempted to actively reduce consumption in the home.

Comparing daily consumption patterns between years in energy terms, high consumption ADRS customers in PG&E and SCE service territory shifted load more aggressively from Super Peak and peak periods to off-peak periods in 2005 compared to 2004, with subsequent reductions in net energy conservation. High consumption ADRS homes in SDG&E service territory, on the other hand, appeared to have used technology to reduce overall energy consumption as opposed to shifting load on both event and non-event days, for both summer 2005 and summer 2004. It may be that in SDG&E, where average temperatures were typically 10^{o}F cooler that the statewide average, customers were better able to respond to peak pricing signals by reducing energy consumption overall. In PG&E and SCE service territory where temperatures tended to be higher than the statewide average, high consumption ADRS customers resorted to shifting load in order to save money while maintaining thermal comfort.

Peak temperatures experienced by ADRS customers within each utility territory did not always coincide with days when statewide Super Peak events were called. SDG&E, for example, typically experienced lower temperatures than the statewide average temperature on any given event day that was called. Although ADRS homes in PG&E and SCE territories in climate zone

3 are on average hotter than SDG&E, ADRS homes in the two territories alternated between hotter and cooler temperatures than the statewide average when event days were called[26].

[26] Additional analysis showing differences in average daily temperatures by utility for summer 2005 is included in the body of this report and in Appendix A, Data Development and Analysis Methodology.