Opinion Dynamics

AMEREN MISSOURI - PROGRAM YEAR 2023 ANNUAL EM&V REPORT

VOLUME 4: DEMAND RESPONSE PORTFOLIO APPENDICES

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Table 1 summarizes drops, by device manufacturer and event day, made to the AMI data set as part of the data preparation and cleaning process. Notably, Opinion Dynamics received AMI data in 15-minute intervals and conducted cleaning on 15-minute interval data before converting it to hourly data.

Table 1. Residential DR Program: Event Day Modeling AMI Data Cleaning Steps

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Event 1						
Initial Count	**17,796**	**1,709,184**	**6,131**	**588,672**	**5,176**	**496,832**
Drop exact duplicates	17,796	1,709,184	6,131	588,672	5,176	496,832
Average duplicates with different interval amounts	17,796	1,709,088	6,131	588,672	5,176	496,832
Drop invalid intervals (NA usage)	17,796	1,709,088	6,131	588,672	5,176	496,832
Impute and roll up meters to account level	17,796	1,709,088	6,131	588,672	5,176	496,832
Roll up 15-minute interval data to hourly	17,796	427,080	6,131	147,144	5,176	124,208
Exclude participants with unknown dispatch status	15,357	368,552	5,785	138,840	4,918	118,016
Drop for insufficient hourly data during event day	14,932	358,352	5,656	135,744	4,886	117,248
Event 2						
Initial Count	**18,077**	**1,736,031**	**6,233**	**598,424**	**5,238**	**502,848**
Drop exact duplicates	18,077	1,736,031	6,233	598,424	5,238	502,848
Average duplicates with different interval amounts	18,077	1,735,935	6,233	598,424	5,238	502,848
Drop invalid intervals (NA usage)	18,077	1,735,935	6,233	598,424	5,238	502,848
Impute and roll up meters to account level	18,077	1,735,936	6,233	598,424	5,238	502,848
Roll up 15-minute interval data to hourly	18,077	433,792	6,233	149,582	5,238	125,712
Exclude participants with unknown dispatch status	15,795	379,050	5,950	142,800	4,216	101,184
Drop for insufficient hourly data during event day	15,009	360,186	5,709	137,016	4,137	99,288
Event 3						
Initial Count	**18,077**	**1,735,913**	**6,238**	**598,769**	**5,235**	**502,560**

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Drop exact duplicates	18,077	1,735,913	6,238	598,769	5,235	502,560
Average duplicates with different interval amounts	18,077	1,735,817	6,238	598,769	5,235	502,560
Drop invalid intervals (NA usage)	18,077	1,735,817	6,238	598,769	5,235	502,560
Impute and roll up meters to account level	18,077	1,735,820	6,238	598,772	5,235	502,560
Roll up 15-minute interval data to hourly	18,077	433,763	6,238	149,669	5,235	125,640
Exclude non-dispatched participants and participants with unknown dispatch status	1,901	45,610	662	15,888	458	10,992
Drop for insufficient hourly data during event day	1,788	42,898	639	15,336	455	10,920
Event 4						
Initial Count	**18,163**	**1,744,480**	**6,268**	**601,824**	**5,244**	**503,424**
Drop exact duplicates	18,163	1,744,480	6,268	601,824	5,244	503,424
Average duplicates with different interval amounts	18,163	1,744,384	6,268	601,824	5,244	503,424
Drop invalid intervals (NA usage)	18,163	1,744,384	6,268	601,824	5,244	503,424
Impute and roll up meters to account level	18,163	1,744,384	6,268	601,824	5,244	503,424
Roll up 15-minute interval data to hourly	18,163	435,904	6,268	150,432	5,244	125,856
Exclude non-dispatched participants and participants with unknown dispatch status	1,900	45,600	663	15,912	456	10,944
Drop for insufficient hourly data during event day	1,787	42,888	639	15,336	453	10,872
Event 5						
Initial Count	**18,479**	**1,774,944**	**6,383**	**612,864**	**5,380**	**516,480**
Drop exact duplicates	18,479	1,774,944	6,383	612,864	5,380	516,480
Average duplicates with different interval amounts	18,479	1,774,848	6,383	612,864	5,380	516,480
Drop invalid intervals (NA usage)	18,479	1,774,848	6,383	612,864	5,380	516,480
Impute and roll up meters to account level	18,479	1,774,848	6,383	612,864	5,380	516,480
Roll up 15-minute interval data to hourly	18,479	443,496	6,383	153,192	5,380	129,120
Exclude participants with unknown dispatch status	16,499	395,976	6,168	148,032	4,377	105,048
Drop for insufficient hourly data during event day	15,227	365,448	5,815	139,560	4,226	101,424

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Event 6						
Initial Count	**18,484**	**1,775,372**	**6,384**	**612,903**	**5,379**	**516,384**
Drop exact duplicates	18,484	1,775,372	6,384	612,903	5,379	516,384
Average duplicates with different interval amounts	18,484	1,775,276	6,384	612,903	5,379	516,384
Drop invalid intervals (NA usage)	18,484	1,775,276	6,384	612,903	5,379	516,384
Impute and roll up meters to account level	18,484	1,775,276	6,384	612,904	5,379	516,384
Roll up 15-minute interval data to hourly	18,484	443,603	6,384	153,202	5,379	129,096
Exclude participants with unknown dispatch status	16,519	396,443	6,171	148,104	4,371	104,904
Drop for insufficient hourly data during event day	15,027	360,634	5,741	137,784	4,153	99,672
Event 7						
Initial Count	**18,633**	**1,789,791**	**6,423**	**616,656**	**5,441**	**522,336**
Drop exact duplicates	18,633	1,789,791	6,423	616,656	5,441	522,336
Average duplicates with different interval amounts	18,633	1,789,695	6,423	616,656	5,441	522,336
Drop invalid intervals (NA usage)	18,633	1,789,695	6,423	616,656	5,441	522,336
Impute and Roll up meters to account level	18,633	1,789,696	6,423	616,656	5,441	522,336
Roll up 15-minute interval data to hourly	18,633	447,184	6,423	154,140	5,441	130,584
Exclude participants with unknown dispatch status	16,772	402,528	6,237	149,388	4,405	105,720
Drop for insufficient hourly data during event day	15,282	366,768	5,842	140,196	4,233	101,592
Event 8						
Initial Count	**18,695**	**1,795,712**	**6,446**	**618,912**	**5,446**	**522,816**
Drop exact duplicates	18,695	1,795,712	6,446	618,912	5,446	522,816
Average duplicates with different interval amounts	18,695	1,795,616	6,446	618,912	5,446	522,816
Drop invalid intervals (NA usage)	18,695	1,795,616	6,446	618,912	5,446	522,816
Impute and roll up meters to account level	18,695	1,795,616	6,446	618,912	5,446	522,816
Roll up 15-minute interval data to hourly	18,695	448,664	6,446	154,704	5,446	130,704
Exclude participants with unknown dispatch status	16,923	406,152	6,259	150,216	4,397	105,528
Drop for insufficient hourly data during event day	15,254	366,096	5,823	139,560	4,204	100,896
Event 9						
Initial Count	**18,693**	**1,795,536**	**6,447**	**618,912**	**5,446**	**522,816**
Drop exact duplicates	18,693	1,795,536	6,447	618,912	5,446	522,816

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Average duplicates with different interval amounts	18,693	1,795,440	6,447	618,912	5,446	522,816
Drop invalid intervals (NA usage)	18,693	1,795,440	6,447	618,912	5,446	522,816
Impute and roll up meters to account level	18,693	1,795,440	6,447	618,912	5,446	522,816
Roll up 15-minute interval data to hourly	18,693	448,620	6,447	154,704	5,446	130,704
Exclude participants with unknown dispatch status	16,932	406,356	6,257	150,152	4,393	105,432
Drop for insufficient hourly data during event day	15,243	365,820	5,819	139,640	4,198	100,752
Event 10						
Initial Count	**18,802**	**1,806,008**	**6,475**	**621,696**	**5,538**	**531,648**
Drop exact duplicates	18,802	1,806,008	6,475	621,696	5,538	531,648
Average duplicates with different interval amounts	18,802	1,805,912	6,475	621,696	5,538	531,648
Drop invalid intervals (NA usage)	18,802	1,805,912	6,475	621,696	5,538	531,648
Impute and roll up meters to account level	18,802	1,805,912	6,475	621,696	5,538	531,648
Roll up 15-minute interval data to hourly	18,802	451,238	6,475	155,400	5,538	132,912
Exclude non-dispatched participants and participants with unknown dispatch status	1,864	44,736	651	15,624	434	10,416
Drop for insufficient hourly data during event day	1,752	42,048	625	15,000	432	10,368

Note: Initial counts are only inclusive of participating accounts.

SENSI NON-EVENT ENERGY OPTIMIZATION IMPACTS

Table 2 summarizes drops made to the AMI data set as part of the data preparation and cleaning process for the purposes of non-event energy savings estimation from Sensi devices.

Table 2. Residential DR Program: Non-Event Day Sensi Energy Optimization Modeling AMI Data Cleaning Steps

Drop Reason	Number of Remaining Unique Sensi Accounts	Number of Remaining Sensi Observations
Initial Count	**5,980**	**78,057,883**
Drop exact duplicates	5,980	78,057,883
Average duplicates with different interval amounts	5,980	78,057,883
Drop invalid intervals (NA usage)	5,980	78,057,883
Impute and roll up meters to account level	5,980	78,057,896
Roll up 15-minute interval data to hourly	5,980	19,514,474
Drop non-locational event days	5,980	18,614,346

Drop Reason	Number of Remaining Unique Sensi Accounts	Number of Remaining Sensi Observations
Exclude records without relevant experimental assignment	4,306	8,037,826
Drop account-days with insufficient data	4,306	7,267,162

Note: Initial counts are only inclusive of participating accounts.

EXPERIMENTAL ASSIGNMENT DATA CLEANING

EVENT IMPACTS AND RESOURCE CAPABILITY IMPACTS

Table 3 summarizes drops, by event and manufacturer, that were made to the event-day experimental assignment data as a part of the data preparation and cleaning process for the purposes of event energy savings estimations.

Table 3. Residential DR Program: Experimental Assignment Data Cleaning Steps

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Event 1						
Initial Count	**26,613**	**31,353**	**10,287**	**12,544**	**9,544**	**10,668**
Drop devices with conflicting assignments	26,608	31,345	10,282	12,536	9,535	10,650
Drop duplicate device IDs that span multiple accounts within an event	26,494	31,209	10,204	12,436	9,494	10,596
Drop perfect duplicates	26,494	31,209	10,201	12,430	9,494	10,596
Drop accounts with conflicting assignments	26,494	31,205	10,201	12,424	9,494	10,571
Drop non-participants	25,459	30,209	9,710	11,723	7,596	8,324
Event 2						
Initial Count	**26,603**	**31,367**	**10,238**	**12,510**	**7,879**	**8,670**
Drop devices with conflicting assignments	26,597	31,359	10,226	12,494	7,863	8,638
Drop duplicate device IDs that span multiple accounts within an event	26,520	31,261	10,184	12,440	7,835	8,604
Drop perfect duplicates	26,518	31,255	10,181	12,430	7,835	8,604
Drop accounts with conflicting assignments	26,518	31,250	10,181	12,423	7,835	8,585
Drop non-participants	25,459	30,224	9,678	11,692	7,431	8,141
Event 3						
Initial Count	**2,925**	**3,547**	**1,057**	**1,337**	**714**	**808**
Drop devices with conflicting assignments	2,925	3,547	1,057	1,337	714	808
Drop duplicate device IDs that span multiple accounts within an event	2,925	3,547	1,055	1,333	714	808
Drop perfect duplicates	2,925	3,547	1,055	1,333	714	808
Drop accounts with conflicting assignments	2,925	3,547	1,055	1,333	714	806
Drop non-participants	2,814	3,461	991	1,246	680	769

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Event 4						
Initial Count	**2,917**	**3,539**	**1,057**	**1,337**	**712**	**805**
Drop devices with conflicting assignments	2,917	3,539	1,057	1,337	712	805
Drop duplicate device IDs that span multiple accounts within an event	2,917	3,539	1,055	1,333	712	805
Drop perfect duplicates	2,917	3,539	1,055	1,333	712	805
Drop accounts with conflicting assignments	2,917	3,539	1,055	1,333	712	803
Drop non-participants	2,809	3,455	991	1,246	677	766
Event 5						
Initial Count	**27,128**	**32,014**	**10,333**	**12,623**	**7,919**	**8,723**
Drop devices with conflicting assignments	27,121	32,002	10,322	12,605	7,903	8,693
Drop duplicate device IDs that span multiple accounts within an event	27,043	31,906	10,279	12,547	7,880	8,667
Drop perfect duplicates	27,043	31,906	10,275	12,536	7,880	8,667
Drop accounts with conflicting assignments	27,043	31,901	10,275	12,532	7,880	8,643
Drop non-participants	25,861	30,729	9,730	11,750	7,446	8,158
Event 6						
Initial Count	**27,164**	**32,061**	**10,339**	**12,633**	**7,907**	**8,709**
Drop devices with conflicting assignments	27,164	32,061	10,339	12,633	7,907	8,709
Drop duplicate device IDs that span multiple accounts within an event	27,079	31,953	10,286	12,563	7,872	8,665
Drop perfect duplicates	27,079	31,953	10,286	12,563	7,872	8,665
Drop accounts with conflicting assignments	27,079	31,948	10,286	12,556	7,872	8,635
Drop non-participants	25,895	30,776	9,737	11,767	7,449	8,161
Event 7a						
Initial Count	**13,375**	**15,620**	**5,224**	**6,222**	**4,090**	**4,448**
Drop devices with conflicting assignments	13,371	15,614	5,224	6,222	4,081	4,438
Drop duplicate device IDs that span multiple accounts within an event	13,345	15,580	5,210	6,206	4,075	4,428
Drop perfect duplicates	13,345	15,580	5,210	6,206	4,075	4,428
Drop accounts with conflicting assignments	13,345	15,580	5,210	6,206	4,075	4,428
Drop non-participants	12,771	15,015	4,922	5,825	3,877	4,207
Event 7b						
Initial Count	**13,865**	**16,565**	**5,094**	**6,364**	**3,753**	**4,184**
Drop devices with conflicting assignments	13,861	16,561	5,091	6,360	3,744	4,166
Drop duplicate device IDs that span multiple accounts within an event	13,845	16,539	5,081	6,344	3,739	4,160
Drop perfect duplicates	13,845	16,539	5,080	6,341	3,738	4,158
Drop accounts with conflicting assignments	13,845	16,535	5,080	6,341	3,738	4,142
Drop non-participants	13,227	15,913	4,819	5,950	3,524	3,899

Drop Reason	Number Remaining					
	Nest		ecobee		Sensi	
	Accounts	Observations	Accounts	Observations	Accounts	Observations
Event 8						
Initial Count	**27,395**	**32,389**	**10,336**	**12,638**	**7,820**	**8,607**
Drop devices with conflicting assignments	27,392	32,385	10,326	12,626	7,807	8,589
Drop duplicate device IDs that span multiple accounts within an event	27,302	32,271	10,284	12,568	7,784	8,557
Drop perfect duplicates	27,302	32,271	10,282	12,564	7,784	8,557
Drop accounts with conflicting assignments	27,302	32,266	10,282	12,558	7,784	8,533
Drop non-participants	26,081	31,266	9,732	11,811	7,354	8,053
Event 9						
Initial Count	**27,412**	**32,414**	**10,339**	**12,641**	**7,823**	**8,609**
Drop devices with conflicting assignments	27,406	32,408	10,329	12,627	7,809	8,587
Drop duplicate device IDs that span multiple accounts within an event	27,315	32,292	10,286	12,571	7,787	8,559
Drop perfect duplicates	27,315	32,292	10,284	12,566	7,786	8,557
Drop accounts with conflicting assignments	27,315	32,287	10,284	12,560	7,786	8,534
Drop non-participants	26,088	31,270	9,737	11,816	7,355	8,054
Event 10						
Initial Count	**2,786**	**3,388**	**1,022**	**1,295**	**669**	**759**
Drop devices with conflicting assignments	2,786	3,388	1,022	1,295	669	759
Drop duplicate device IDs that span multiple accounts within an event	2,786	3,388	1,022	1,295	669	759
Drop perfect duplicates	2,786	3,388	1,022	1,295	669	759
Drop accounts with conflicting assignments	2,786	3,388	1,022	1,295	669	759
Drop non-participants	2,681	3,325	958	1,208	638	722

SENSI NON-EVENT ENERGY OPTIMIZATION IMPACTS

Table 4 summarizes drops made to the experimental assignment data as part of the data preparation and cleaning process for the purposes of non-event energy savings estimation from Sensi devices.

Table 4. Residential DR Program: Non-Event Day Sensi Energy Optimization Experimental Assignment Cleaning Steps

Drop Reason	Number Remaining	
	Sensi	
	Accounts	Observations
Initial Count	**12,587**	**992,572**
Drop devices with conflicting assignments	12,473	992,039
Drop accounts with conflicting assignments	12,462	991,796
Drop duplicate device IDs, Account ID, Date	12,462	991,550
Drop Event days except location dispatch events - (for location dispatch events drop records that are DR)	12,462	933,731
Drop duplicate Account ID, Date, Assignment	12,462	851,121
Drop non-participants	7,808	773,442

AMI AND NON-AMI PARTICIPATION COMPARISON

We assessed the extent to which the available data were representative of the program participant population across available observable information (e.g., distribution of participants with and without AMI data by device manufacturer, enrollment channel and enrollment year). Table 5 presents the percent distribution of participating accounts with and without AMI data by device manufacturer, enrollment channel, and year of enrollment. We did not find any large or meaningful differences in the composition of participants with vs. without AMI data.

Table 5. Residential DR Program: AMI and Non-AMI Participant Comparison

	Participants with AMI Data (N=31.322)	Participants without AMI Data (N=15,329)	Participants with AMI Data (67%)	Participants without AMI Data (33%)
Device Manufacturer				
Nest	19,283	9,151	61%	59%
ecobee	7,018	3,400	22%	22%
Sensi	5,178	2,853	16%	19%
Enrollment Channel				
BYOT	24,858	11,773	79%	76%
Marketplace	6,772	3,663	21%	24%
Year of Enrollment				
2019	4,107	2,055	13%	13%
2020	7,063	3,744	22%	24%
2021	8,007	4,066	25%	26%
2022	6,858	3,143	22%	20%
2023	5,612	2,444	18%	16%

Note: Counts are for participants that were enrolled at any point during the event season, and that they do not sum to the total number of participants due to some participants having more than one device or device manufacturer.

RCT EVENT DAY MODEL EQUIVALENCY ANALYSIS RESULTS

An equivalency analysis was completed to confirm the fidelity of the randomized control trial's (RCT) experimental assignments. A different RCT is generated for each event day and manufacturer, so a separate equivalency analysis is conducted by event day and device manufacturer. Figure 1 through Figure 30 illustrate the equivalency analysis for each event and brand.

Figure 1. Residential DR Program: ecobee June 2, 2023 Event – Non-Event Day Equivalency

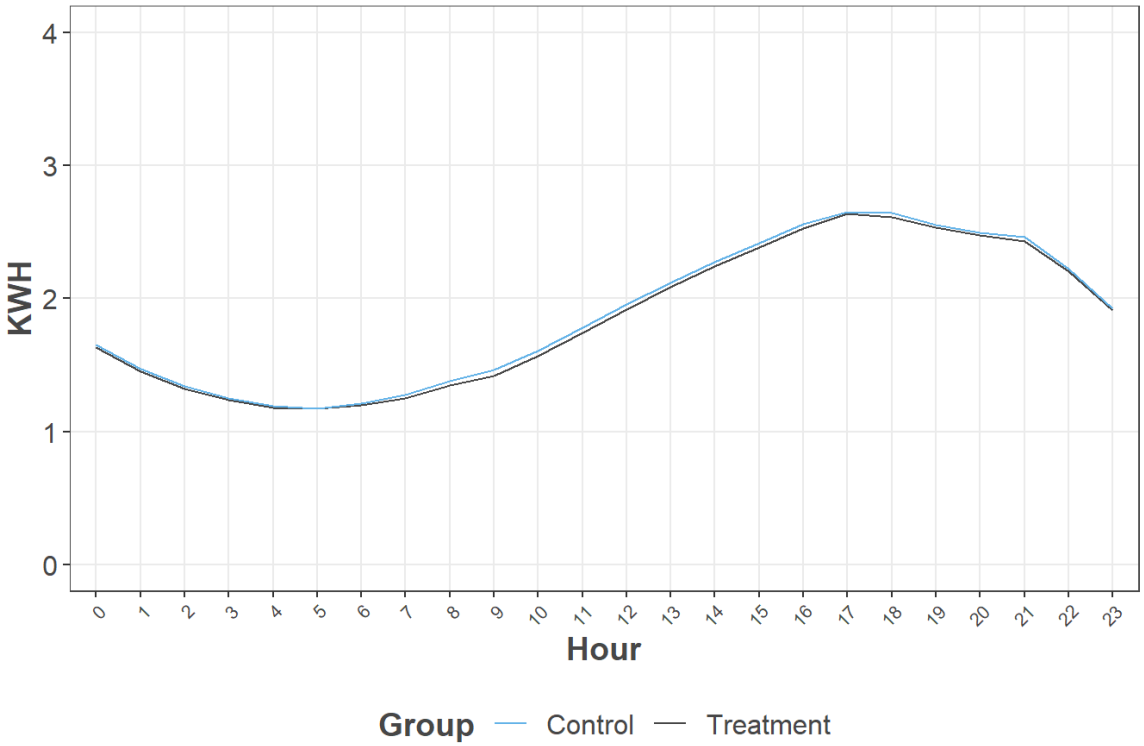


Figure 2. Residential DR Program: ecobee June 29, 2023 Event – Non-Event Day Equivalency

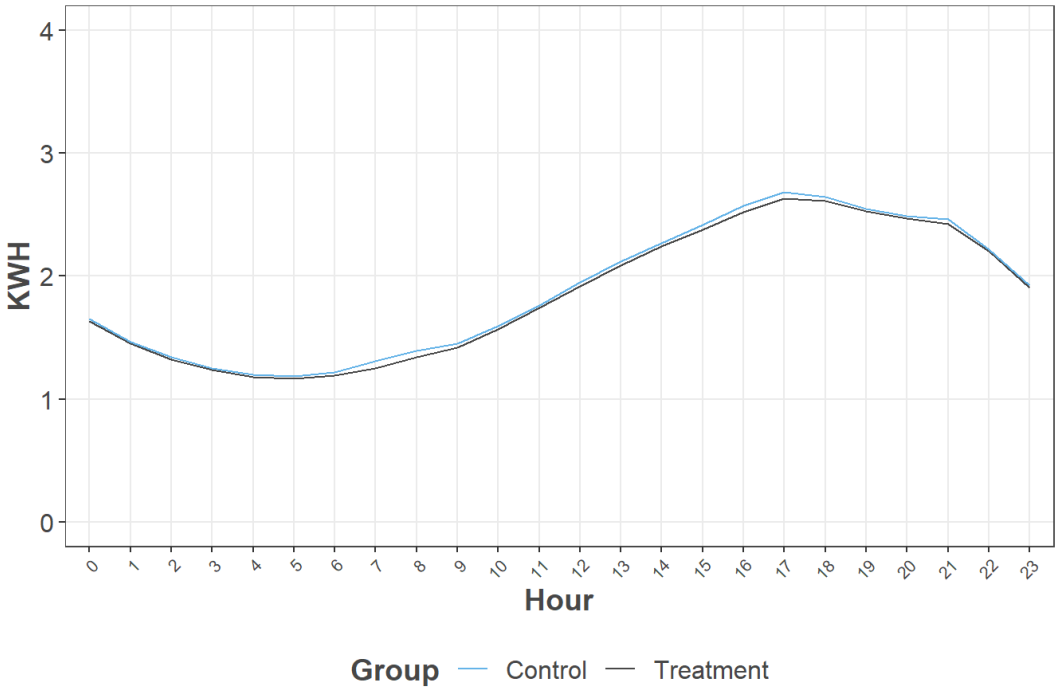


Figure 3. Residential DR Program: ecobee June 30, 2023 Event – Non-Event Day Equivalency

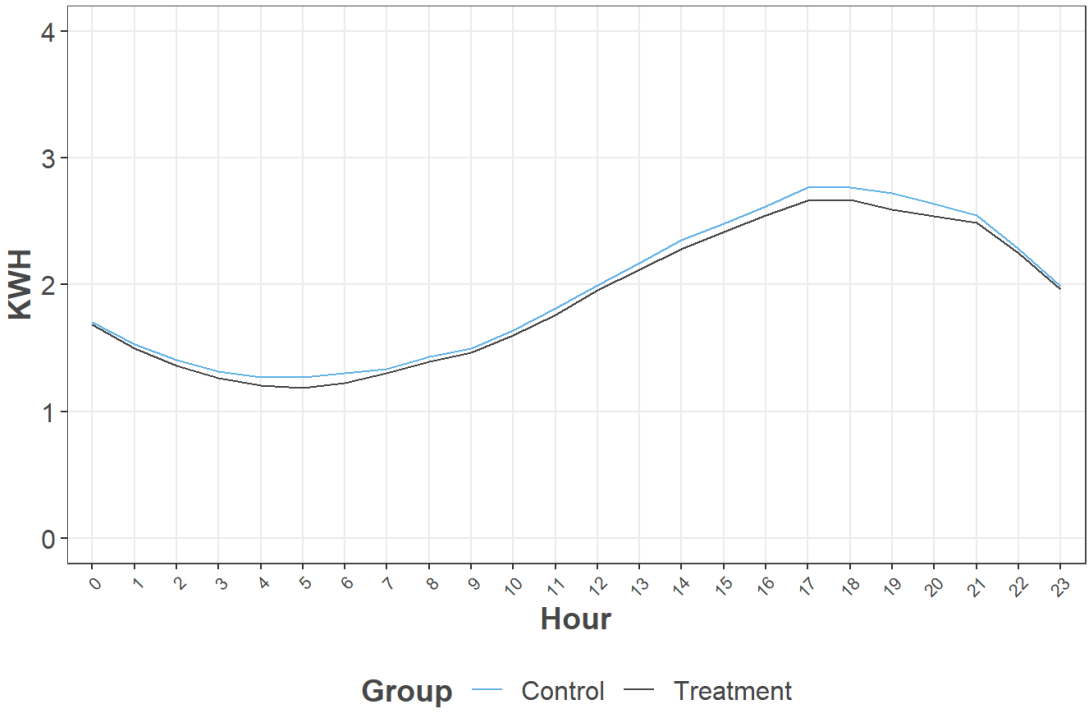


Figure 4. Residential DR Program: ecobee July 5, 2023 Event – Non-Event Day Equivalency

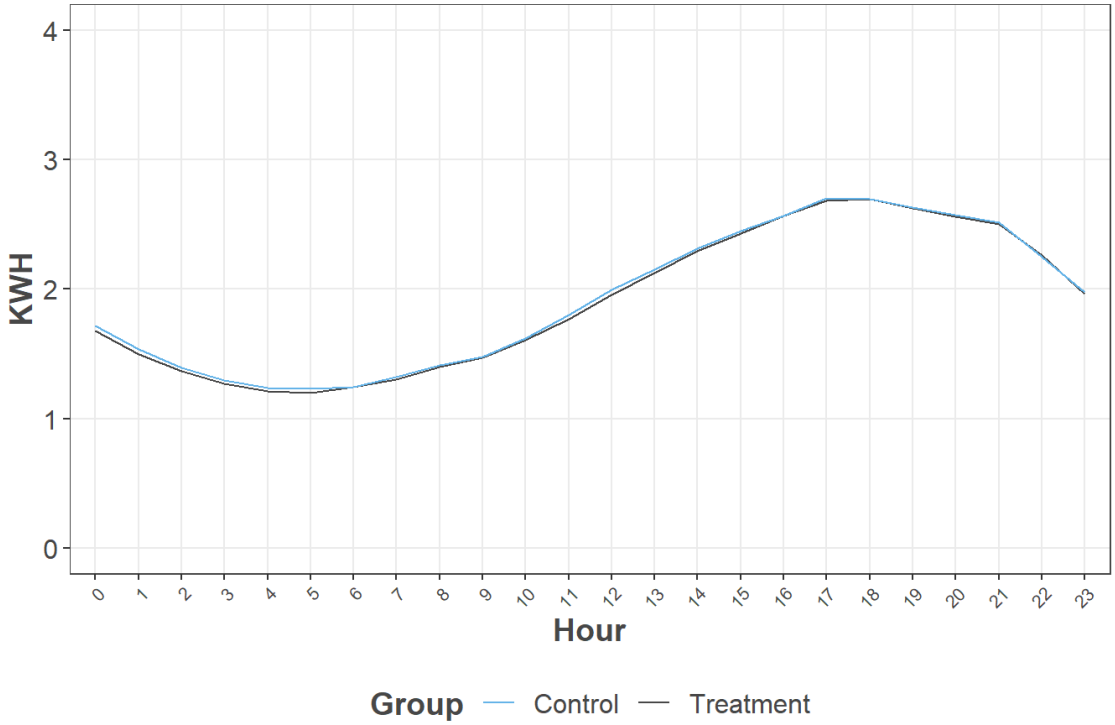


Figure 5. Residential DR Program: ecobee July 27, 2023 Event – Non-Event Day Equivalency

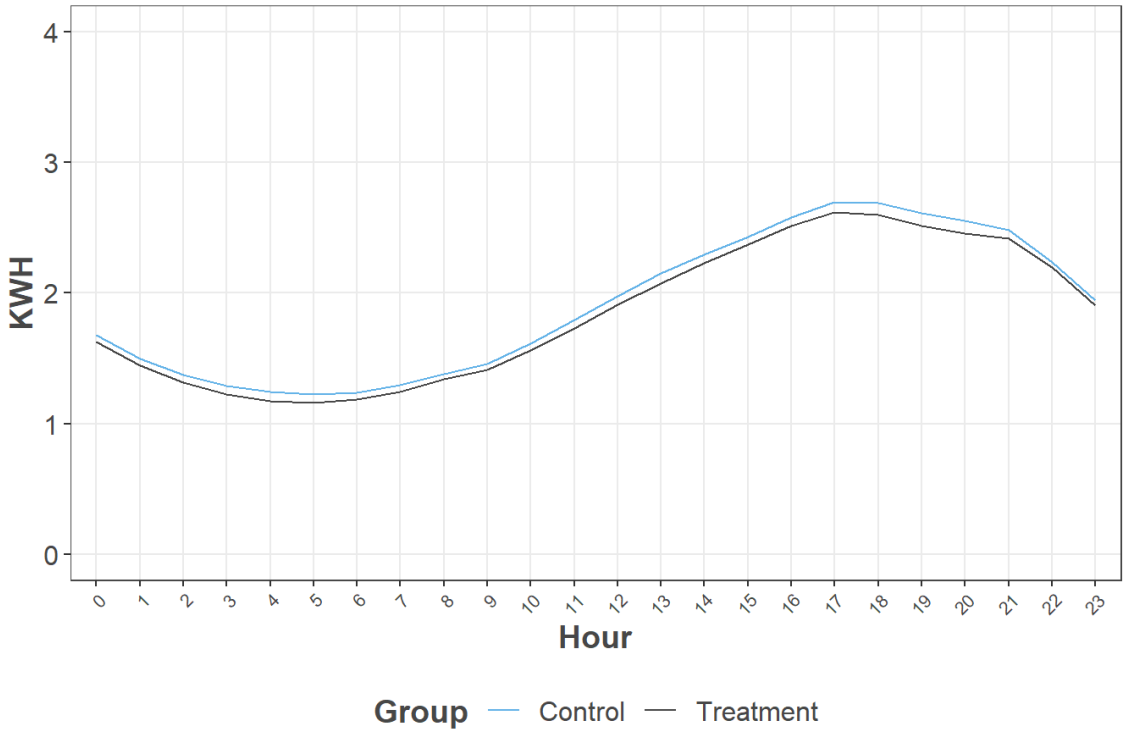


Figure 6. Residential DR Program: ecobee August 11, 2023 Event (Group A) – Non-Event Day Equivalency

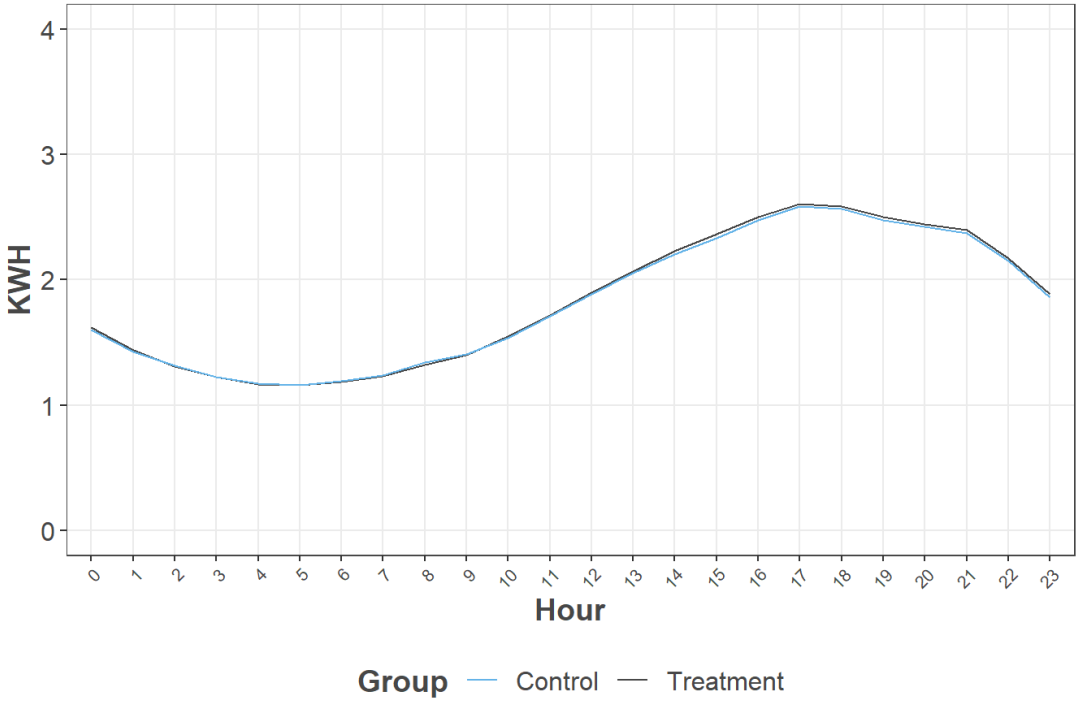


Figure 7. Residential DR Program: ecobee August 11, 2023 Event (Group B) – Non-Event Day Equivalency

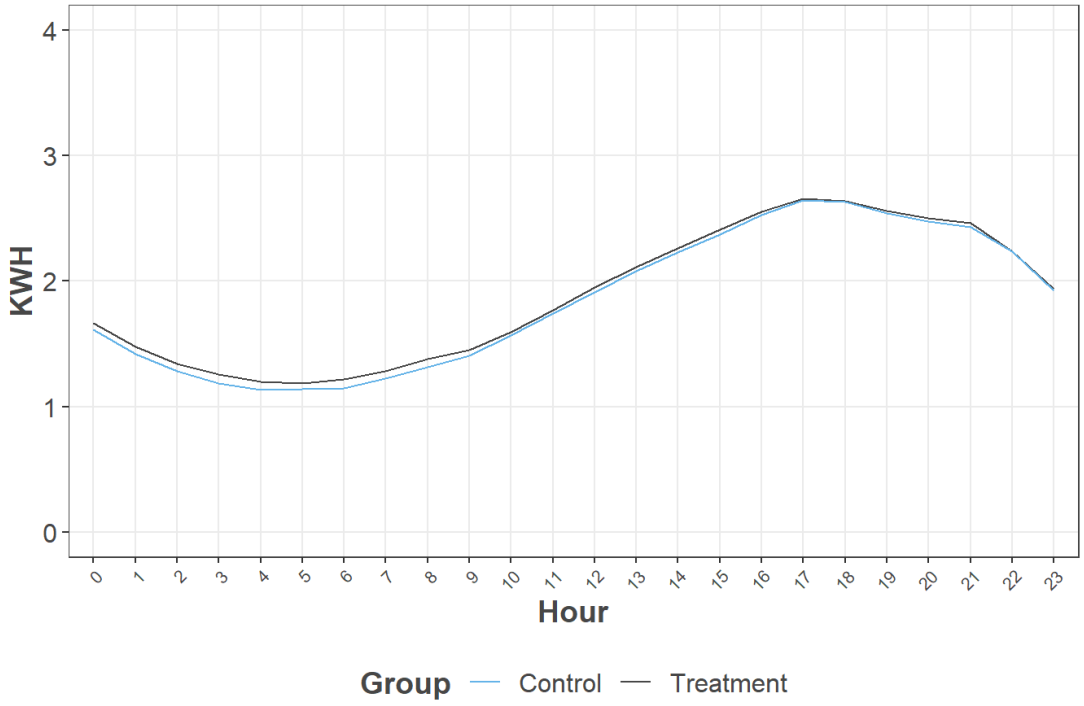


Figure 8. Residential DR Program: ecobee August 23, 2023 Event – Non-Event Day Equivalency

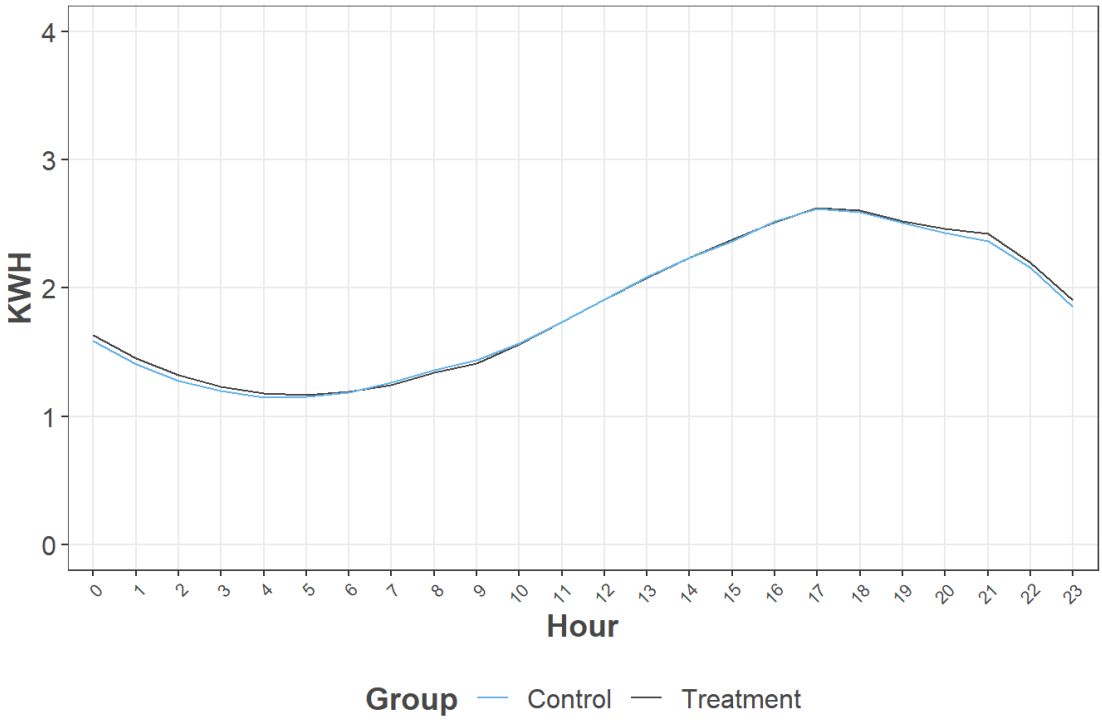


Figure 9. Residential DR Program: ecobee August 24, 2023 Event – Non-Event Day Equivalency

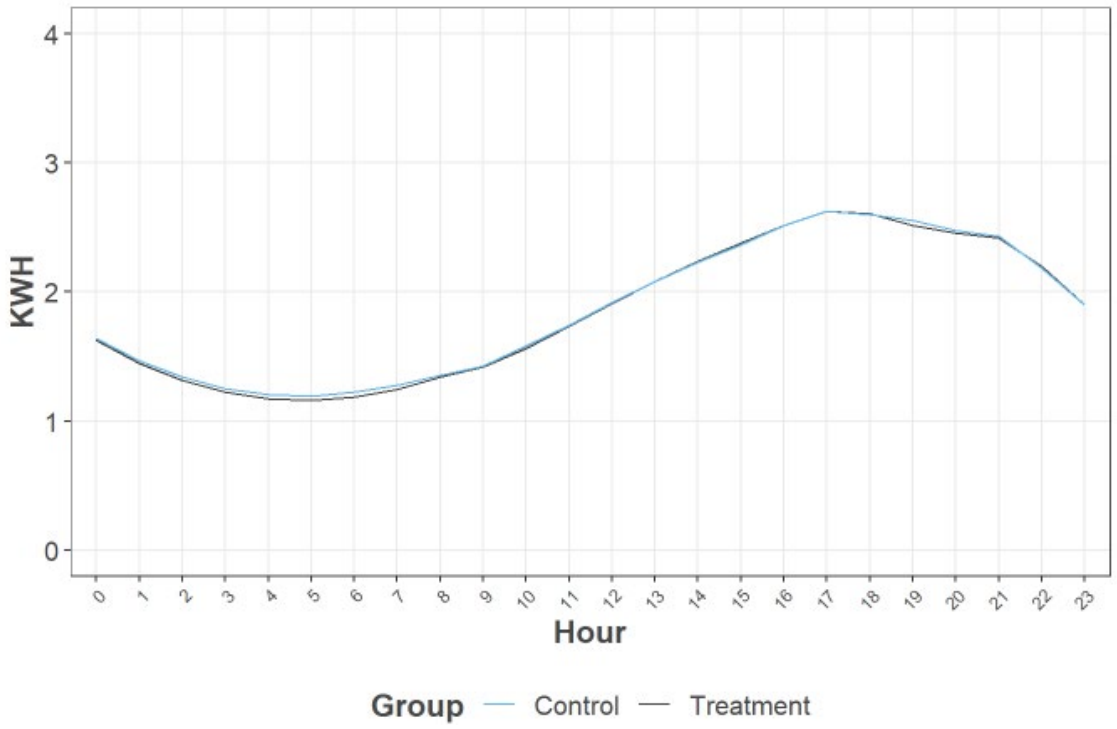


Figure 10. Residential DR Program: ecobee September 19, 2023 Event – Non-Event Day Equivalency

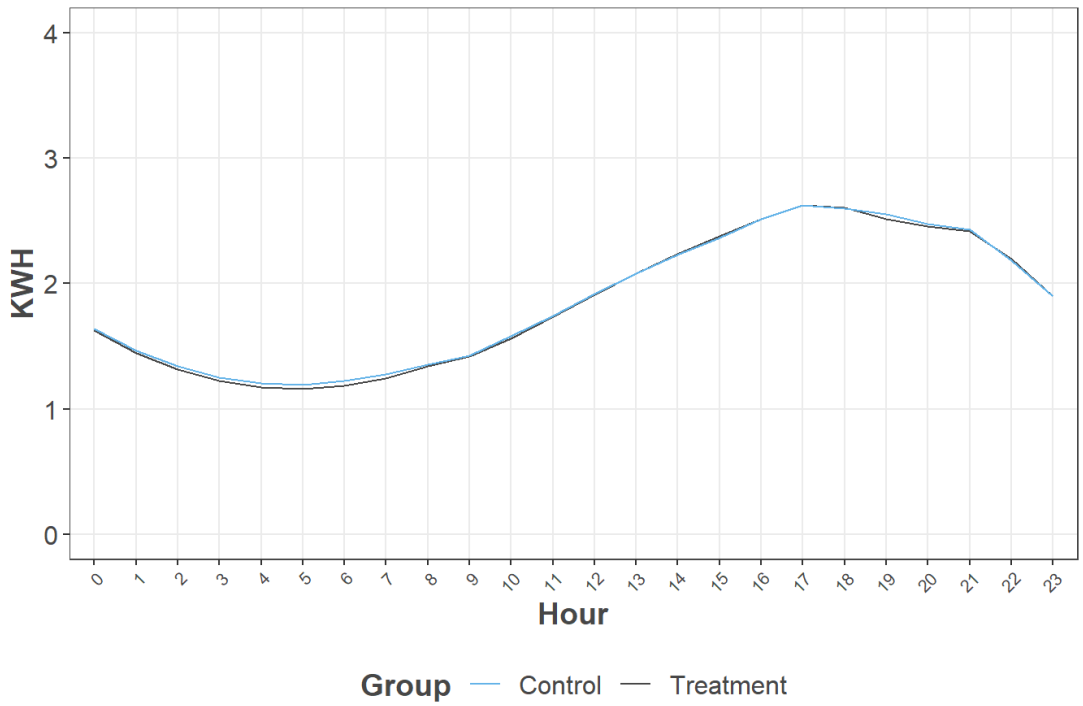


Figure 11. Residential DR Program: Sensi June 2, 2023 Event – Non-Event Day Equivalency

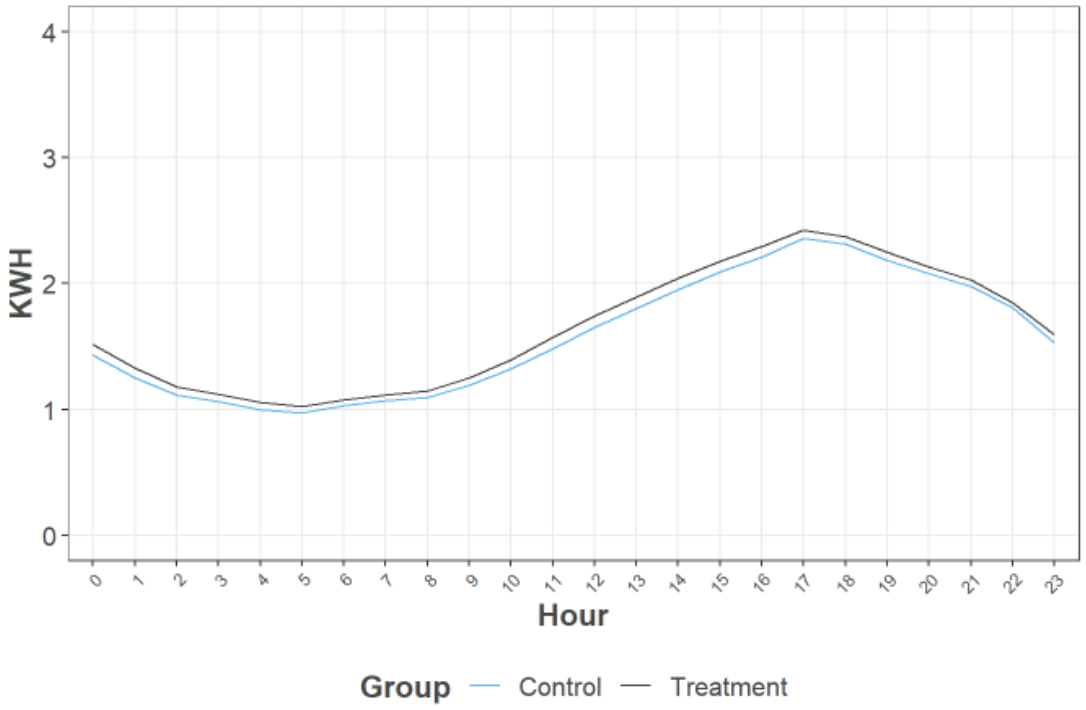


Figure 12. Residential DR Program: Sensi June 29, 2023 Event – Non-Event Day Equivalency

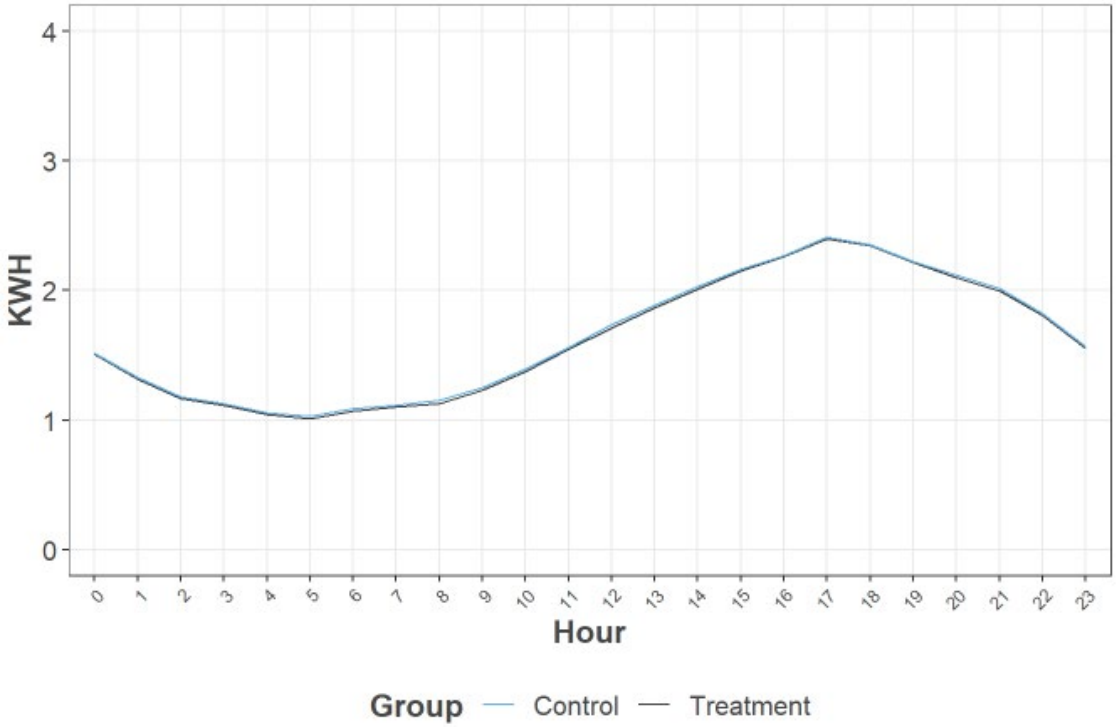


Figure 13. Residential DR Program: Sensi June 30, 2023 Event – Non-Event Day Equivalency

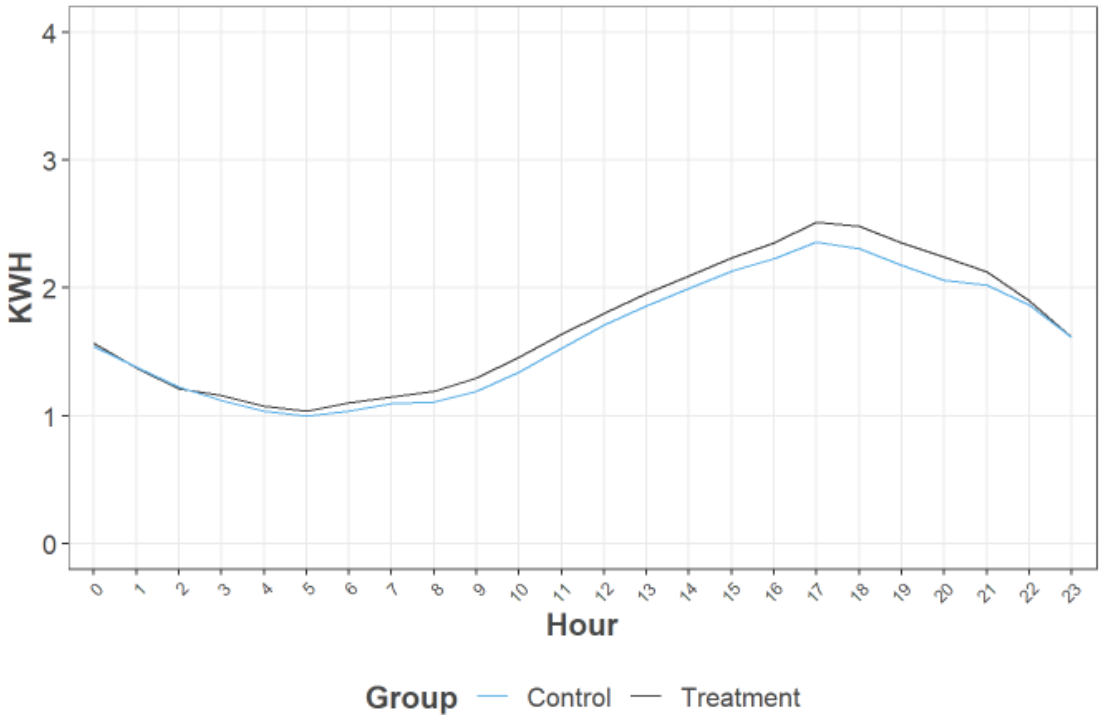


Figure 14. Residential DR Program: Sensi July 5, 2023 Event – Non-Event Day Equivalency

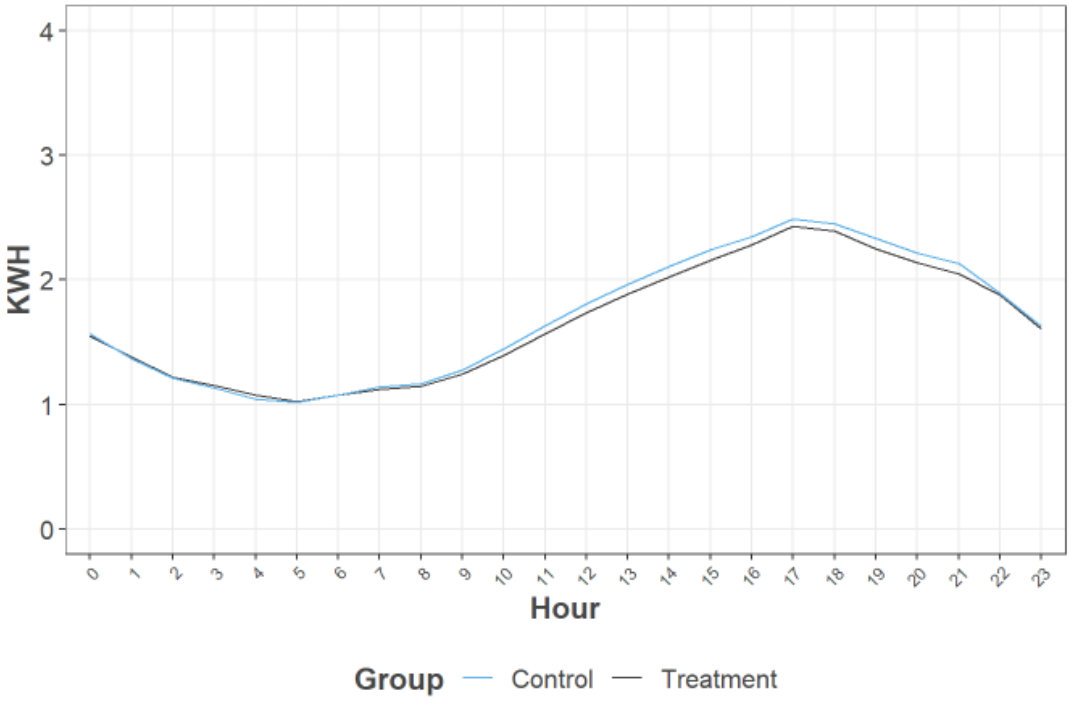


Figure 15. Residential DR Program: Sensi July 27, 2023 Event – Non-Event Day Equivalency

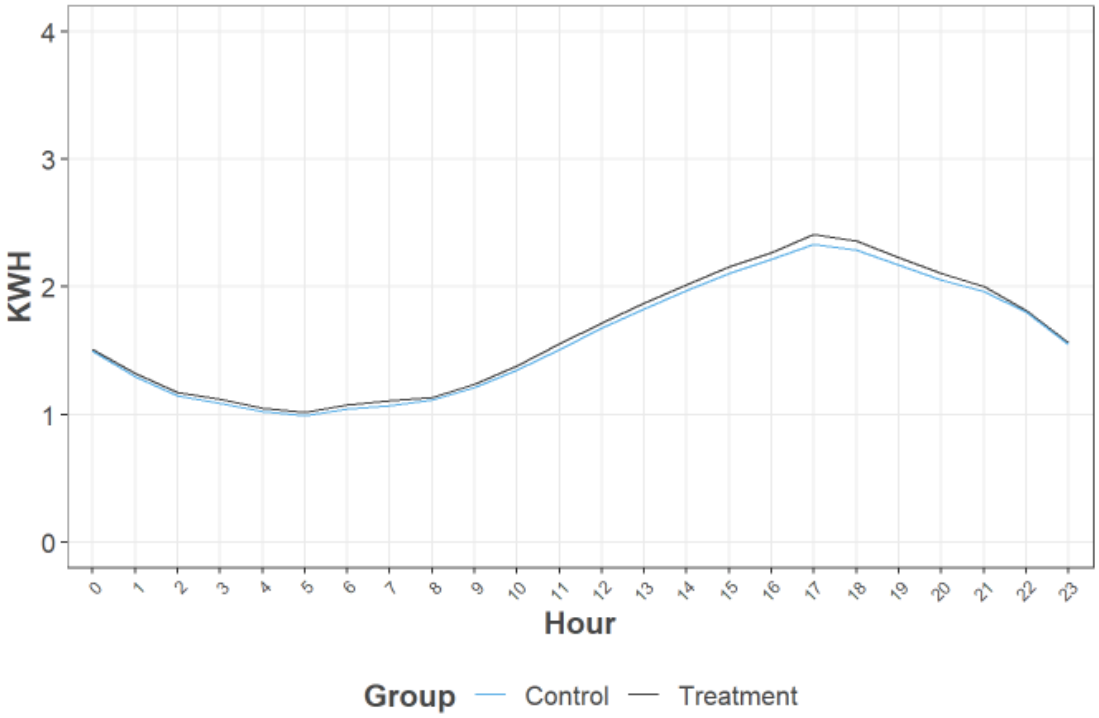


Figure 16. Residential DR Program: Sensi August 11, 2023 Event (Group A) – Non-Event Day Equivalency

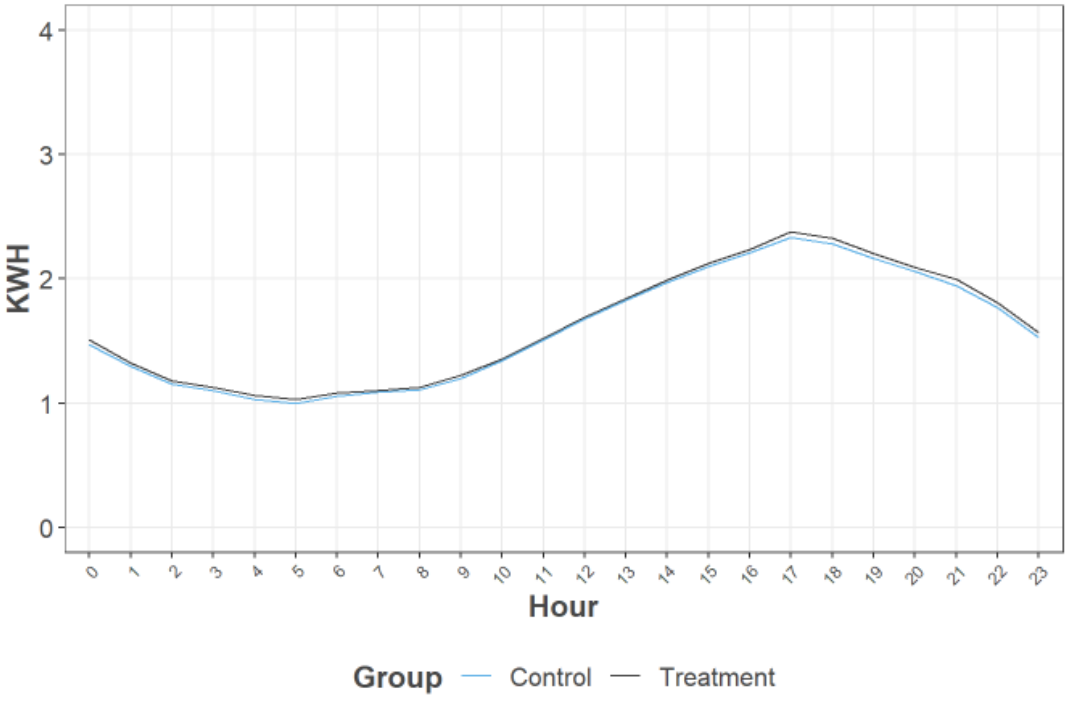


Figure 17. Residential DR Program: Sensi August 11, 2023 Event (Group B) – Non-Event Day Equivalency

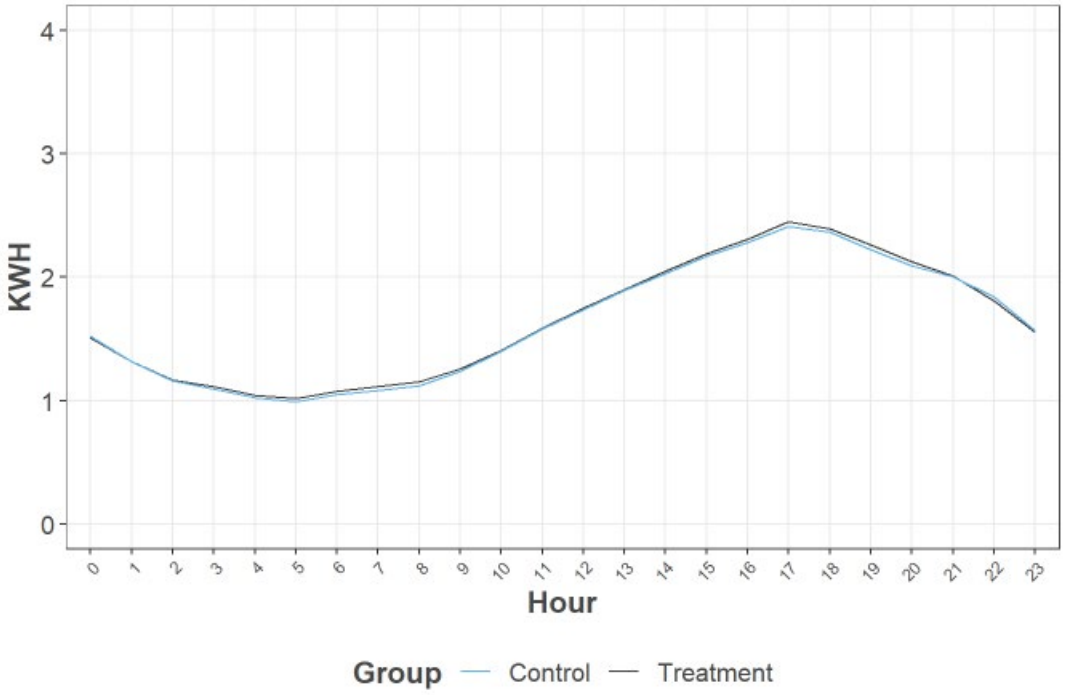


Figure 18. Residential DR Program: Sensi August 23, 2023 Event – Non-Event Day Equivalency

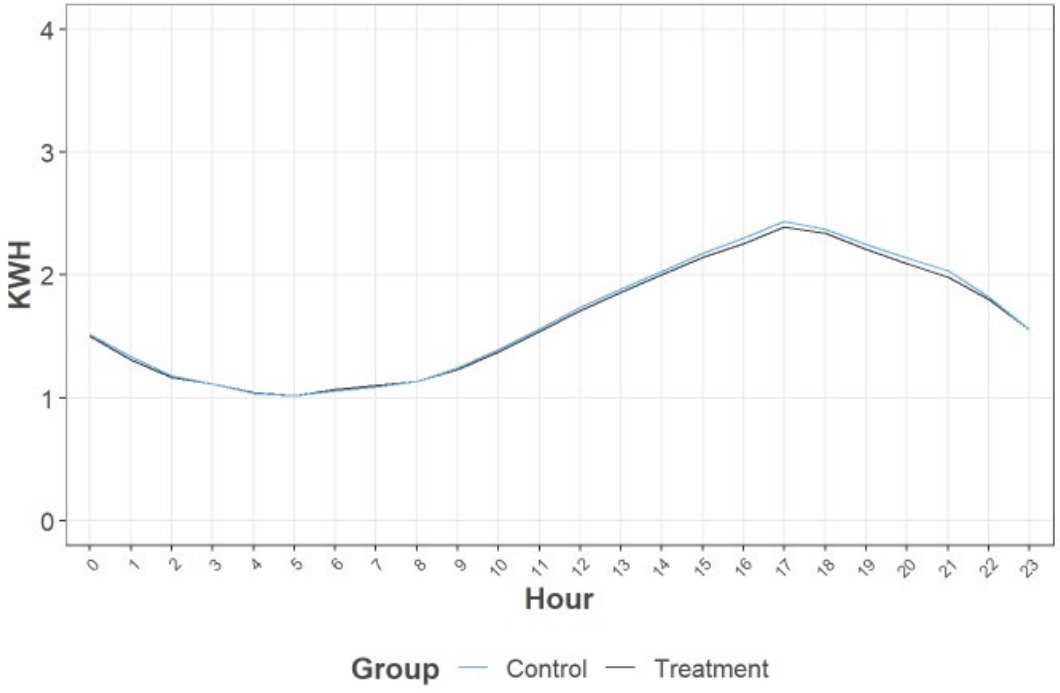


Figure 19. Residential DR Program: Sensi August 24, 2023 Event – Non-Event Day Equivalency

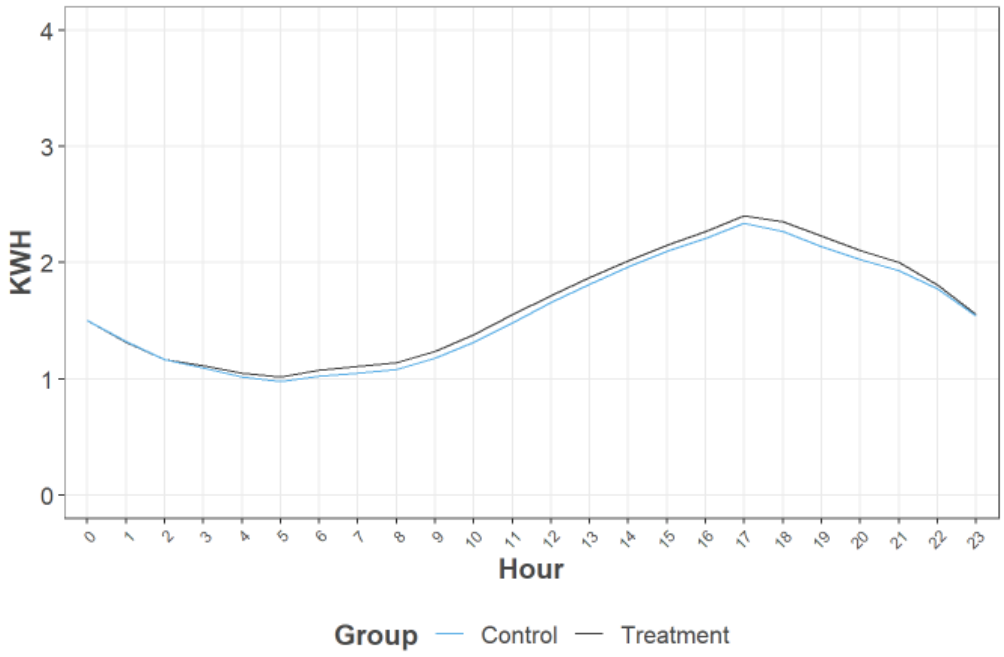


Figure 20. Residential DR Program: Sensi September 19, 2023 Event – Non-Event Day Equivalency

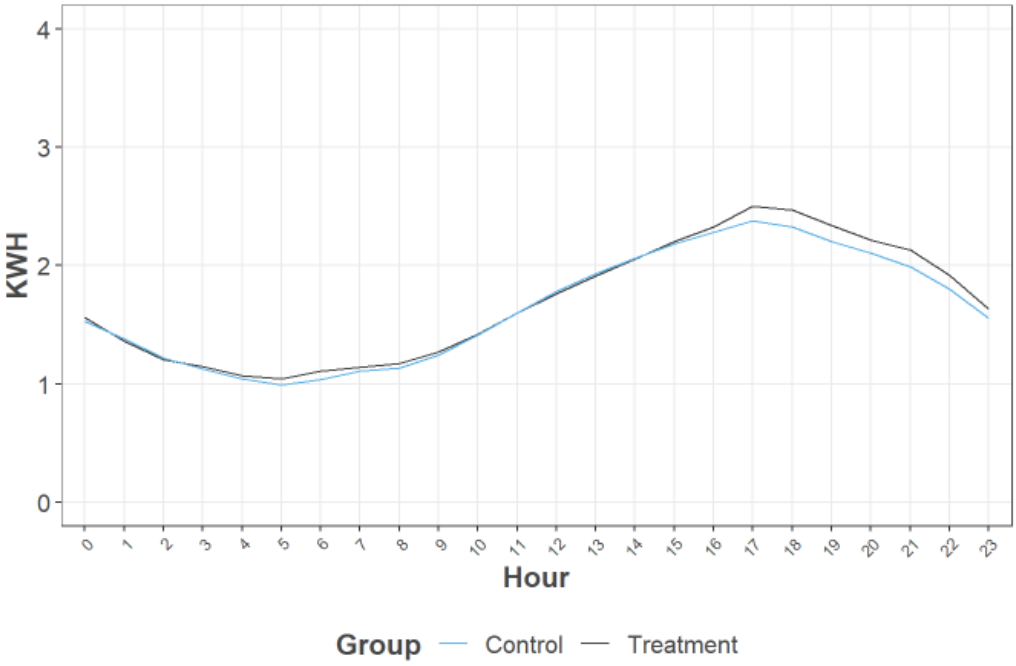


Figure 21. Residential DR Program: Nest June 2, 2023 Event – Non-Event Day Equivalency

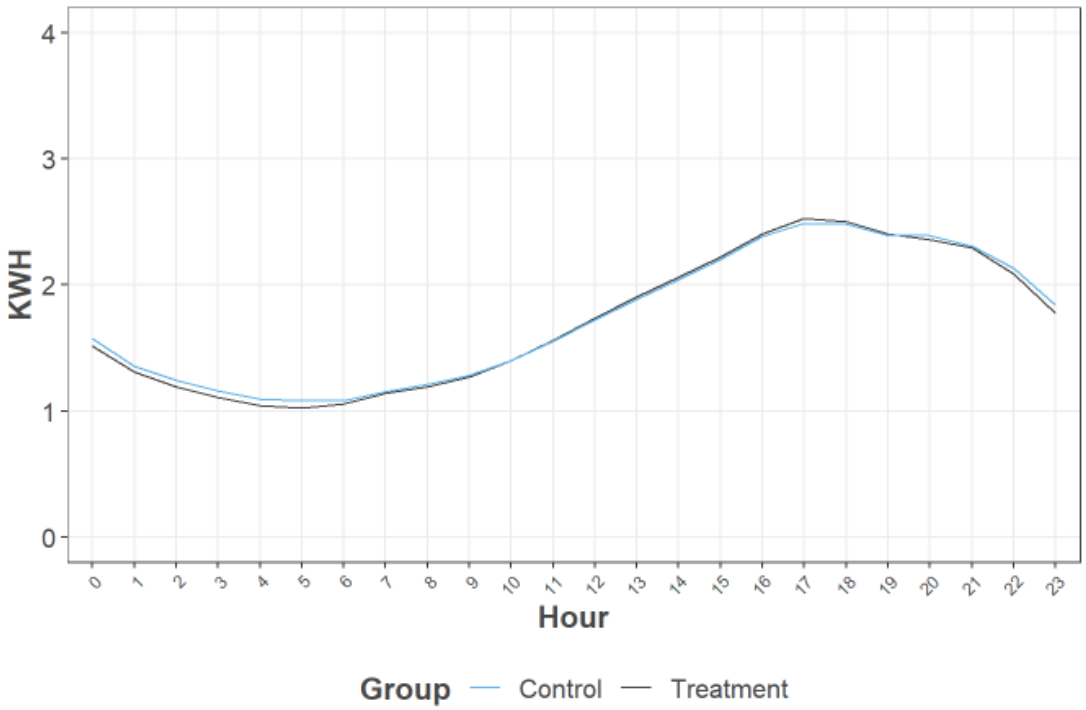


Figure 22. Residential DR Program: Nest June 29, 2023 Event – Non-Event Day Equivalency

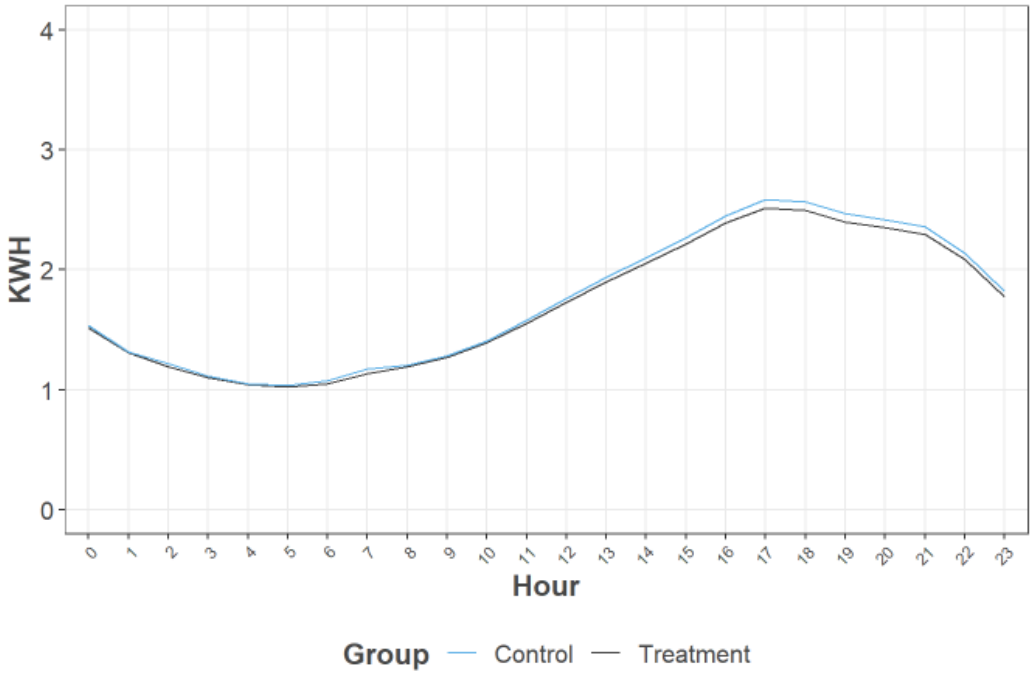


Figure 23. Residential DR Program: Nest June 30, 2023 Event – Non-Event Day Equivalency

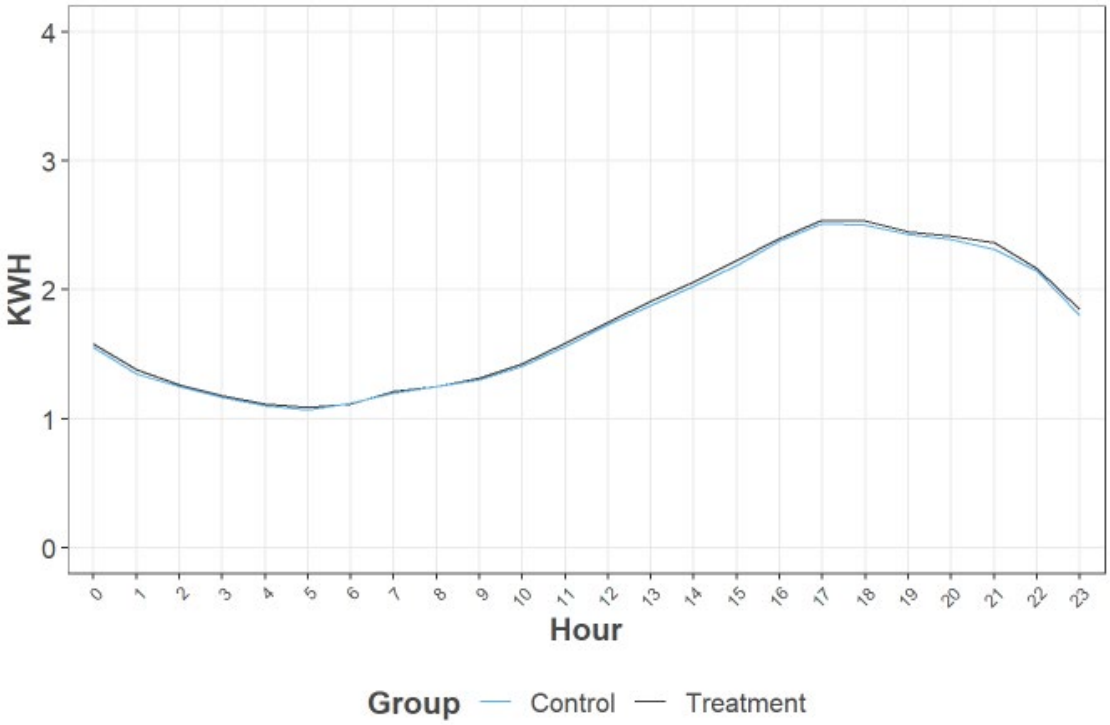


Figure 24. Residential DR Program: Nest July 5, 2023 Event – Non-Event Day Equivalency

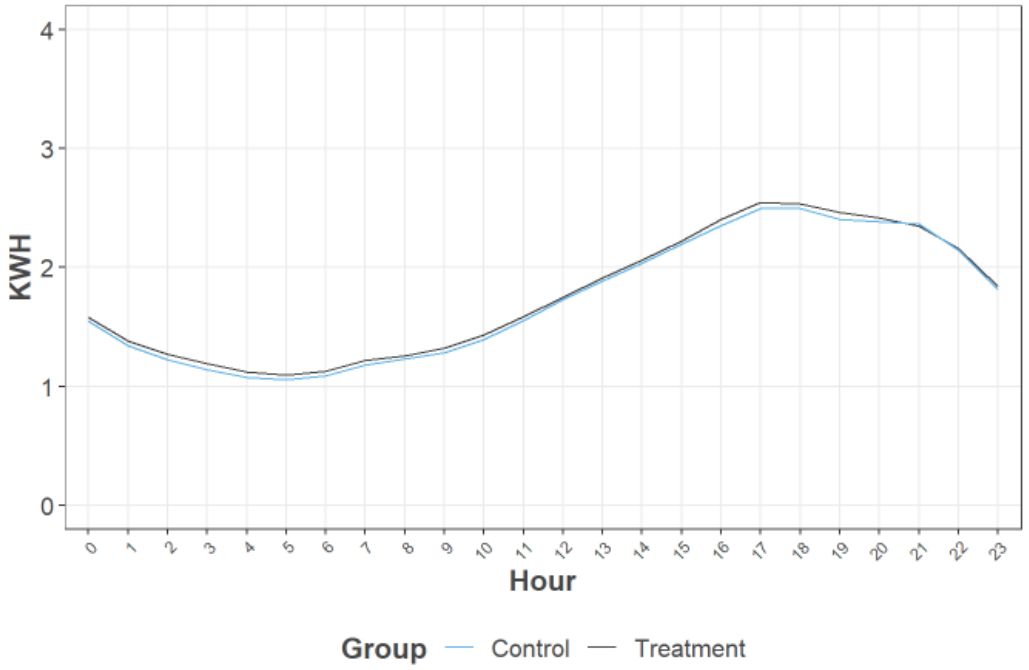


Figure 25. Residential DR Program: Nest July 27, 2023 Event – Non-Event Day Equivalency

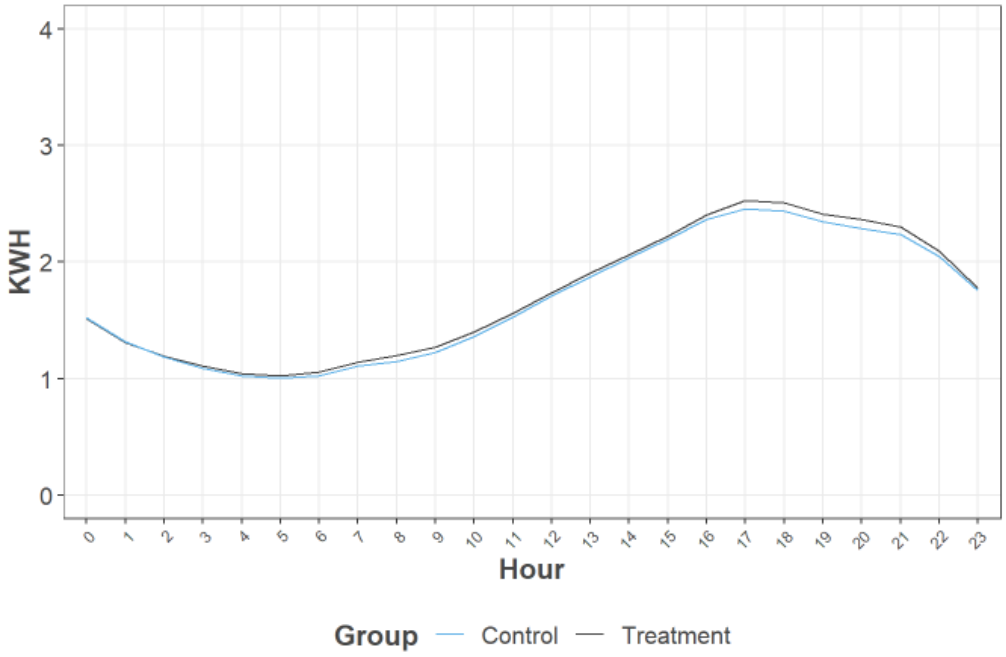


Figure 26. Residential DR Program: Nest August 11, 2023 Event (Group A) – Non-Event Day Equivalency

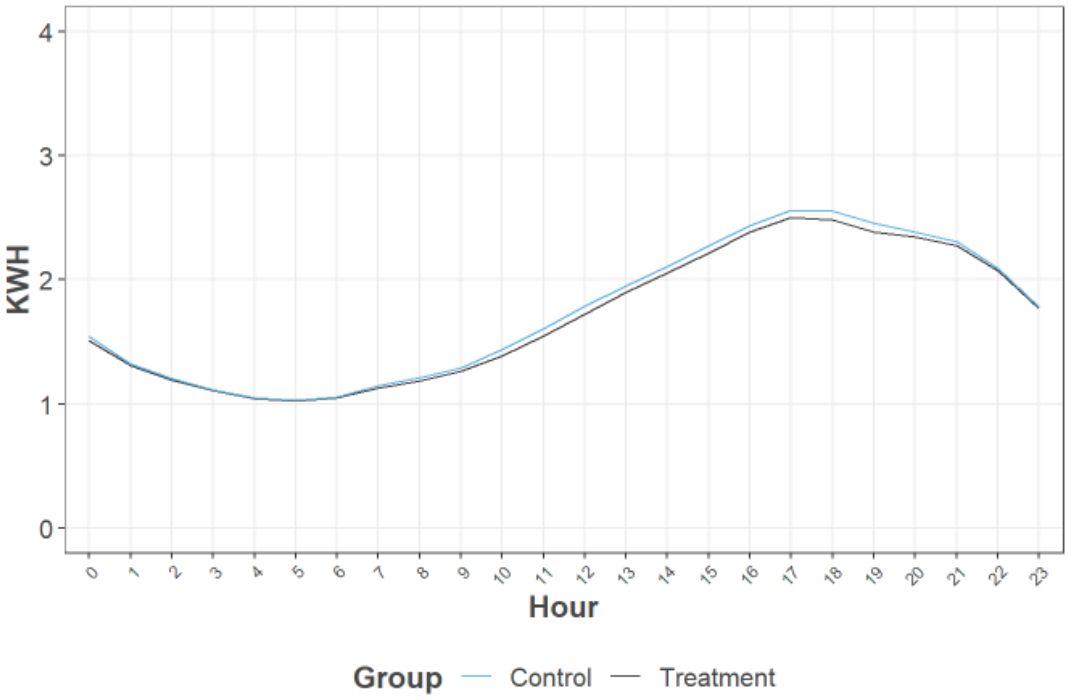


Figure 27. Residential DR Program: Nest August 11, 2023 Event (Group B) – Non-Event Day Equivalency

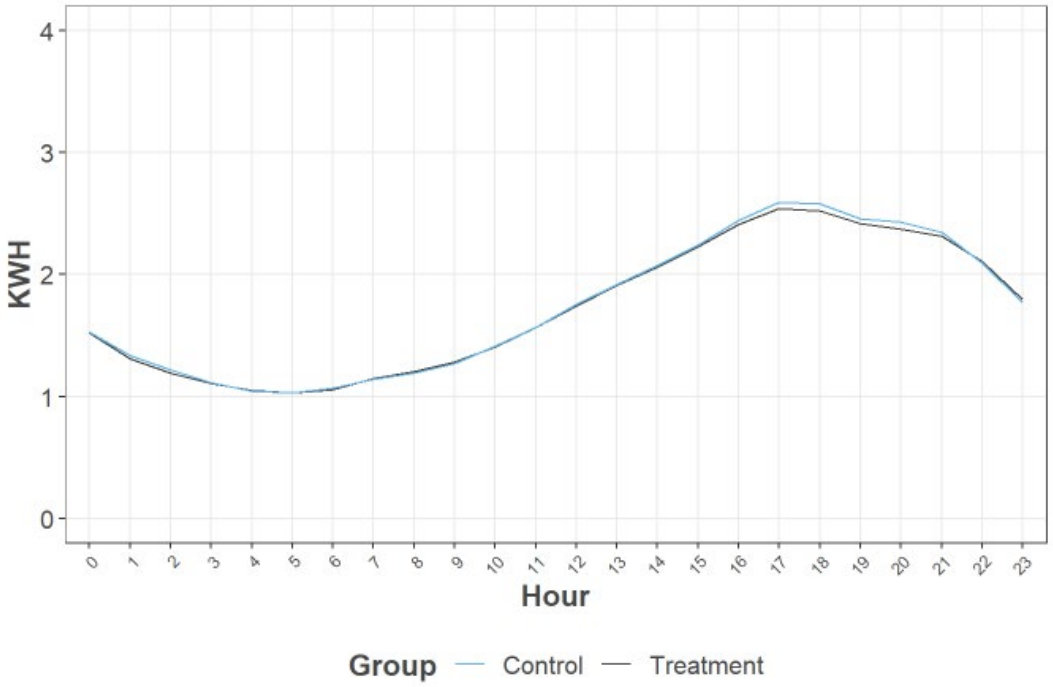


Figure 28. Residential DR Program: Nest August 23, 2023 Event – Non-Event Day Equivalency

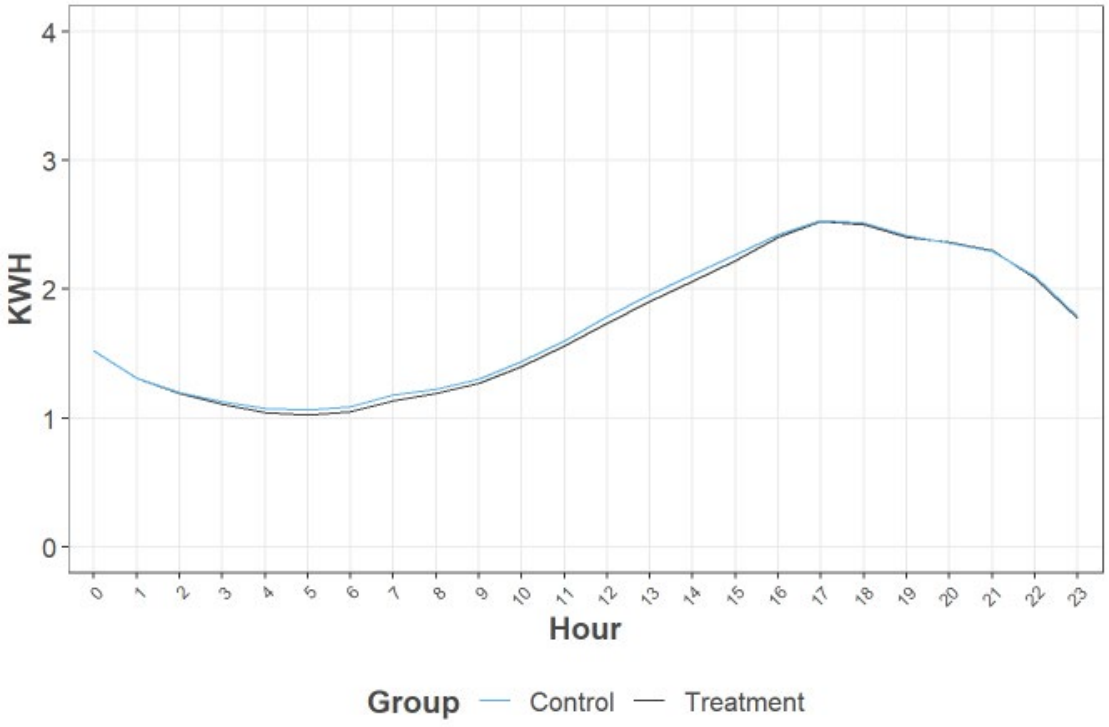


Figure 29. Residential DR Program: Nest August 24, 2023 Event – Non-Event Day Equivalency

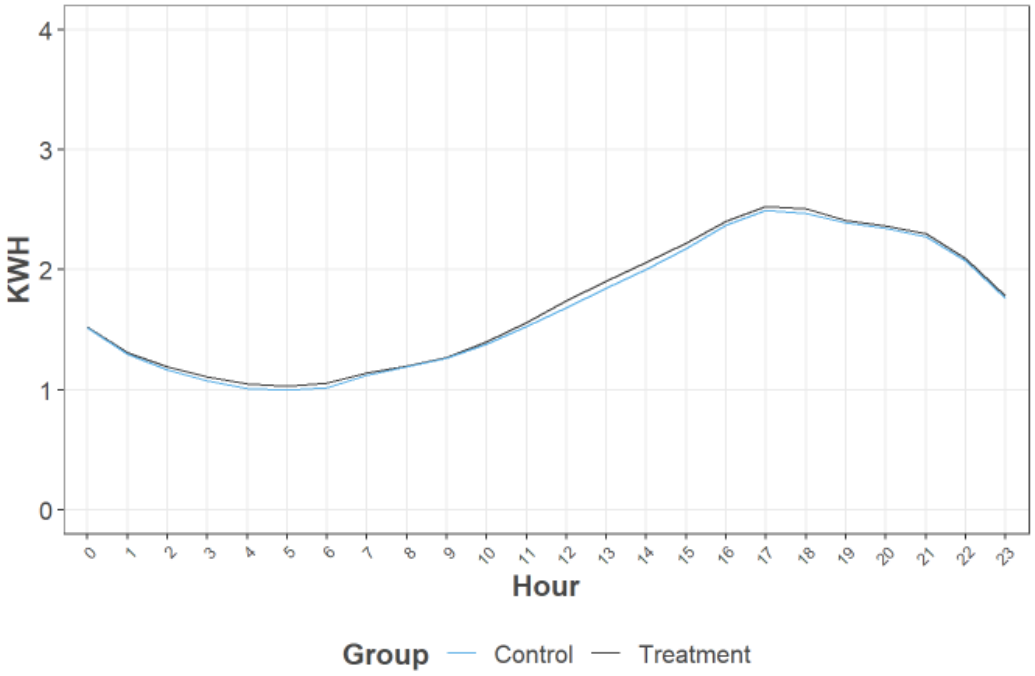
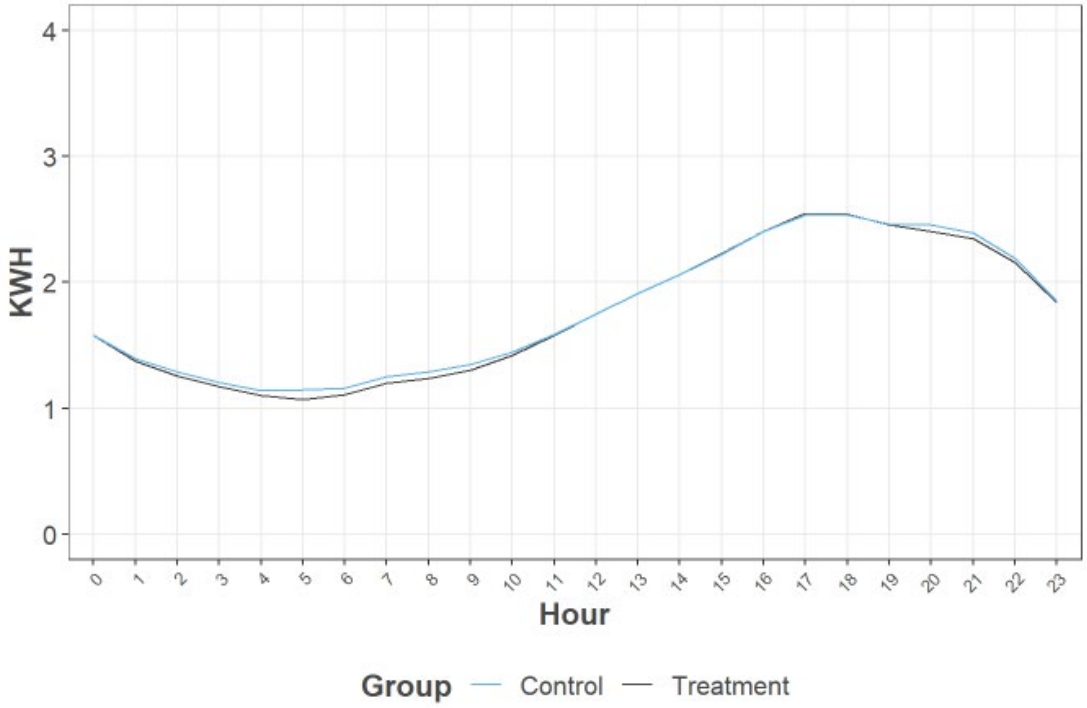


Figure 30. Residential DR Program: Nest September 19, 2023 Event – Non-Event Day Equivalency



FULL-POPULATION EVENT PROXY DAY SELECTION AND EQUIVALENCY ANALYSIS RESULTS

For the July 28th event, no customers were withheld in a control group, therefore, a non-event "proxy" day was selected as a baseline. Weather was used to select the best proxy day. Figure 31 illustrates the ten best matching non-event days of the 2023 event season in comparison to the event day. August 25th was determined to have the most similar temperature profile to the event day and was thus the final proxy day selection.

Figure 31. Residential DR Program: Proxy Day Candidates and Final Proxy Day Selection

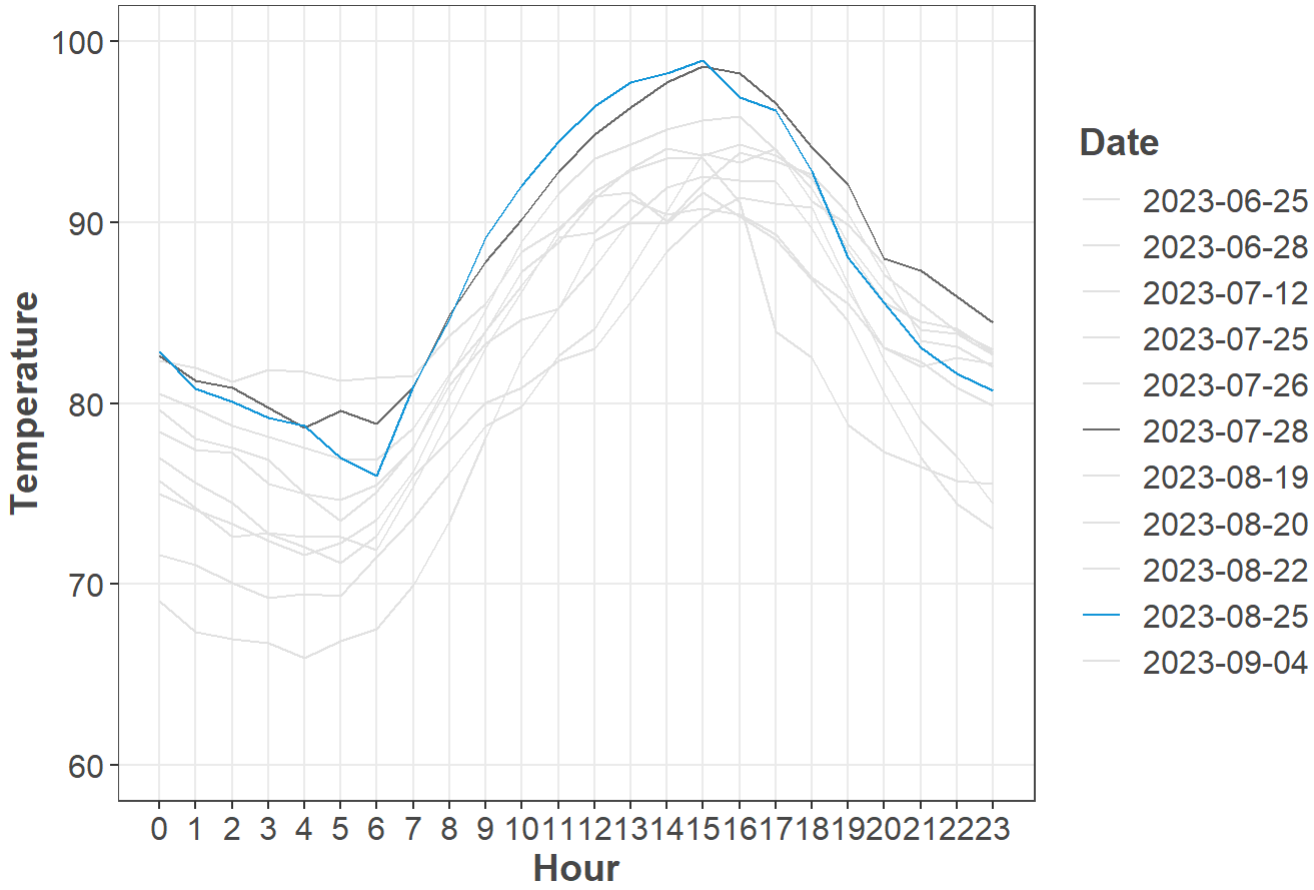


Figure 32 through Figure 34 show load profiles during non-event hours. The comparison of these hours was used to ensure that load behavior was similar between the event and proxy days. Overall, these figures show August 25th is a good proxy day for July 28th.

Figure 32. Residential DR Program: ecobee July 28, 2023 Event – Proxy Day Equivalency

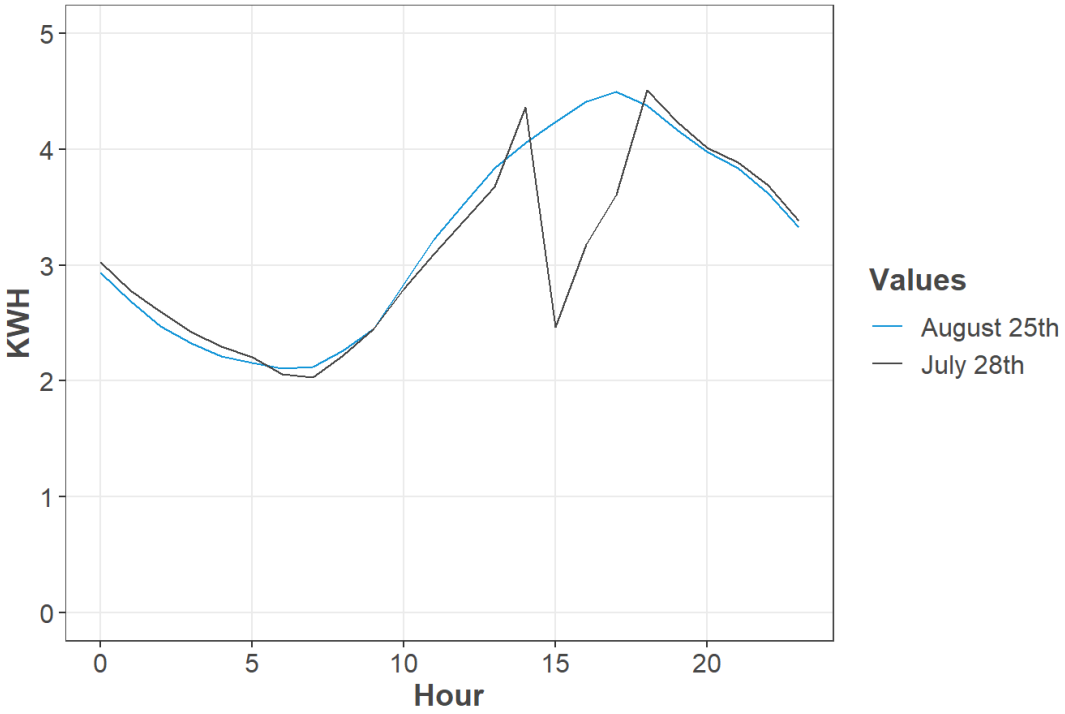


Figure 33. Residential DR Program: Sensi July 28, 2023 Event – Proxy Day Equivalency

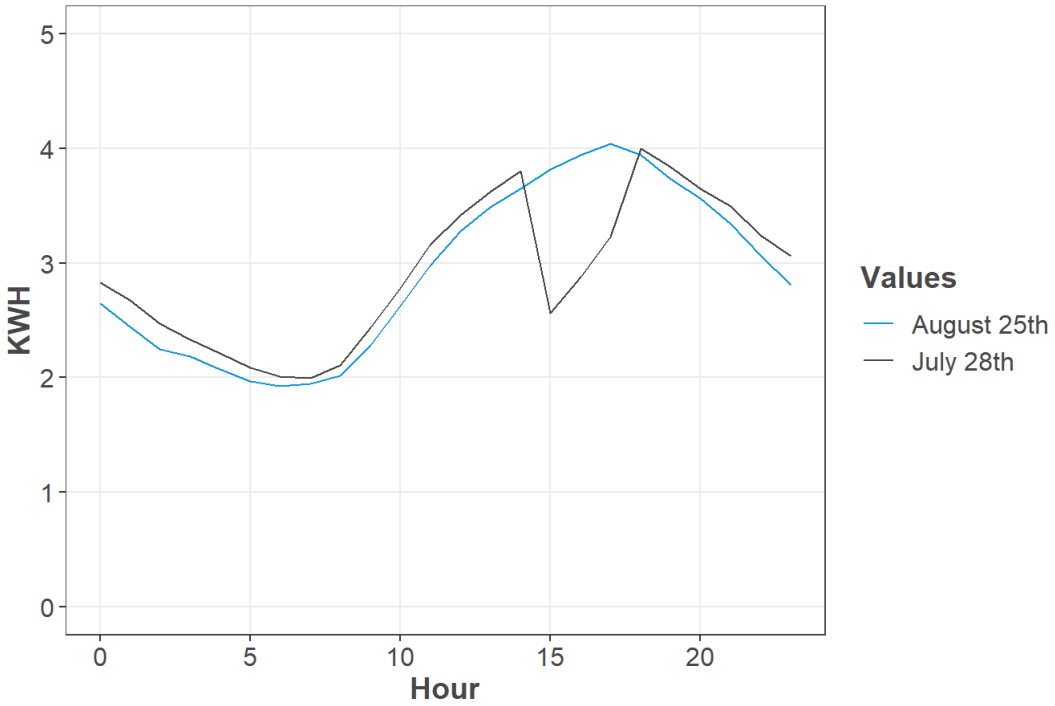
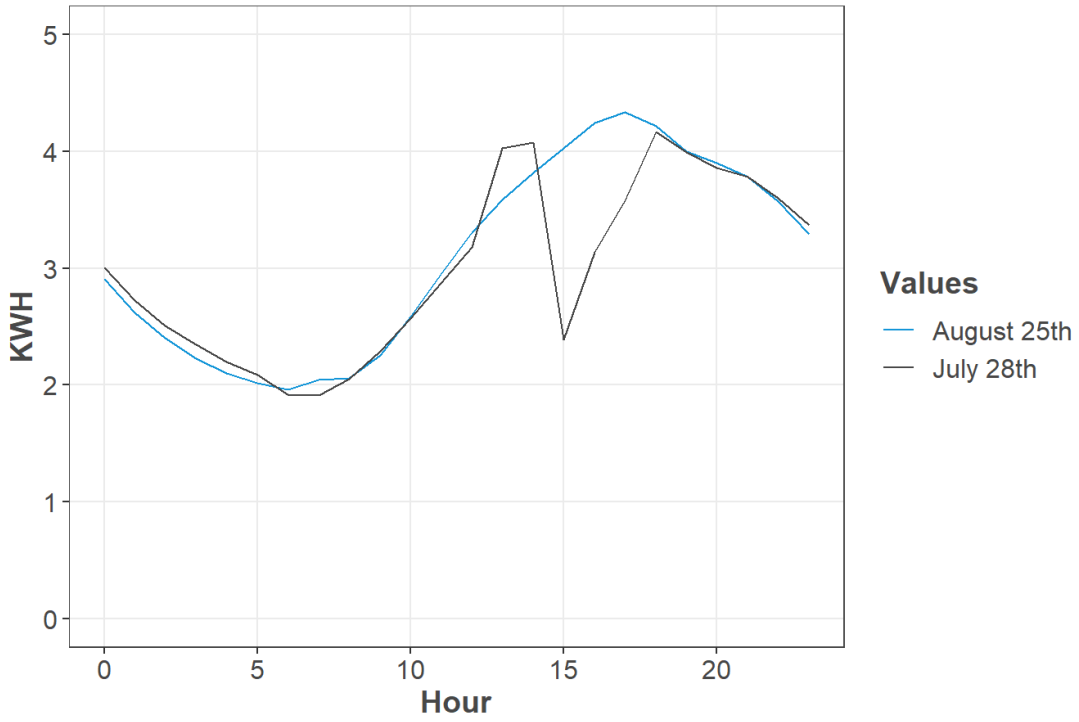


Figure 34. Residential DR Program: Nest July 28, 2023 Event – Proxy Day Equivalency



EVENT SEASON DEMAND MODEL SPECIFICATION AND OUTPUTS

RCT EVENT MODEL SPECIFICATION

Table 6 below shows the specific number of hours that were flagged in the models to account for the differences in load that are associated with being in precooling, event, or snapback hours. Snapback hours were determined by examining the raw load shapes of the treatment groups in each event and identifying the hours of increased usage after the event hours that are likely caused by participating in the event. Precooling hours were determined by the dispatch intent of each thermostat brand (Nest precools for 2 hours, ecobee precools for 1.5 hours, and Sensi can start precooling as early as midnight). Sensi had 2 cases of dispatch abnormalities that were accounted for in the models:

1. July 27th: This was dispatched with a 2-hour precool.
2. September 19th: The midnight precooling pattern that is usually seen in Sensi events was not seen on this event day, thus the precool was tailored to reflect the likely precool settings.

Table 6. Residential DR Program: Hours Flagged in Models

Brand/Event	Length of Precooling	Length of Snapback
ecobee (All Events)	2 hours	5 hours
Sensi (7/27)	2 hours	5 hours
Sensi (9/19)	5 hours	5 hours
Sensi (Remaining Events)	Midnight to the Event Start	5 Hours
Nest (All Events)	2 hours	5 hours

Equation 1 shows the model specification used to develop event day demand impacts for ecobee, Sensi and Nest. The fixed effect was specified at the account level.

Equation 1. Residential DR Program: Event Day Impact Model Specification – ecobee, Sensi, and Nest

$$kWh_{it} = \alpha_i + \sum_{t=0}^{23} \beta_t \cdot Hour_t + \sum_{t=Precool\ Hour\ Start}^{Precool\ Hour\ End} \beta_t Treatment_i \cdot PrecoolHour_t \cdot Hour_t + \sum_{t=Event\ Start}^{Event\ End} \beta_t Treatment_i \cdot EventHour_t \cdot Hour_t + \sum_{t=Recovery\ Hour\ Start}^{Recovery\ Hour\ End} \beta_t Treatment_i \cdot SnapbackHour_t \cdot Hour_t + \beta_{CDH} \cdot CDH_{it} + \varepsilon_{it}$$

Where:

α_i = Account--specific intercept for account *i*

$Treatment_i$ = Indicator variable for treatment customers for account *i (coded "0" for control and "1" for treatment)*

$PrecoolHour_t$ = Indicator variable for precooling hours for hour *t* (coded "0" for non-precooling hours and "1" for precooling hours)

$EventHour_t$= Indicator variable for event hours for hour *t* (coded "0" for non-event hours and "1" for event hours)

$SnapbackHour_t$ = Indicator variable for snapback hours for hour *t* (coded "0" for non- snapback hours and "1" for snapback hours)

$Hour_t$ = Set of 23 indicator variables of hours of the day; hour 0 is the reference hour

$Treatment_i \cdot PrecoolHour_t \cdot Hour_t$= The interaction of treatment account *i* with separate precool hours *t*

$Treatment_i \cdot EventHour_t \cdot Hour_t$= The interaction of treatment account *i* with separate event hours *t*

$Treatment_i \cdot Snapback_t \cdot Hour_t$= The interaction of treatment account *i* with separate event hours *t*

CDH_t = Cooling degree-hours for hour *t* (base 75 degrees Fahrenheit)

ε_{it} = Error term

FULL-POPULATION EVENT MODEL SPECIFICATION

Equation 2 shows the model specification used to develop event day demand impacts for ecobee, Sensi and Nest on the full population event day. The fixed effect was specified at the account level.

Equation 2. Residential DR Program: Full-Population Event Day Impact Model Specification – Nest, Sensi, and ecobee

$$kWh_{it} = \alpha_i + \sum_{t=0}^{23} \beta_t \cdot Hour_t + \sum_{t=Precool\ Start}^{Recovery\ End} \beta_t \cdot Event \cdot Hour_t + \beta_{CDH} \cdot CDH_{it} + \varepsilon_{it}$$

Where:

α_i = Account-specific intercept for account *i*

$Event$ = Indicator variable for the event day at (coded "0" for the proxy day and "1" for the event day)

$Hour_t$ = Set of 23 indicator variables of hours of the day; hour 0 is the reference hour

$\text{Event} \cdot \text{Hour}_t$ = The interaction of the event day indicator with separate precooling, event, and snapback hours

CDH_{it} = Cooling degree-hours for account *i* in hour t (base 75 degrees Fahrenheit)

ε_{it} = Error term

MODEL OUTPUTS

Table 7 through Table 9 show the impact values for each event and event day hour by device manufacturer.

Table 7. Residential DR Program: Average Hour Ex Post DR kW Impacts by Event, Event Hour (ecobee)

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
1	0	1.87	1.88	0.00	-0.14%	0.15	-0.25	0.24
	1	1.63	1.64	-0.01	-0.35%	0.15	-0.25	0.24
	2	1.46	1.46	0.00	-0.30%	0.15	-0.25	0.24
	3	1.33	1.34	0.00	-0.24%	0.15	-0.25	0.24
	4	1.26	1.26	0.00	-0.07%	0.15	-0.25	0.24
	5	1.23	1.24	-0.01	-0.45%	0.15	-0.25	0.24
	6	1.26	1.26	0.00	-0.11%	0.15	-0.25	0.24
	7	1.41	1.41	0.00	-0.10%	0.14	-0.23	0.23
	8	1.61	1.61	0.01	0.40%	0.04	-0.06	0.07
	9	1.78	1.77	0.01	0.59%	0.03	-0.05	0.07
	10	2.06	2.05	0.01	0.31%	0.09	-0.14	0.15
	11	2.32	2.31	0.00	0.21%	0.14	-0.23	0.24
	12	2.55	2.55	0.00	0.00%	0.14	-0.24	0.24
	13	2.87	2.82	0.05	1.77%	0.07	-0.06	0.16
	14	3.07	3.44	-0.37	-12.21%	0.07	-0.50	-0.25
	15	3.18	1.78	1.40	44.06%	0.07	1.28	1.52
	16	3.29	2.23	1.06	32.27%	0.07	0.95	1.17
	17	3.41	3.78	-0.37	-10.86%	0.08	-0.50	-0.24
	18	3.33	3.50	-0.17	-5.09%	0.07	-0.29	-0.05

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	19	3.13	3.26	-0.13	-4.28%	0.07	-0.25	-0.02
	20	2.86	3.02	-0.16	-5.51%	0.06	-0.26	-0.05
	21	2.86	2.89	-0.02	-0.72%	0.06	-0.12	0.08
	22	2.61	2.61	0.00	-0.05%	0.06	-0.09	0.09
	23	2.23	2.24	0.00	-0.08%	0.13	-0.22	0.22
2	0	2.34	2.34	0.00	0.04%	0.04	-0.06	0.06
	1	2.16	2.15	0.00	0.17%	0.04	-0.06	0.07
	2	2.01	2.01	0.00	-0.09%	0.04	-0.07	0.07
	3	1.92	1.92	0.00	0.04%	0.05	-0.08	0.08
	4	1.85	1.85	0.00	-0.09%	0.05	-0.08	0.08
	5	1.80	1.80	0.00	0.11%	0.05	-0.08	0.08
	6	1.77	1.77	0.00	0.17%	0.04	-0.07	0.07
	7	1.83	1.82	0.01	0.45%	0.04	-0.06	0.07
	8	2.00	1.99	0.01	0.43%	0.04	-0.05	0.07
	9	2.23	2.24	-0.01	-0.45%	0.02	-0.05	0.03
	10	2.61	2.61	0.00	-0.18%	0.02	-0.04	0.03
	11	2.87	2.87	0.00	0.06%	0.02	-0.04	0.04
	12	3.05	3.05	0.00	0.13%	0.05	-0.07	0.08
	13	2.90	2.90	0.00	-0.13%	0.05	-0.09	0.08
	14	2.89	2.88	0.01	0.26%	0.05	-0.08	0.09
	15	3.02	4.04	-1.02	-33.61%	0.05	-1.10	-0.93
	16	3.16	1.80	1.36	43.07%	0.06	1.27	1.45
	17	3.26	2.23	1.03	31.60%	0.06	0.94	1.12
	18	3.24	3.69	-0.45	-13.97%	0.05	-0.54	-0.37
	19	3.26	3.38	-0.12	-3.69%	0.05	-0.21	-0.03
	20	3.10	3.20	-0.10	-3.12%	0.06	-0.20	0.00
	21	3.12	3.12	-0.01	-0.29%	0.06	-0.11	0.09
	22	2.83	2.89	-0.07	-2.34%	0.06	-0.16	0.03
	23	2.53	2.54	-0.01	-0.42%	0.07	-0.12	0.10
3	0	2.20	2.22	-0.03	-1.15%	0.36	-0.62	0.57
	1	1.96	1.96	0.00	0.15%	0.40	-0.66	0.67
	2	1.81	1.80	0.02	0.96%	0.48	-0.78	0.81
	3	1.70	1.69	0.01	0.46%	0.48	-0.79	0.80
	4	1.60	1.60	0.01	0.33%	0.49	-0.79	0.80
	5	1.56	1.56	0.00	0.23%	0.49	-0.79	0.80
	6	1.53	1.53	-0.01	-0.41%	0.45	-0.74	0.73
	7	1.58	1.59	-0.01	-0.88%	0.40	-0.68	0.65
	8	1.84	1.86	-0.02	-0.83%	0.25	-0.43	0.40
	9	2.03	2.03	0.00	-0.14%	0.11	-0.18	0.17
	10	2.45	2.43	0.02	0.79%	0.17	-0.26	0.30
	11	2.80	2.76	0.05	1.70%	0.25	-0.36	0.45
	12	3.19	3.16	0.03	0.98%	0.25	-0.38	0.44
	13	3.60	3.48	0.12	3.27%	0.13	-0.10	0.34
	14	3.62	4.08	-0.46	-12.80%	0.13	-0.67	-0.25

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	15	3.62	2.20	1.42	39.16%	0.12	1.22	1.62
	16	3.80	2.83	0.97	25.60%	0.14	0.75	1.20
	17	3.77	4.22	-0.44	-11.71%	0.14	-0.67	-0.21
	18	3.51	3.76	-0.26	-7.30%	0.13	-0.46	-0.05
	19	3.19	3.26	-0.07	-2.25%	0.13	-0.28	0.14
	20	2.99	3.07	-0.08	-2.52%	0.12	-0.27	0.12
	21	2.86	2.97	-0.12	-4.12%	0.11	-0.30	0.06
	22	2.71	2.74	-0.03	-1.10%	0.34	-0.59	0.53
	23	2.47	2.52	-0.04	-1.69%	0.40	-0.70	0.62
4	0	2.26	2.26	-0.01	-0.32%	0.18	-0.30	0.29
	1	2.02	2.03	-0.01	-0.36%	0.19	-0.32	0.31
	2	1.86	1.86	0.01	0.29%	0.21	-0.33	0.34
	3	1.72	1.73	-0.01	-0.33%	0.22	-0.37	0.36
	4	1.61	1.60	0.01	0.44%	0.24	-0.39	0.40
	5	1.57	1.56	0.01	0.56%	0.24	-0.39	0.40
	6	1.55	1.55	0.00	-0.03%	0.22	-0.37	0.37
	7	1.64	1.66	-0.01	-0.89%	0.21	-0.35	0.32
	8	1.80	1.80	0.00	0.12%	0.15	-0.25	0.25
	9	1.98	1.99	-0.01	-0.42%	0.11	-0.19	0.17
	10	2.23	2.22	0.01	0.31%	0.07	-0.10	0.12
	11	2.60	2.58	0.02	0.65%	0.07	-0.10	0.14
	12	2.89	2.89	0.00	0.15%	0.08	-0.13	0.13
	13	3.17	3.20	-0.03	-0.80%	0.08	-0.16	0.11
	14	3.09	3.08	0.01	0.37%	0.11	-0.17	0.20
	15	3.12	4.01	-0.89	-28.58%	0.12	-1.09	-0.70
	16	3.23	1.85	1.38	42.72%	0.10	1.21	1.55
	17	3.41	2.39	1.02	29.89%	0.11	0.83	1.21
	18	3.51	3.92	-0.41	-11.67%	0.12	-0.61	-0.21
	19	3.41	3.64	-0.23	-6.72%	0.13	-0.44	-0.02
	20	3.35	3.56	-0.21	-6.13%	0.14	-0.43	0.02
	21	3.33	3.34	-0.01	-0.31%	0.14	-0.24	0.22
	22	3.13	3.05	0.09	2.78%	0.13	-0.13	0.30
	23	2.64	2.62	0.02	0.66%	0.19	-0.29	0.32
5	0	2.61	2.61	0.00	0.06%	0.29	-0.48	0.48
	1	2.39	2.39	0.00	0.04%	0.29	-0.48	0.48
	2	2.23	2.23	0.00	0.17%	0.31	-0.51	0.52
	3	2.11	2.10	0.01	0.41%	0.33	-0.53	0.55
	4	2.02	2.02	0.00	0.17%	0.35	-0.57	0.57
	5	1.98	1.97	0.01	0.51%	0.36	-0.59	0.61
	6	1.90	1.90	0.00	0.12%	0.33	-0.54	0.54
	7	1.97	1.97	0.00	-0.07%	0.31	-0.51	0.51
	8	2.18	2.18	0.00	0.01%	0.26	-0.42	0.42
	9	2.34	2.35	0.00	-0.19%	0.20	-0.33	0.33
	10	2.64	2.64	0.00	0.04%	0.17	-0.27	0.27

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	11	2.99	3.07	-0.08	-2.70%	0.07	-0.19	0.03
	12	3.28	3.87	-0.59	-17.90%	0.07	-0.70	-0.48
	13	3.54	1.92	1.61	45.57%	0.07	1.50	1.72
	14	3.75	2.48	1.27	33.84%	0.07	1.15	1.38
	15	3.90	3.03	0.87	22.43%	0.07	0.76	0.99
	16	4.07	3.48	0.59	14.59%	0.07	0.48	0.71
	17	4.24	4.61	-0.37	-8.72%	0.08	-0.49	-0.24
	18	4.27	4.51	-0.24	-5.60%	0.08	-0.37	-0.11
	19	4.12	4.28	-0.15	-3.74%	0.07	-0.27	-0.04
	20	3.93	4.06	-0.13	-3.30%	0.06	-0.23	-0.03
	21	3.82	3.94	-0.13	-3.32%	0.06	-0.23	-0.02
	22	3.69	3.71	-0.01	-0.35%	0.19	-0.32	0.29
	23	3.36	3.37	-0.01	-0.39%	0.20	-0.35	0.32
6	0	3.04	3.06	-0.02	-0.72%	0.00	-0.03	-0.02
	1	2.79	2.82	-0.02	-0.81%	0.01	-0.04	-0.01
	2	2.60	2.63	-0.03	-1.03%	0.01	-0.05	0.00
	3	2.44	2.45	-0.01	-0.60%	0.02	-0.04	0.01
	4	2.32	2.33	-0.01	-0.38%	0.02	-0.04	0.03
	5	2.24	2.23	0.01	0.40%	0.02	-0.03	0.05
	6	2.12	2.08	0.04	2.12%	0.02	0.00	0.09
	7	2.11	2.05	0.06	2.69%	0.02	0.02	0.10
	8	2.27	2.24	0.03	1.38%	0.02	0.00	0.06
	9	2.46	2.48	-0.01	-0.58%	0.02	-0.05	0.02
	10	2.81	2.83	-0.01	-0.50%	0.03	-0.06	0.03
	11	3.15	3.13	0.02	0.59%	0.03	-0.04	0.07
	12	3.48	3.43	0.05	1.40%	0.04	-0.01	0.11
	13	3.82	3.72	0.10	2.60%	0.02	0.06	0.13
	14	4.04	4.42	-0.38	-9.30%	0.02	-0.41	-0.34
	15	4.22	2.43	1.79	42.41%	0.03	1.74	1.83
	16	4.42	3.17	1.24	28.13%	0.03	1.20	1.29
	17	4.48	3.62	0.86	19.16%	0.03	0.82	0.90
	18	4.40	4.57	-0.16	-3.73%	0.02	-0.20	-0.13
	19	4.20	4.28	-0.08	-1.97%	0.02	-0.12	-0.05
	20	4.02	4.06	-0.04	-0.98%	0.02	-0.07	-0.01
	21	3.87	3.94	-0.06	-1.63%	0.02	-0.10	-0.03
	22	3.72	3.74	-0.01	-0.39%	0.02	-0.05	0.02
	23	3.42	3.42	0.00	0.06%	0.01	-0.02	0.02
7	0	1.87	1.85	0.02	1.04%	0.01	-0.01	0.05
	1	1.66	1.64	0.02	1.14%	0.03	-0.04	0.08
	2	1.52	1.50	0.02	1.59%	0.06	-0.09	0.14
	3	1.41	1.39	0.02	1.28%	0.06	-0.10	0.13
	4	1.35	1.34	0.02	1.19%	0.06	-0.10	0.13
	5	1.35	1.34	0.01	0.92%	0.06	-0.11	0.13
	6	1.37	1.85	0.01	0.96%	0.06	-0.11	0.13

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	7	1.43	1.64	0.02	1.24%	0.06	-0.10	0.14
	8	1.60	1.50	0.02	1.22%	0.03	-0.03	0.07
	9	1.79	1.39	0.04	2.35%	0.08	-0.11	0.19
	10	2.08	1.34	0.03	1.56%	0.12	-0.20	0.26
	11	2.39	1.34	0.03	1.39%	0.15	-0.25	0.32
	12	2.70	1.36	0.06	2.35%	0.13	-0.20	0.32
	13	2.99	1.42	-0.36	-11.89%	0.14	-0.63	-0.08
	14	3.18	1.58	0.72	22.54%	0.06	0.60	0.84
	15	3.44	1.75	0.17	4.97%	0.07	0.04	0.30
	16	3.58	2.05	0.66	18.52%	0.07	0.53	0.80
	17	3.56	2.36	0.51	14.24%	0.07	0.37	0.64
	18	3.47	2.64	-0.22	-6.45%	0.07	-0.36	-0.09
	19	3.34	3.34	-0.11	-3.34%	0.06	-0.24	0.01
	20	3.24	2.47	-0.05	-1.43%	0.06	-0.17	0.08
	21	3.20	3.27	-0.02	-0.55%	0.09	-0.20	0.16
	22	2.99	2.92	-0.01	-0.22%	0.08	-0.16	0.15
	23	2.72	3.05	0.02	0.79%	0.08	-0.15	0.19
8	0	2.87	2.87	0.00	-0.05%	0.27	-0.45	0.45
	1	2.64	2.64	0.00	-0.02%	0.28	-0.46	0.46
	2	2.44	2.44	0.00	0.00%	0.31	-0.51	0.51
	3	2.30	2.30	0.00	0.05%	0.33	-0.54	0.54
	4	2.19	2.19	0.00	-0.03%	0.35	-0.57	0.57
	5	2.13	2.12	0.00	0.23%	0.36	-0.59	0.60
	6	2.07	2.06	0.00	0.22%	0.36	-0.59	0.60
	7	2.07	2.06	0.01	0.28%	0.34	-0.55	0.56
	8	2.15	2.14	0.01	0.24%	0.27	-0.44	0.45
	9	2.37	2.37	0.00	-0.08%	0.24	-0.39	0.39
	10	2.67	2.68	0.00	-0.10%	0.18	-0.30	0.29
	11	2.98	2.98	-0.01	-0.30%	0.16	-0.28	0.26
	12	3.26	3.26	0.00	-0.09%	0.15	-0.24	0.24
	13	3.45	3.59	-0.15	-4.21%	0.05	-0.23	-0.06
	14	3.67	4.15	-0.48	-13.22%	0.05	-0.57	-0.40
	15	3.88	2.26	1.61	41.56%	0.06	1.52	1.71
	16	3.99	3.00	0.99	24.86%	0.06	0.90	1.09
	17	4.15	3.50	0.66	15.80%	0.06	0.56	0.75
	18	4.07	4.55	-0.47	-11.58%	0.06	-0.57	-0.38
	19	4.06	4.34	-0.28	-6.85%	0.06	-0.38	-0.18
	20	4.00	4.11	-0.11	-2.79%	0.07	-0.22	0.00
	21	3.78	3.88	-0.10	-2.56%	0.06	-0.20	0.01
	22	3.51	3.55	-0.04	-1.22%	0.06	-0.14	0.06
	23	3.16	3.16	0.00	-0.07%	0.29	-0.48	0.47
9	0	2.81	2.81	0.00	0.01%	0.35	-0.57	0.57
	1	2.59	2.59	0.00	-0.04%	0.36	-0.59	0.59
	2	2.40	2.39	0.01	0.26%	0.39	-0.63	0.65

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	3	2.25	2.25	0.00	0.21%	0.39	-0.64	0.64
	4	2.15	2.15	0.00	0.20%	0.41	-0.67	0.68
	5	2.13	2.12	0.00	0.12%	0.41	-0.68	0.68
	6	2.06	2.05	0.01	0.42%	0.41	-0.67	0.69
	7	2.05	2.04	0.01	0.36%	0.37	-0.60	0.62
	8	2.16	2.16	0.00	-0.08%	0.32	-0.53	0.53
	9	2.31	2.32	0.00	-0.20%	0.26	-0.43	0.42
	10	2.64	2.64	0.00	-0.15%	0.20	-0.33	0.32
	11	3.01	3.02	-0.01	-0.26%	0.15	-0.26	0.25
	12	3.32	3.38	-0.06	-1.80%	0.06	-0.16	0.04
	13	3.61	4.43	-0.82	-22.71%	0.07	-0.93	-0.70
	14	3.85	2.24	1.62	41.95%	0.07	1.50	1.73
	15	4.04	2.99	1.05	25.92%	0.07	0.93	1.16
	16	4.22	3.62	0.60	14.16%	0.07	0.48	0.71
	17	4.39	3.97	0.43	9.69%	0.07	0.31	0.54
	18	4.35	4.72	-0.36	-8.38%	0.07	-0.48	-0.25
	19	4.17	4.47	-0.30	-7.12%	0.06	-0.40	-0.19
	20	4.05	4.28	-0.23	-5.56%	0.06	-0.33	-0.12
	21	3.89	4.07	-0.18	-4.53%	0.06	-0.28	-0.07
	22	3.54	3.73	-0.19	-5.38%	0.06	-0.29	-0.09
	23	3.29	3.31	-0.01	-0.45%	0.28	-0.48	0.45
10	0	1.15	1.16	0.00	-0.20%	0.09	-0.15	0.15
	1	1.04	1.04	0.00	0.13%	0.09	-0.15	0.15
	2	0.95	0.95	0.01	0.56%	0.09	-0.15	0.16
	3	0.88	0.87	0.01	1.46%	0.09	-0.14	0.17
	4	0.86	0.87	-0.01	-0.74%	0.09	-0.16	0.15
	5	0.89	0.90	0.00	-0.41%	0.10	-0.16	0.15
	6	1.01	1.03	-0.02	-1.91%	0.10	-0.19	0.15
	7	1.10	1.12	-0.02	-1.86%	0.10	-0.19	0.15
	8	1.07	1.08	-0.01	-0.99%	0.10	-0.17	0.15
	9	1.08	1.09	-0.01	-0.91%	0.10	-0.17	0.15
	10	1.10	1.10	0.00	0.34%	0.06	-0.09	0.10
	11	1.23	1.23	0.00	-0.27%	0.06	-0.10	0.10
	12	1.37	1.36	0.00	0.30%	0.13	-0.20	0.21
	13	1.55	1.55	0.01	0.40%	0.23	-0.38	0.39
	14	1.88	1.81	0.07	3.59%	0.10	-0.10	0.23
	15	2.09	2.55	-0.46	-22.19%	0.12	-0.66	-0.27
	16	2.27	1.37	0.89	39.44%	0.11	0.72	1.07
	17	2.40	1.68	0.72	29.87%	0.11	0.53	0.90
	18	2.43	2.62	-0.20	-8.15%	0.13	-0.41	0.01
	19	2.48	2.46	0.02	0.99%	0.13	-0.18	0.23
	20	2.39	2.34	0.05	2.29%	0.12	-0.14	0.25
	21	2.28	2.24	0.04	1.78%	0.12	-0.15	0.23
	22	2.07	1.95	0.13	6.19%	0.10	-0.04	0.29

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	23	1.67	1.62	0.04	2.53%	0.10	-0.13	0.21

Table 8. Residential DR Program: Average Hour Ex Post DR kW Impacts by Event, Event Hour (Sensi)

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
1	0	1.70	1.92	-0.22	-12.75%	0.04	-0.29	-0.14
	1	1.48	1.67	-0.20	-13.40%	0.04	-0.27	-0.12
	2	1.33	1.42	-0.10	-7.42%	0.04	-0.17	-0.03
	3	1.21	1.30	-0.09	-7.21%	0.05	-0.17	0.00
	4	1.14	1.21	-0.07	-6.35%	0.05	-0.16	0.02
	5	1.12	1.19	-0.08	-6.82%	0.05	-0.16	0.01
	6	1.15	1.25	-0.10	-8.79%	0.06	-0.20	0.00
	7	1.22	1.34	-0.12	-9.67%	0.06	-0.21	-0.02
	8	1.36	1.53	-0.17	-12.43%	0.06	-0.26	-0.07
	9	1.61	1.76	-0.14	-8.85%	0.06	-0.25	-0.04
	10	1.84	2.03	-0.19	-10.24%	0.07	-0.30	-0.08
	11	2.13	2.38	-0.26	-12.13%	0.07	-0.38	-0.14
	12	2.33	2.64	-0.32	-13.68%	0.07	-0.43	-0.21
	13	2.56	2.78	-0.22	-8.56%	0.07	-0.33	-0.11
	14	2.68	2.97	-0.29	-10.66%	0.07	-0.40	-0.17
	15	2.86	1.79	1.07	37.46%	0.07	0.96	1.19
	16	3.03	2.15	0.88	28.96%	0.07	0.77	0.99
	17	3.14	3.22	-0.07	-2.27%	0.07	-0.18	0.04
	18	3.12	3.09	0.04	1.20%	0.07	-0.08	0.15
	19	2.90	2.88	0.02	0.79%	0.06	-0.08	0.12
	20	2.74	2.64	0.10	3.80%	0.06	0.01	0.20
	21	2.53	2.50	0.03	1.36%	0.05	-0.05	0.12
	22	2.22	2.22	0.00	-0.01%	0.05	-0.09	0.09
	23	1.89	1.89	0.00	0.01%	0.10	-0.16	0.16
2	0	2.29	2.46	-0.16	-7.07%	0.06	-0.26	-0.07
	1	2.08	2.31	-0.22	-10.76%	0.05	-0.31	-0.14
	2	1.88	2.08	-0.19	-10.26%	0.05	-0.28	-0.11
	3	1.76	1.94	-0.17	-9.68%	0.05	-0.25	-0.09
	4	1.64	1.82	-0.18	-11.03%	0.05	-0.26	-0.10
	5	1.66	1.73	-0.08	-4.60%	0.05	-0.16	0.01
	6	1.71	1.76	-0.06	-3.34%	0.07	-0.17	0.05
	7	1.73	1.81	-0.09	-5.14%	0.07	-0.20	0.02
	8	1.78	1.93	-0.15	-8.30%	0.07	-0.26	-0.04
	9	2.01	2.19	-0.18	-8.87%	0.07	-0.30	-0.06
	10	2.30	2.53	-0.23	-10.00%	0.07	-0.35	-0.11
	11	2.60	2.80	-0.19	-7.39%	0.08	-0.32	-0.07
	12	2.81	3.07	-0.26	-9.16%	0.08	-0.39	-0.13

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	13	2.64	2.93	-0.29	-10.99%	0.07	-0.41	-0.17
	14	2.66	2.85	-0.20	-7.36%	0.07	-0.31	-0.08
	15	2.83	3.02	-0.19	-6.55%	0.07	-0.30	-0.07
	16	2.91	1.61	1.30	44.63%	0.07	1.19	1.42
	17	3.11	2.03	1.09	34.93%	0.07	0.97	1.21
	18	3.10	3.20	-0.11	-3.48%	0.07	-0.22	0.00
	19	2.93	2.98	-0.05	-1.82%	0.06	-0.16	0.05
	20	2.85	2.81	0.04	1.32%	0.06	-0.07	0.14
	21	2.69	2.69	0.00	0.17%	0.05	-0.08	0.09
	22	2.46	2.45	0.01	0.25%	0.04	-0.06	0.07
	23	2.15	2.15	0.00	0.00%	0.08	-0.13	0.13
3	0	1.86	2.12	-0.26	-13.94%	0.11	-0.45	-0.07
	1	1.74	1.93	-0.20	-11.41%	0.13	-0.41	0.02
	2	1.53	1.78	-0.25	-16.09%	0.12	-0.45	-0.04
	3	1.36	1.66	-0.30	-22.06%	0.11	-0.49	-0.11
	4	1.19	1.54	-0.34	-28.66%	0.11	-0.52	-0.16
	5	1.19	1.47	-0.28	-23.88%	0.11	-0.47	-0.10
	6	1.25	1.45	-0.19	-15.32%	0.13	-0.40	0.01
	7	1.38	1.62	-0.23	-16.97%	0.13	-0.46	-0.01
	8	1.47	1.78	-0.31	-21.37%	0.14	-0.55	-0.08
	9	1.76	2.06	-0.31	-17.46%	0.14	-0.54	-0.07
	10	2.15	2.42	-0.27	-12.63%	0.15	-0.52	-0.03
	11	2.52	2.97	-0.45	-17.91%	0.16	-0.71	-0.19
	12	2.83	3.42	-0.60	-21.14%	0.16	-0.86	-0.34
	13	3.04	3.65	-0.61	-20.16%	0.16	-0.87	-0.35
	14	3.19	3.74	-0.55	-17.41%	0.15	-0.81	-0.30
	15	3.34	2.11	1.22	36.63%	0.17	0.94	1.50
	16	3.51	2.59	0.92	26.22%	0.16	0.65	1.19
	17	3.45	3.93	-0.48	-13.85%	0.14	-0.72	-0.24
	18	3.23	3.63	-0.39	-12.09%	0.13	-0.60	-0.18
	19	2.72	3.02	-0.30	-10.91%	0.11	-0.48	-0.11
	20	2.59	2.78	-0.18	-7.08%	0.10	-0.36	-0.01
	21	2.57	2.68	-0.11	-4.29%	0.09	-0.26	0.03
	22	2.43	2.42	0.00	0.05%	0.35	-0.57	0.57
	23	2.14	2.14	0.00	-0.05%	0.40	-0.66	0.66
4	0	2.10	2.11	0.00	-0.19%	0.10	-0.17	0.16
	1	1.82	1.92	-0.09	-5.18%	0.11	-0.28	0.09
	2	1.62	1.69	-0.07	-4.28%	0.11	-0.25	0.11
	3	1.45	1.60	-0.15	-10.69%	0.10	-0.33	0.02
	4	1.30	1.49	-0.18	-13.96%	0.11	-0.36	-0.01
	5	1.27	1.38	-0.10	-8.23%	0.11	-0.28	0.07
	6	1.35	1.40	-0.06	-4.31%	0.12	-0.26	0.15
	7	1.42	1.58	-0.15	-10.84%	0.12	-0.36	0.05
	8	1.53	1.68	-0.15	-9.46%	0.13	-0.36	0.07

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	9	1.84	1.85	-0.01	-0.28%	0.15	-0.25	0.24
	10	2.17	2.14	0.03	1.40%	0.15	-0.22	0.28
	11	2.41	2.46	-0.05	-1.88%	0.15	-0.29	0.20
	12	2.69	2.97	-0.28	-10.25%	0.15	-0.52	-0.03
	13	2.93	3.17	-0.25	-8.40%	0.14	-0.48	-0.01
	14	2.87	3.12	-0.24	-8.52%	0.14	-0.48	-0.01
	15	2.87	3.09	-0.22	-7.51%	0.13	-0.44	0.01
	16	3.11	1.68	1.43	45.87%	0.15	1.18	1.67
	17	3.30	2.27	1.03	31.31%	0.15	0.79	1.28
	18	3.32	3.47	-0.15	-4.48%	0.14	-0.38	0.09
	19	3.14	3.16	-0.01	-0.36%	0.13	-0.23	0.21
	20	2.94	2.95	-0.01	-0.37%	0.12	-0.21	0.19
	21	2.82	2.85	-0.03	-1.14%	0.11	-0.21	0.15
	22	2.56	2.64	-0.08	-3.13%	0.08	-0.21	0.05
	23	2.27	2.27	0.00	0.00%	0.17	-0.29	0.29
5	0	2.15	2.15	0.00	0.05%	0.24	-0.39	0.40
	1	2.05	2.05	0.00	-0.04%	0.24	-0.40	0.40
	2	1.93	1.94	0.00	-0.11%	0.26	-0.42	0.42
	3	1.84	1.85	0.00	-0.23%	0.27	-0.45	0.44
	4	2.04	2.04	0.00	0.11%	0.29	-0.47	0.47
	5	1.99	1.99	0.00	0.04%	0.30	-0.49	0.49
	6	1.96	1.96	0.00	-0.15%	0.27	-0.45	0.44
	7	1.97	1.97	0.00	-0.14%	0.26	-0.42	0.42
	8	1.97	1.97	0.00	0.02%	0.21	-0.34	0.35
	9	2.13	2.13	0.01	0.29%	0.16	-0.27	0.28
	10	2.40	2.39	0.01	0.54%	0.14	-0.21	0.24
	11	2.76	3.43	-0.66	-24.02%	0.06	-0.76	-0.57
	12	2.94	3.42	-0.48	-16.47%	0.06	-0.58	-0.39
	13	3.18	1.96	1.22	38.34%	0.06	1.12	1.32
	14	3.37	2.43	0.94	27.91%	0.06	0.84	1.04
	15	3.58	2.81	0.77	21.56%	0.06	0.67	0.88
	16	3.76	3.25	0.51	13.46%	0.06	0.40	0.61
	17	3.92	4.13	-0.21	-5.29%	0.06	-0.31	-0.11
	18	3.83	4.09	-0.26	-6.71%	0.06	-0.35	-0.17
	19	3.68	3.91	-0.23	-6.21%	0.06	-0.32	-0.14
	20	3.55	3.73	-0.17	-4.92%	0.05	-0.26	-0.09
	21	3.47	3.57	-0.09	-2.67%	0.05	-0.18	-0.01
	22	3.27	3.27	-0.01	-0.21%	0.15	-0.26	0.24
	23	3.01	3.01	0.00	-0.13%	0.17	-0.28	0.27
6	0	2.73	2.84	-0.11	-3.97%	0.02	-0.15	-0.07
	1	2.55	2.70	-0.15	-5.86%	0.03	-0.19	-0.11
	2	2.38	2.49	-0.11	-4.64%	0.03	-0.16	-0.06
	3	2.34	2.35	-0.01	-0.41%	0.03	-0.05	0.04
	4	2.22	2.23	-0.02	-0.80%	0.03	-0.06	0.03

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	5	2.10	2.10	0.00	0.01%	0.03	-0.05	0.05
	6	2.01	2.04	-0.02	-1.17%	0.02	-0.06	0.01
	7	1.98	2.01	-0.03	-1.76%	0.02	-0.06	-0.01
	8	2.05	2.11	-0.07	-3.30%	0.02	-0.10	-0.04
	9	2.21	2.46	-0.25	-11.28%	0.02	-0.28	-0.21
	10	2.46	2.81	-0.35	-14.35%	0.03	-0.41	-0.30
	11	2.77	3.20	-0.43	-15.54%	0.04	-0.49	-0.37
	12	3.15	3.46	-0.30	-9.65%	0.03	-0.35	-0.26
	13	3.32	3.66	-0.34	-10.12%	0.03	-0.39	-0.28
	14	3.48	3.84	-0.37	-10.52%	0.03	-0.42	-0.32
	15	3.65	2.33	1.33	36.29%	0.04	1.27	1.38
	16	3.81	2.67	1.14	30.02%	0.03	1.09	1.19
	17	3.87	3.08	0.80	20.55%	0.03	0.74	0.85
	18	3.88	4.03	-0.15	-3.95%	0.02	-0.19	-0.11
	19	3.68	3.87	-0.19	-5.04%	0.02	-0.22	-0.15
	20	3.53	3.67	-0.14	-4.02%	0.02	-0.18	-0.11
	21	3.31	3.52	-0.21	-6.38%	0.02	-0.25	-0.17
	22	3.14	3.24	-0.10	-3.27%	0.03	-0.15	-0.05
	23	2.98	3.05	-0.07	-2.49%	0.02	-0.10	-0.05
7	0	1.86	1.94	-0.08	-4.25%	0.06	-0.20	0.04
	1	1.63	1.71	-0.08	-5.16%	0.06	-0.21	0.04
	2	1.41	1.48	-0.07	-4.92%	0.06	-0.19	0.05
	3	1.26	1.34	-0.08	-6.32%	0.06	-0.19	0.03
	4	1.14	1.25	-0.11	-9.51%	0.06	-0.22	0.01
	5	1.15	1.21	-0.06	-5.48%	0.06	-0.18	0.06
	6	1.26	1.26	0.00	-0.31%	0.07	-0.14	0.13
	7	1.27	1.31	-0.05	-3.68%	0.07	-0.18	0.09
	8	1.33	1.41	-0.09	-6.44%	0.07	-0.22	0.05
	9	1.55	1.67	-0.12	-7.91%	0.07	-0.26	0.01
	10	1.84	2.07	-0.23	-12.57%	0.07	-0.37	-0.09
	11	2.15	2.42	-0.26	-12.21%	0.07	-0.41	-0.12
	12	2.40	2.74	-0.34	-14.06%	0.08	-0.49	-0.19
	13	2.67	3.04	-0.37	-14.05%	0.08	-0.52	-0.23
	14	2.88	2.47	0.41	14.17%	0.08	0.25	0.56
	15	3.04	2.85	0.18	6.11%	0.07	0.04	0.33
	16	3.18	2.55	0.63	19.68%	0.07	0.49	0.77
	17	3.31	2.90	0.41	12.40%	0.07	0.27	0.55
	18	3.24	3.45	-0.22	-6.65%	0.07	-0.35	-0.08
	19	3.10	3.25	-0.15	-4.89%	0.07	-0.28	-0.02
	20	2.91	3.05	-0.14	-4.78%	0.06	-0.25	-0.03
	21	2.76	2.89	-0.13	-4.71%	0.10	-0.33	0.07
	22	2.57	2.60	-0.03	-1.09%	0.09	-0.20	0.15
	23	2.34	2.34	0.00	0.14%	0.11	-0.20	0.21
	0	2.74	2.73	0.00	0.12%	0.05	-0.08	0.08

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
8	1	2.52	2.74	-0.22	-8.78%	0.05	-0.30	-0.14
	2	2.27	2.43	-0.16	-7.14%	0.05	-0.24	-0.09
	3	2.11	2.25	-0.14	-6.63%	0.05	-0.22	-0.06
	4	1.98	2.08	-0.11	-5.38%	0.05	-0.19	-0.02
	5	1.96	1.99	-0.03	-1.31%	0.06	-0.12	0.07
	6	1.94	1.99	-0.05	-2.73%	0.07	-0.16	0.06
	7	1.87	1.98	-0.11	-5.69%	0.06	-0.21	0.00
	8	1.90	2.06	-0.16	-8.33%	0.07	-0.27	-0.05
	9	2.09	2.30	-0.21	-9.95%	0.07	-0.32	-0.10
	10	2.34	2.65	-0.32	-13.55%	0.07	-0.44	-0.20
	11	2.62	3.03	-0.40	-15.39%	0.07	-0.53	-0.28
	12	2.88	3.32	-0.44	-15.40%	0.07	-0.57	-0.32
	13	3.14	3.48	-0.34	-10.72%	0.07	-0.45	-0.22
	14	3.37	3.65	-0.28	-8.23%	0.07	-0.39	-0.16
	15	3.56	2.11	1.45	40.71%	0.07	1.34	1.56
	16	3.71	2.48	1.23	33.13%	0.07	1.11	1.34
	17	3.84	2.95	0.89	23.08%	0.07	0.77	1.00
	18	3.82	3.95	-0.12	-3.26%	0.07	-0.24	-0.01
	19	3.65	3.81	-0.16	-4.51%	0.06	-0.27	-0.06
	20	3.54	3.63	-0.09	-2.60%	0.06	-0.19	0.01
	21	3.34	3.41	-0.07	-2.06%	0.05	-0.16	0.02
	22	2.97	3.02	-0.05	-1.69%	0.04	-0.11	0.01
	23	2.73	2.73	0.00	0.00%	0.23	-0.38	0.38
9	0	2.59	2.61	-0.02	-0.89%	0.04	-0.09	0.05
	1	2.37	2.45	-0.08	-3.47%	0.05	-0.16	-0.01
	2	2.21	2.26	-0.04	-2.03%	0.05	-0.13	0.04
	3	2.12	2.13	-0.02	-0.85%	0.05	-0.10	0.06
	4	2.00	2.02	-0.02	-1.24%	0.05	-0.10	0.06
	5	1.95	1.98	-0.03	-1.45%	0.05	-0.11	0.06
	6	2.00	1.99	0.01	0.33%	0.06	-0.10	0.11
	7	1.94	1.99	-0.05	-2.70%	0.06	-0.16	0.05
	8	1.88	2.07	-0.19	-10.25%	0.07	-0.30	-0.08
	9	2.06	2.34	-0.28	-13.63%	0.07	-0.39	-0.17
	10	2.42	2.80	-0.38	-15.89%	0.07	-0.50	-0.27
	11	2.80	3.17	-0.37	-13.12%	0.07	-0.48	-0.25
	12	3.13	3.42	-0.29	-9.22%	0.07	-0.40	-0.17
	13	3.37	3.67	-0.30	-8.89%	0.07	-0.41	-0.19
	14	3.55	2.22	1.33	37.49%	0.07	1.22	1.44
	15	3.71	2.58	1.14	30.59%	0.07	1.03	1.25
	16	3.89	2.91	0.99	25.38%	0.07	0.88	1.10
	17	4.07	3.27	0.79	19.47%	0.07	0.68	0.91
	18	3.97	4.11	-0.14	-3.44%	0.07	-0.24	-0.03
	19	3.84	4.01	-0.17	-4.50%	0.06	-0.28	-0.07
	20	3.72	3.83	-0.11	-3.04%	0.06	-0.21	-0.01

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	21	3.56	3.60	-0.04	-1.17%	0.05	-0.13	0.05
	22	3.18	3.22	-0.05	-1.42%	0.04	-0.11	0.02
	23	2.90	2.90	0.00	0.00%	0.19	-0.32	0.32
10	0	1.09	1.14	-0.05	-4.32%	0.09	-0.20	0.11
	1	0.94	0.91	0.03	3.30%	0.10	-0.13	0.19
	2	0.80	0.80	0.00	-0.03%	0.09	-0.15	0.15
	3	0.75	0.75	0.00	0.05%	0.09	-0.15	0.15
	4	0.72	0.71	0.01	1.53%	0.10	-0.15	0.17
	5	0.74	0.73	0.01	0.74%	0.09	-0.15	0.16
	6	0.90	0.90	0.00	-0.26%	0.09	-0.16	0.15
	7	0.91	0.93	-0.03	-3.00%	0.09	-0.18	0.13
	8	0.86	0.85	0.01	1.25%	0.09	-0.15	0.17
	9	0.91	0.90	0.02	1.88%	0.09	-0.14	0.17
	10	0.96	0.90	0.06	6.25%	0.06	-0.04	0.16
	11	1.14	1.02	0.12	10.24%	0.07	-0.01	0.24
	12	1.28	1.27	0.01	0.59%	0.10	-0.15	0.17
	13	1.44	1.46	-0.03	-1.86%	0.11	-0.20	0.15
	14	1.61	1.68	-0.06	-3.83%	0.11	-0.24	0.12
	15	1.80	1.97	-0.17	-9.29%	0.12	-0.37	0.03
	16	1.93	1.25	0.69	35.63%	0.11	0.51	0.87
	17	2.15	1.69	0.46	21.57%	0.13	0.26	0.67
	18	2.14	2.33	-0.18	-8.56%	0.13	-0.39	0.03
	19	1.95	2.08	-0.13	-6.72%	0.11	-0.32	0.06
	20	1.76	2.05	-0.29	-16.59%	0.11	-0.47	-0.11
	21	1.75	1.89	-0.14	-7.97%	0.11	-0.32	0.04
	22	1.51	1.70	-0.18	-12.17%	0.09	-0.34	-0.03
	23	1.34	1.40	-0.06	-4.39%	0.10	-0.22	0.10

Table 9. Residential DR Program: Average Hour Ex Post DR kW Impacts by Event, Event Hour (Nest)

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
1	0	1.77	1.77	0.00	-0.09%	0.09	-0.14	0.14
	1	1.52	1.52	0.01	0.36%	0.09	-0.14	0.15
	2	1.33	1.33	0.00	-0.23%	0.09	-0.14	0.14
	3	1.22	1.22	0.00	0.32%	0.09	-0.14	0.14
	4	1.13	1.13	0.00	0.14%	0.09	-0.14	0.14
	5	1.09	1.09	0.00	0.16%	0.09	-0.14	0.14
	6	1.12	1.12	0.00	0.20%	0.09	-0.14	0.14
	7	1.28	1.28	0.00	0.05%	0.08	-0.13	0.13
	8	1.41	1.41	0.00	0.02%	0.02	-0.04	0.04
	9	1.57	1.57	0.00	0.03%	0.02	-0.03	0.03
	10	1.80	1.80	0.00	-0.04%	0.05	-0.08	0.08

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	11	2.06	2.07	-0.01	-0.26%	0.08	-0.14	0.13
	12	2.32	2.32	-0.01	-0.27%	0.08	-0.14	0.13
	13	2.44	3.39	-0.95	-39.08%	0.06	-1.06	-0.85
	14	2.61	3.30	-0.68	-26.18%	0.07	-0.79	-0.58
	15	2.85	1.57	1.27	44.75%	0.06	1.17	1.38
	16	3.00	2.05	0.95	31.82%	0.07	0.85	1.06
	17	3.19	3.40	-0.21	-6.71%	0.07	-0.33	-0.09
	18	3.06	3.25	-0.19	-6.07%	0.07	-0.30	-0.07
	19	2.94	3.04	-0.10	-3.51%	0.07	-0.22	0.01
	20	2.82	2.87	-0.05	-1.77%	0.07	-0.16	0.06
	21	2.71	2.77	-0.06	-2.15%	0.06	-0.16	0.04
	22	2.51	2.51	0.00	0.04%	0.03	-0.05	0.05
	23	2.13	2.13	0.00	-0.02%	0.08	-0.13	0.12
2	0	2.30	2.30	0.00	0.00%	0.03	-0.05	0.05
	1	2.06	2.06	0.00	-0.07%	0.03	-0.05	0.05
	2	1.90	1.90	0.00	0.03%	0.03	-0.06	0.06
	3	1.79	1.79	0.00	-0.01%	0.04	-0.06	0.06
	4	1.70	1.70	0.00	-0.09%	0.04	-0.06	0.06
	5	1.63	1.64	0.00	-0.23%	0.04	-0.07	0.06
	6	1.61	1.61	0.00	0.10%	0.03	-0.05	0.05
	7	1.69	1.69	0.00	0.09%	0.03	-0.05	0.05
	8	1.76	1.76	0.00	0.03%	0.03	-0.04	0.04
	9	1.96	1.96	0.00	0.04%	0.02	-0.03	0.03
	10	2.24	2.24	0.00	0.08%	0.02	-0.03	0.03
	11	2.55	2.54	0.00	0.14%	0.02	-0.02	0.03
	12	2.77	2.77	0.00	-0.01%	0.04	-0.06	0.06
	13	2.65	2.65	0.00	0.03%	0.04	-0.06	0.06
	14	2.73	3.53	-0.80	-29.35%	0.06	-0.89	-0.71
	15	2.96	3.45	-0.49	-16.58%	0.06	-0.59	-0.39
	16	2.99	1.67	1.33	44.32%	0.06	1.23	1.42
	17	3.16	2.13	1.03	32.57%	0.07	0.92	1.14
	18	3.23	3.39	-0.16	-4.84%	0.06	-0.26	-0.05
	19	3.13	3.20	-0.07	-2.18%	0.06	-0.17	0.03
	20	3.01	3.08	-0.07	-2.18%	0.06	-0.16	0.03
	21	2.96	3.05	-0.09	-2.87%	0.06	-0.18	0.01
	22	2.79	2.82	-0.03	-1.14%	0.06	-0.13	0.06
	23	2.46	2.46	0.00	-0.15%	0.05	-0.09	0.08
3	0	2.20	2.20	0.00	-0.07%	0.32	-0.53	0.53
	1	1.94	1.95	-0.01	-0.49%	0.36	-0.60	0.58
	2	1.75	1.75	0.00	0.22%	0.43	-0.70	0.71
	3	1.61	1.60	0.01	0.76%	0.43	-0.69	0.72
	4	1.53	1.53	0.00	0.19%	0.43	-0.71	0.71
	5	1.48	1.47	0.01	0.39%	0.43	-0.70	0.71
	6	1.44	1.43	0.01	1.01%	0.40	-0.64	0.67

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	7	1.56	1.54	0.02	1.08%	0.36	-0.57	0.60
	8	1.64	1.64	0.00	0.06%	0.22	-0.36	0.36
	9	1.79	1.82	-0.02	-1.39%	0.09	-0.17	0.12
	10	2.13	2.15	-0.02	-0.92%	0.15	-0.26	0.22
	11	2.49	2.51	-0.02	-0.82%	0.22	-0.38	0.34
	12	2.90	2.90	0.00	-0.16%	0.22	-0.36	0.35
	13	3.21	3.91	-0.70	-21.66%	0.09	-0.84	-0.55
	14	3.32	3.87	-0.55	-16.53%	0.09	-0.70	-0.40
	15	3.50	1.97	1.53	43.74%	0.08	1.39	1.67
	16	3.72	2.64	1.08	29.03%	0.09	0.93	1.23
	17	3.85	3.91	-0.06	-1.55%	0.09	-0.21	0.09
	18	3.47	3.51	-0.04	-1.14%	0.08	-0.17	0.10
	19	3.01	3.04	-0.03	-0.90%	0.08	-0.15	0.10
	20	2.82	2.85	-0.03	-0.99%	0.07	-0.15	0.09
	21	2.83	2.79	0.04	1.27%	0.08	-0.09	0.16
	22	2.68	2.65	0.03	1.26%	0.31	-0.47	0.54
	23	2.39	2.40	-0.01	-0.43%	0.36	-0.60	0.58
4	0	2.23	2.23	0.00	0.15%	0.14	-0.23	0.24
	1	1.97	1.96	0.01	0.42%	0.15	-0.24	0.26
	2	1.76	1.77	0.00	-0.28%	0.16	-0.27	0.26
	3	1.65	1.63	0.02	1.23%	0.17	-0.26	0.31
	4	1.54	1.53	0.01	0.74%	0.19	-0.30	0.32
	5	1.43	1.45	-0.01	-0.98%	0.19	-0.33	0.30
	6	1.45	1.45	0.00	0.07%	0.18	-0.29	0.29
	7	1.55	1.54	0.02	1.04%	0.16	-0.25	0.28
	8	1.61	1.62	-0.01	-0.49%	0.12	-0.20	0.18
	9	1.74	1.76	-0.02	-1.23%	0.08	-0.15	0.10
	10	1.95	1.95	0.00	-0.17%	0.04	-0.07	0.07
	11	2.27	2.27	0.00	0.05%	0.05	-0.08	0.08
	12	2.60	2.58	0.03	1.00%	0.05	-0.06	0.12
	13	2.86	2.89	-0.04	-1.34%	0.06	-0.13	0.06
	14	2.79	3.67	-0.88	-31.70%	0.07	-1.01	-0.76
	15	2.89	3.53	-0.64	-22.17%	0.08	-0.77	-0.51
	16	3.16	1.78	1.38	43.75%	0.08	1.25	1.51
	17	3.32	2.33	0.99	29.84%	0.09	0.85	1.14
	18	3.45	3.69	-0.25	-7.20%	0.09	-0.40	-0.10
	19	3.28	3.51	-0.23	-7.10%	0.09	-0.38	-0.09
	20	3.24	3.42	-0.18	-5.69%	0.08	-0.32	-0.05
	21	3.17	3.27	-0.09	-2.94%	0.08	-0.23	0.04
	22	3.01	2.96	0.04	1.48%	0.08	-0.08	0.17
	23	2.59	2.59	0.00	0.08%	0.15	-0.24	0.24
5	0	2.53	2.53	0.00	0.07%	0.20	-0.32	0.33
	1	2.30	2.29	0.00	0.14%	0.20	-0.32	0.33
	2	2.13	2.12	0.00	0.07%	0.21	-0.34	0.35

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	3	2.00	2.00	0.00	0.15%	0.22	-0.36	0.37
	4	1.89	1.89	0.00	-0.07%	0.23	-0.39	0.38
	5	1.82	1.82	0.00	-0.12%	0.25	-0.41	0.40
	6	1.74	1.73	0.00	0.27%	0.22	-0.36	0.37
	7	1.86	1.86	0.00	0.06%	0.21	-0.34	0.35
	8	1.98	1.98	0.00	-0.06%	0.17	-0.28	0.28
	9	2.13	2.12	0.00	0.02%	0.14	-0.22	0.22
	10	2.38	2.38	0.00	0.00%	0.11	-0.18	0.18
	11	2.70	3.55	-0.85	-31.53%	0.06	-0.95	-0.75
	12	3.02	3.58	-0.56	-18.60%	0.07	-0.67	-0.45
	13	3.22	1.70	1.52	47.29%	0.07	1.41	1.64
	14	3.50	2.24	1.26	35.92%	0.07	1.14	1.37
	15	3.74	2.84	0.90	24.16%	0.07	0.79	1.02
	16	3.92	3.34	0.57	14.67%	0.07	0.46	0.69
	17	4.04	4.26	-0.23	-5.66%	0.07	-0.34	-0.12
	18	4.08	4.23	-0.14	-3.55%	0.07	-0.26	-0.03
	19	3.94	4.08	-0.14	-3.47%	0.07	-0.25	-0.02
	20	3.77	3.96	-0.19	-4.93%	0.06	-0.29	-0.08
	21	3.65	3.87	-0.22	-6.03%	0.06	-0.32	-0.12
	22	3.63	3.64	-0.01	-0.17%	0.13	-0.21	0.20
	23	3.34	3.34	-0.01	-0.15%	0.14	-0.23	0.22
6	0	3.00	3.02	-0.02	-0.73%	0.00	-0.03	-0.02
	1	2.72	2.73	-0.02	-0.73%	0.01	-0.03	-0.01
	2	2.51	2.52	-0.01	-0.53%	0.01	-0.03	0.00
	3	2.34	2.36	-0.02	-0.96%	0.01	-0.04	0.00
	4	2.20	2.22	-0.02	-0.70%	0.01	-0.04	0.01
	5	2.10	2.10	0.00	-0.07%	0.01	-0.03	0.02
	6	1.97	1.93	0.04	2.04%	0.02	0.01	0.07
	7	1.98	1.91	0.07	3.57%	0.02	0.05	0.10
	8	2.05	2.03	0.02	0.89%	0.01	0.00	0.04
	9	2.24	2.27	-0.03	-1.47%	0.01	-0.06	-0.01
	10	2.52	2.55	-0.03	-1.24%	0.02	-0.06	0.00
	11	2.85	2.86	-0.01	-0.37%	0.02	-0.05	0.03
	12	3.21	3.17	0.03	1.01%	0.03	-0.01	0.07
	13	3.51	4.08	-0.57	-16.20%	0.02	-0.59	-0.54
	14	3.75	4.11	-0.36	-9.54%	0.02	-0.38	-0.33
	15	3.97	2.23	1.73	43.66%	0.02	1.70	1.76
	16	4.20	3.04	1.16	27.57%	0.02	1.13	1.19
	17	4.27	3.53	0.74	17.27%	0.02	0.71	0.77
	18	4.19	4.19	0.00	0.04%	0.02	-0.02	0.03
	19	3.99	4.01	-0.02	-0.53%	0.01	-0.05	0.00
	20	3.90	3.89	0.01	0.35%	0.01	-0.01	0.04
	21	3.79	3.81	-0.02	-0.47%	0.01	-0.04	0.01
	22	3.66	3.62	0.04	0.98%	0.01	0.01	0.06

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	23	3.38	3.38	0.00	0.03%	0.01	-0.01	0.02
7	0	1.76	1.75	0.01	0.69%	0.01	-0.01	0.03
	1	1.52	1.51	0.01	0.69%	0.02	-0.04	0.06
	2	1.36	1.35	0.01	0.40%	0.04	-0.08	0.09
	3	1.25	1.24	0.01	0.57%	0.05	-0.08	0.10
	4	1.19	1.18	0.01	0.46%	0.05	-0.08	0.09
	5	1.16	1.16	0.00	-0.14%	0.05	-0.09	0.09
	6	1.19	1.18	0.01	1.05%	0.05	-0.08	0.10
	7	1.27	1.27	0.01	0.51%	0.05	-0.08	0.10
	8	1.41	1.40	0.01	0.47%	0.02	-0.03	0.04
	9	1.59	1.58	0.01	0.72%	0.06	-0.10	0.12
	10	1.84	1.83	0.01	0.77%	0.09	-0.16	0.19
	11	2.14	2.12	0.02	0.79%	0.11	-0.20	0.23
	12	2.47	2.90	-0.44	-17.63%	0.11	-0.65	-0.23
	13	2.71	3.03	-0.32	-11.62%	0.11	-0.54	-0.10
	14	3.00	2.61	0.39	12.95%	0.07	0.27	0.52
	15	3.22	2.85	0.38	11.50%	0.07	0.24	0.51
	16	3.42	2.70	0.72	21.13%	0.07	0.58	0.86
	17	3.45	2.97	0.48	13.89%	0.07	0.34	0.61
	18	3.34	3.46	-0.12	-3.56%	0.07	-0.25	0.01
	19	3.25	3.29	-0.03	-1.02%	0.07	-0.17	0.10
	20	3.10	3.19	-0.08	-2.61%	0.07	-0.21	0.05
	21	3.10	3.10	0.00	0.01%	0.07	-0.15	0.15
	22	2.90	2.90	0.00	-0.16%	0.07	-0.13	0.13
	23	2.62	2.61	0.01	0.45%	0.06	-0.12	0.14
8	0	2.81	2.81	0.00	-0.08%	0.17	-0.28	0.28
	1	2.53	2.53	0.00	0.03%	0.17	-0.29	0.29
	2	2.33	2.33	0.00	-0.02%	0.19	-0.32	0.32
	3	2.16	2.16	0.00	0.07%	0.20	-0.33	0.34
	4	2.03	2.03	0.00	0.01%	0.21	-0.35	0.35
	5	1.97	1.97	0.00	0.03%	0.23	-0.37	0.37
	6	1.91	1.91	0.00	-0.05%	0.23	-0.37	0.37
	7	1.96	1.96	0.00	-0.07%	0.21	-0.35	0.34
	8	1.93	1.93	0.00	-0.05%	0.17	-0.28	0.28
	9	2.07	2.07	0.00	-0.03%	0.15	-0.24	0.24
	10	2.32	2.32	0.00	0.05%	0.11	-0.18	0.19
	11	2.64	2.64	0.00	0.06%	0.10	-0.17	0.17
	12	2.96	2.95	0.00	0.17%	0.09	-0.14	0.15
	13	3.24	3.87	-0.63	-19.43%	0.06	-0.73	-0.53
	14	3.48	3.90	-0.41	-11.86%	0.06	-0.52	-0.31
	15	3.67	2.05	1.61	44.01%	0.06	1.51	1.72
	16	3.89	2.86	1.03	26.57%	0.06	0.93	1.14
	17	3.92	3.43	0.49	12.54%	0.07	0.38	0.60
	18	3.92	4.24	-0.32	-8.08%	0.06	-0.42	-0.21

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	19	3.84	4.09	-0.25	-6.53%	0.07	-0.36	-0.14
	20	3.83	4.02	-0.19	-4.85%	0.07	-0.30	-0.08
	21	3.73	3.82	-0.09	-2.30%	0.06	-0.19	0.02
	22	3.35	3.49	-0.14	-4.23%	0.06	-0.24	-0.04
	23	3.10	3.10	0.00	-0.13%	0.18	-0.30	0.29
9	0	2.77	2.77	0.00	0.00%	0.19	-0.31	0.31
	1	2.49	2.49	0.00	0.02%	0.20	-0.32	0.33
	2	2.28	2.29	0.00	-0.03%	0.21	-0.35	0.35
	3	2.11	2.11	0.00	0.03%	0.21	-0.35	0.35
	4	2.02	2.01	0.00	0.02%	0.23	-0.37	0.37
	5	1.96	1.96	0.00	0.05%	0.23	-0.37	0.37
	6	1.90	1.91	0.00	-0.08%	0.23	-0.38	0.37
	7	1.95	1.95	0.00	-0.01%	0.20	-0.34	0.34
	8	1.93	1.93	0.00	0.02%	0.18	-0.29	0.29
	9	2.05	2.05	0.00	-0.06%	0.14	-0.24	0.23
	10	2.35	2.35	0.00	0.02%	0.11	-0.18	0.18
	11	2.70	2.70	0.00	0.00%	0.09	-0.14	0.14
	12	2.98	3.80	-0.81	-27.33%	0.06	-0.92	-0.71
	13	3.27	3.86	-0.58	-17.78%	0.07	-0.69	-0.47
	14	3.59	1.97	1.61	45.00%	0.07	1.50	1.73
	15	3.75	2.77	0.98	26.16%	0.07	0.87	1.09
	16	4.07	3.48	0.59	14.54%	0.07	0.48	0.70
	17	4.18	3.88	0.30	7.26%	0.07	0.19	0.41
	18	4.21	4.43	-0.22	-5.22%	0.07	-0.33	-0.11
	19	4.10	4.26	-0.16	-3.99%	0.06	-0.27	-0.06
	20	4.03	4.18	-0.15	-3.79%	0.06	-0.25	-0.05
	21	3.87	3.98	-0.11	-2.80%	0.06	-0.21	-0.01
	22	3.56	3.64	-0.08	-2.31%	0.06	-0.18	0.02
	23	3.26	3.26	0.00	0.01%	0.16	-0.26	0.26
10	0	1.02	1.01	0.00	0.26%	0.06	-0.09	0.09
	1	0.88	0.87	0.01	0.64%	0.06	-0.09	0.10
	2	0.81	0.80	0.01	0.67%	0.06	-0.09	0.10
	3	0.78	0.77	0.01	1.12%	0.06	-0.09	0.11
	4	0.77	0.76	0.01	1.64%	0.06	-0.09	0.11
	5	0.81	0.80	0.02	1.98%	0.06	-0.09	0.12
	6	0.91	0.90	0.01	1.46%	0.06	-0.09	0.11
	7	0.99	0.98	0.01	1.10%	0.06	-0.09	0.11
	8	0.91	0.90	0.01	1.44%	0.06	-0.09	0.11
	9	0.90	0.90	0.00	-0.32%	0.06	-0.10	0.10
	10	0.92	0.93	-0.01	-0.92%	0.04	-0.07	0.05
	11	1.01	1.04	-0.03	-3.04%	0.04	-0.09	0.03
	12	1.15	1.17	-0.02	-1.95%	0.08	-0.15	0.10
	13	1.33	1.34	-0.01	-0.69%	0.14	-0.24	0.22
	14	1.47	2.39	-0.92	-63.09%	0.07	-1.04	-0.81

Event	Hour Beginning	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
	15	1.72	2.40	-0.68	-39.18%	0.08	-0.81	-0.54
	16	1.99	1.22	0.78	38.95%	0.07	0.66	0.89
	17	2.18	1.48	0.69	31.78%	0.08	0.56	0.82
	18	2.15	2.28	-0.13	-6.03%	0.08	-0.27	0.01
	19	2.07	2.19	-0.12	-6.01%	0.08	-0.25	0.00
	20	2.21	2.19	0.02	1.11%	0.08	-0.10	0.15
	21	2.07	2.03	0.04	1.84%	0.07	-0.08	0.15
	22	1.89	1.81	0.08	4.23%	0.07	-0.04	0.20
	23	1.48	1.49	-0.01	-1.01%	0.06	-0.12	0.09

Table 10 summarizes impacts by device manufacturer and hour for each event.

Table 10. Residential DR Program: Summary of Hourly Per Account Impacts by Event and Manufacturer

Manufacturer	Event	Total Number of Accounts Participating in Event	Hour 1			Hour 2			Hour 3			Hour 4		
			Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp
Nest	1	24,427	2.85	1.27	92	3.00	0.95	92						
	2	24,434	2.99	1.33	82	3.16	1.03	85						
	3	2,106	3.50	1.53	94	3.72	1.08	94						
	4	2,098	3.16	1.38	91	3.32	0.99	90						
	5	24,834	3.22	1.52	97	3.50	1.26	99	3.74	0.90	98	3.92	0.57	99
	6	25,819	3.97	1.73	100	4.20	1.16	100	4.27	0.74	98			
	7	24,027	3.00	0.39	94	3.22	0.37	93	3.42	0.72	93	3.45	0.48	92
	8	25,045	3.67	1.61	98	3.89	1.03	96	3.92	0.49	95			
	9	25,047	3.59	1.61	100	3.75	0.98	101	4.07	0.59	101	4.18	0.30	99
	10	2,010	1.99	0.78	86	2.18	0.69	84						
	Average	**17,985**	**3.32**	**1.36**	**95**	**3.52**	**0.97**	**95**	**3.89**	**0.69**	**97**	**3.86**	**0.45**	**97**
ecobee	1	8,718	3.18	1.40	92	3.29	1.06	92						
	2	8,674	3.16	1.36	83	3.26	1.03	85						
	3	697	3.62	1.42	94	3.80	0.97	94						
	4	690	3.23	1.38	91	3.41	1.02	90						
	5	8,751	3.54	1.61	97	3.75	1.27	99	3.90	0.87	98	4.07	0.59	99
	6	9,671	4.22	1.79	100	4.42	1.24	100	4.48	0.86	98			
	7	7,809	3.18	0.72	94	3.44	0.17	93	3.58	0.66	93	3.56	0.51	92
	8	8,743	3.88	1.61	98	3.99	0.99	96	4.15	0.66	95			
	9	8,730	3.85	1.62	100	4.04	1.05	101	4.22	0.60	101	4.39	0.43	99
	10	667	2.27	0.89	86	2.40	0.72	84						
	Average	**6,315**	**3.57**	**1.45**	**95**	**3.74**	**0.99**	**95**	**4.09**	**0.73**	**97**	**4.02**	**0.51**	**97**
Sensi	1	6,792	2.86	1.07	92	3.03	0.88	92						
	2	6,512	2.91	1.30	83	3.11	1.09	85						
	3	406	3.34	1.22	94	3.51	0.92	94						
	4	410	3.11	1.43	90	3.30	1.03	89						
	5	6,501	3.18	1.22	97	3.37	0.94	99	3.58	0.77	98	3.76	0.51	99

Manufact-urer	Event	Total Number of Accounts Participating in Event	Hour 1			Hour 2			Hour 3			Hour 4		
			Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp	Baseline Load	Load Impact	Event Hour Temp
	6	7,431	3.65	1.33	100	3.81	1.14	100	3.87	0.80	98			
	7	5,598	2.88	0.41	94	3.04	0.19	93	3.18	0.63	93	3.31	0.41	92
	8	6,406	3.56	1.45	98	3.71	1.23	96	3.84	0.89	95			
	9	6,416	3.55	1.33	100	3.71	1.14	101	3.89	0.99	101	4.07	0.79	99
	10	386	1.93	0.69	86	2.15	0.46	84						
	Average	**4,686**	**3.23**	**1.17**	**95**	**3.40**	**0.96**	**95**	**3.69**	**0.82**	**97**	**3.73**	**0.58**	**97**
Overall	1	39,936	2.92	1.27	92	3.07	0.96	92						
	2	39,620	3.02	1.33	83	3.17	1.04	85						
	3	3,208	3.51	1.47	94	3.71	1.04	94						
	4	3,197	3.17	1.39	91	3.34	1.00	90						
	5	40,085	3.28	1.49	97	3.53	1.21	99	3.75	0.88	98	3.93	0.57	99
	6	42,920	3.97	1.67	100	4.18	1.18	100	4.25	0.77	98			
	7	37,433	3.02	0.46	94	3.24	0.30	93	3.42	0.70	93	3.45	0.47	92
	8	40,193	3.70	1.59	98	3.88	1.06	96	3.96	0.59	95			
	9	40,192	3.64	1.57	100	3.80	1.02	101	4.08	0.66	101	4.21	0.41	99
	10	3,063	2.05	0.79	86	2.22	0.67	84						
	Average	**28,985**	**3.36**	**1.35**	**95**	**3.55**	**0.97**	**95**	**3.90**	**0.72**	**97**	**3.87**	**0.48**	**97**

RESOURCE CAPABILITY MODEL SPECIFICATION AND OUTPUTS

MODEL SPECIFICATION

Equation 3 shows the model specification used to develop resource capability. This specification was used across all three device manufacturers for impacts. The fixed effect was specified at the account level.

Equation 3. Residential DR Program: Resource Capability Model Specification

$$kWh_{it} = \alpha_i + \sum_{t=0}^{23} \beta_t \cdot Hour_t + \sum_{H=Recovery\ Hour\ 3}^{Recovery\ Hour\ 4} \beta_t \cdot Treatment_{it} * RecoveryHour_{it} + \sum_{H=Event\ Hour\ 1}^{Event\ Hour\ 4} \beta_t \cdot Treatment_{it} \cdot EventHour_{it} \cdot CDH_{it} + \beta_{CDH} \cdot CDH_{it} + \varepsilon_{it}$$

Where:

α_i = Account--specific intercept for account *i*

$Treatment_{it}$ = Indicator variable for precooling, event, and snapback hours for treatment customers for account *i at time t (coded "0" for comparison and "1" for treatment)*

$RecoveryHour_{it}$ = Indicator variable for snapback hours for treatment account *i* in time-period *t* (coded "0" accounts who are not in snapback in normalized hours 3-4 and "1" for accounts who are in snapback hours in normalized hours 3-4)

$EventHour_{it}$ = Indicator variable for event hours for account *i* in time-period *t* (coded "0" accounts who are not in event hours in normalized hours 1-4 and "1" for accounts who are in event hours in normalized hours 1-4)

$Hour_t$ = Set of 23 indicator variables for the hours of the day; hour 0 is the reference

CDH_{it} = Cooling degree-hours for account *i* in time-period *t* (base 75 degrees Fahrenheit)

$Treatment_{it} * RecoveryHour_{it}$ = Treatment indicator interacted with the snapback hour indicator

$Treatment_{it} \cdot EventHour_{it} \cdot CDH_{it}$= Treatment indicator interacted with the event hour indicator and CDH

ε_{it} = Error term

MODEL OUTPUTS

Table 11 provides resource capability impact values for each event and event day hour by device manufacturer.

Table 11. Residential DR Program: Average Hour Resource Capability kW Impacts by Hour

Event Hour	Baseline Load (kW)	Event Day Load (kW)	Load Impact (kW)	% Load Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
Nest							
1	3.73	2.21	1.52	41%	0.03	1.47	1.58
2	3.99	2.82	1.17	29%	0.03	1.11	1.22
3	4.16	3.55	0.61	15%	0.03	0.55	0.66
4	4.21	3.88	0.34	8%	0.16	0.08	0.59
ecobee							
1	3.95	2.43	1.52	39%	0.04	1.45	1.59
2	4.15	3.00	1.15	28%	0.04	1.07	1.22
3	4.31	3.72	0.59	14%	0.04	0.52	0.66
4	4.40	3.91	0.49	11%	0.21	0.15	0.84
Sensi							
1	3.55	2.39	1.17	33%	0.04	1.10	1.24
2	3.72	2.74	0.98	26%	0.04	0.91	1.05
3	3.88	3.27	0.61	16%	0.04	0.55	0.68
4	3.96	3.48	0.48	12%	0.27	0.04	0.93
Overall							
1	3.75	2.29	1.47	39%			
2	3.98	2.85	1.13	28%			
3	4.15	3.54	0.61	15%			
4	4.22	3.82	0.39	9%			

EVENT SEASON IMPACTS AND RESOURCE CAPABILITY – MODEL FIT

This section contains model fit graphs. Figure 35 through Figure 37 illustrate the model fit curves for routine and locational events for each device manufacturer. In addition, Figure 38 to Figure 40 show model fit curves for staggered events for each device manufacturer. Moreover, Figure 41 to Figure 43 show the model fits for the full-population event for each device manufacturer. Lastly, Figure 44 to Figure 46 show model fit curves for resource capability modeling for each device manufacturer.

Figure 35. Residential DR Program: ecobee Event Model Fit

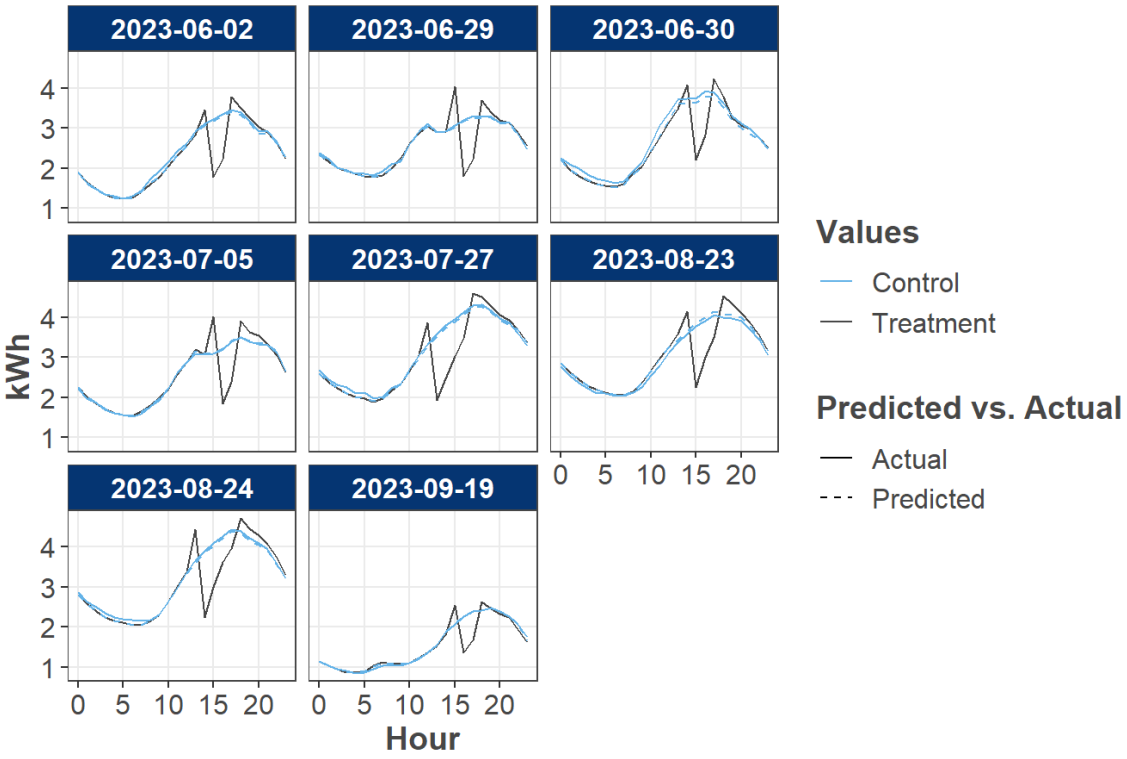


Figure 36. Residential DR Program: Sensi Event Model Fit

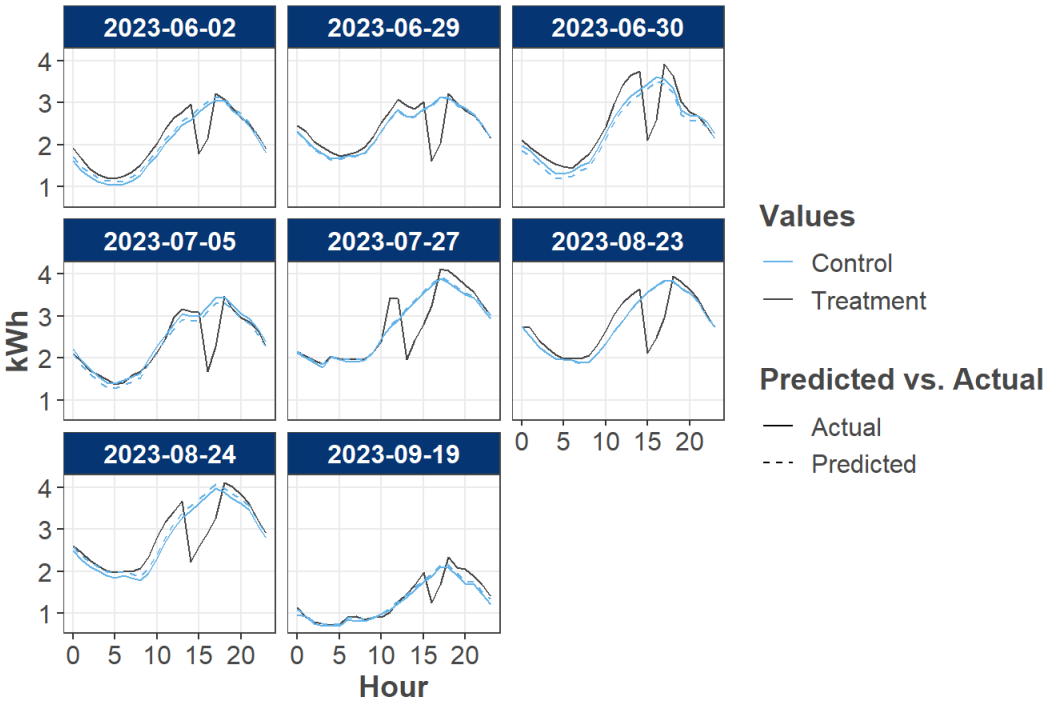
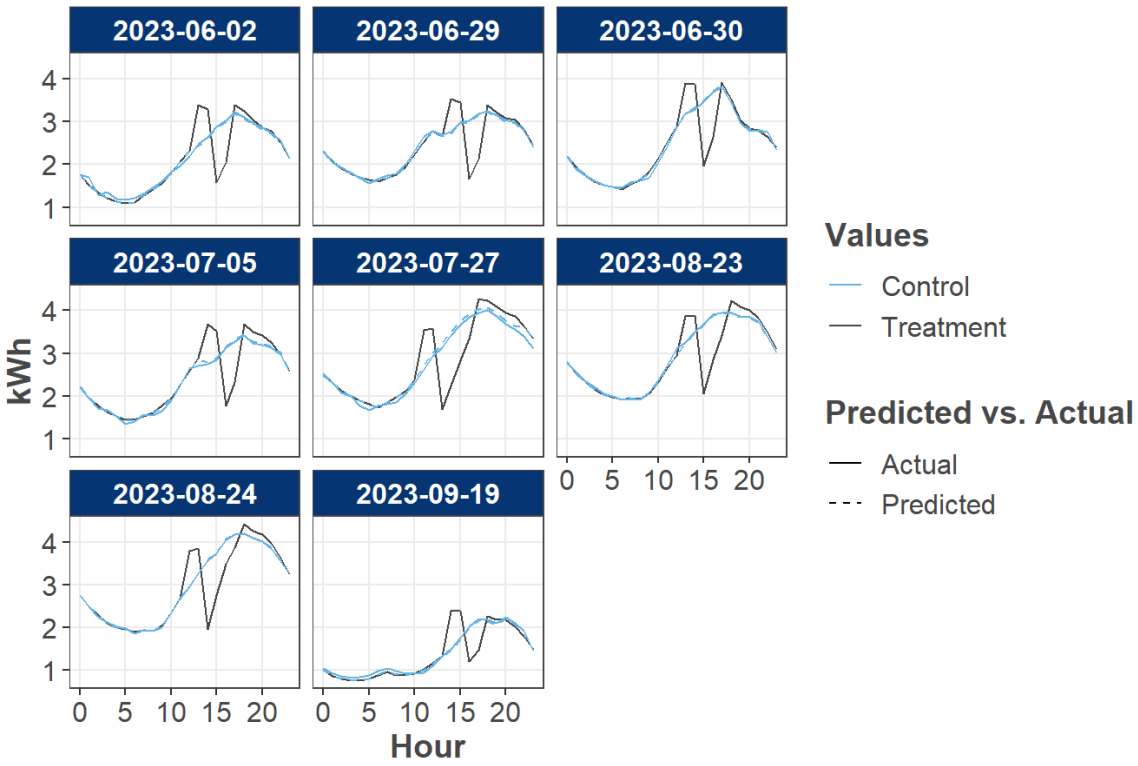


Figure 37. Residential DR Program: Nest Event Model Fit



STAGGERED EVENT

Figure 38. Residential DR Program: ecobee Combined Staggered Event Model Fit

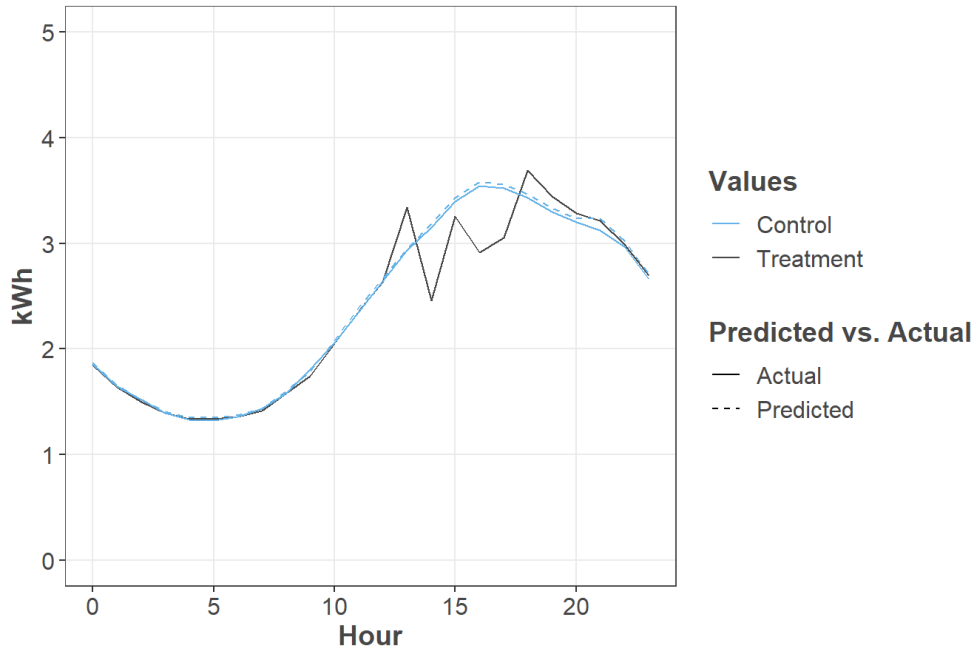


Figure 39. Residential DR Program: Sensi Combined Staggered Event Model Fit

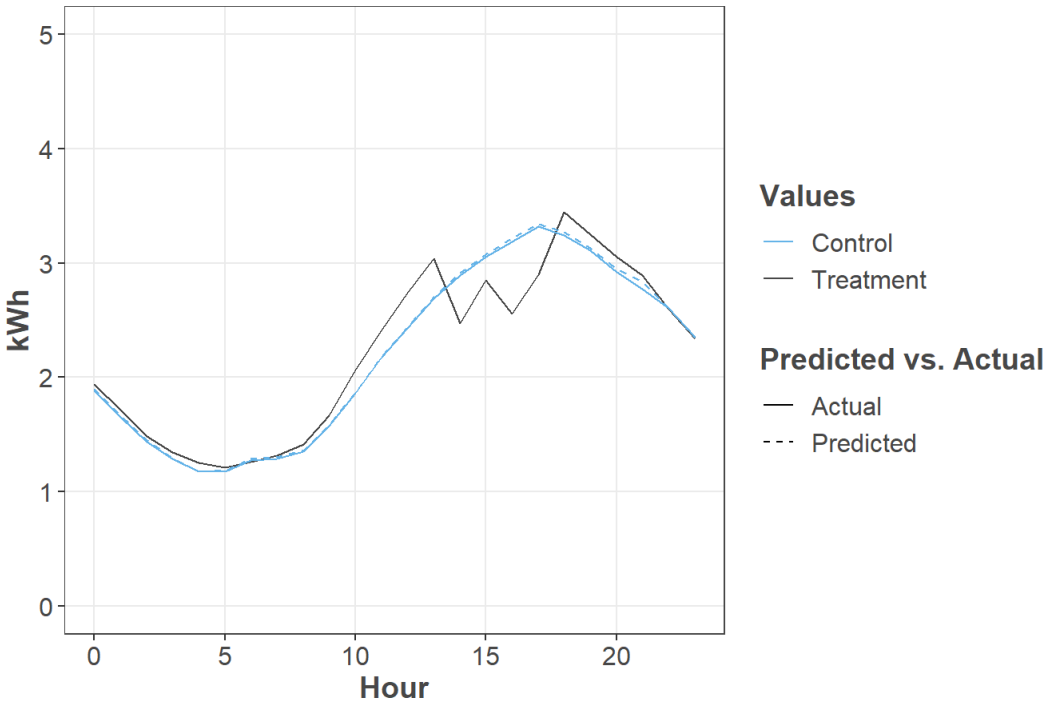
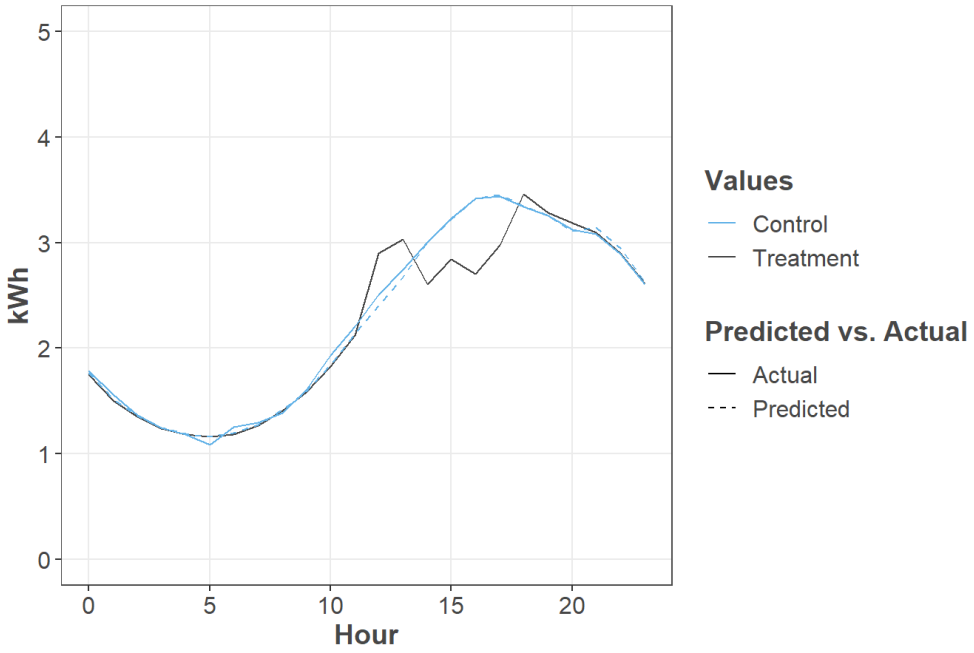


Figure 40. Residential DR Program: Nest Combined Staggered Event Model Fit



FULL-POPULATION EVENT

Figure 41. Residential DR Program: ecobee Full-Population Event Model Fit

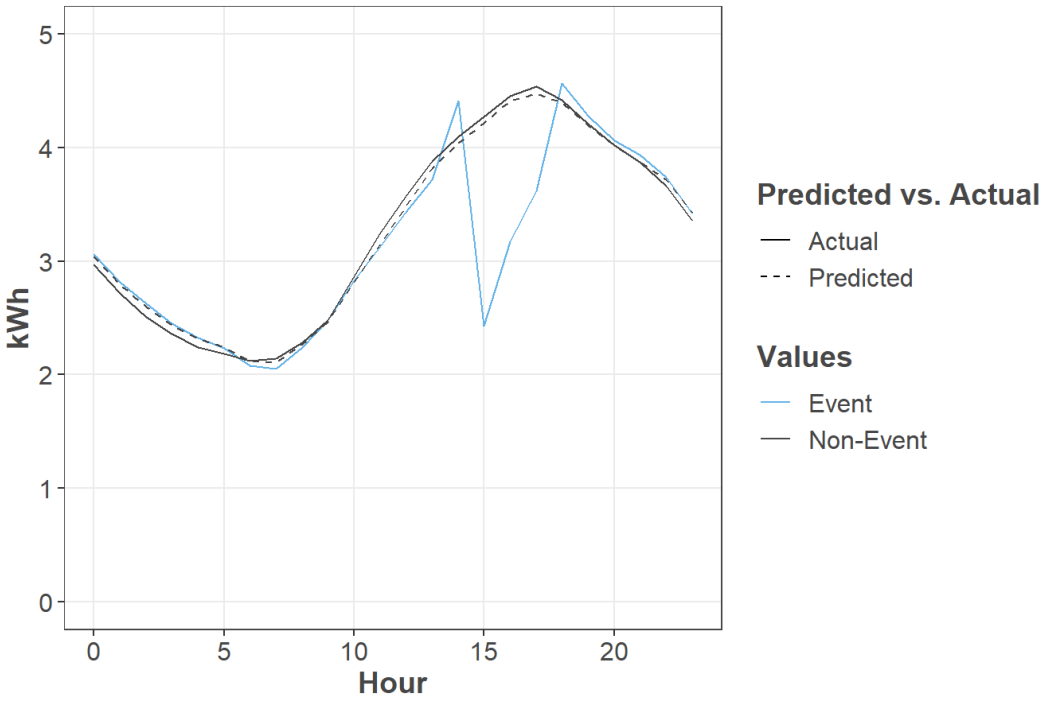


Figure 42. Residential DR Program: Sensi Full-Population Event Model Fit

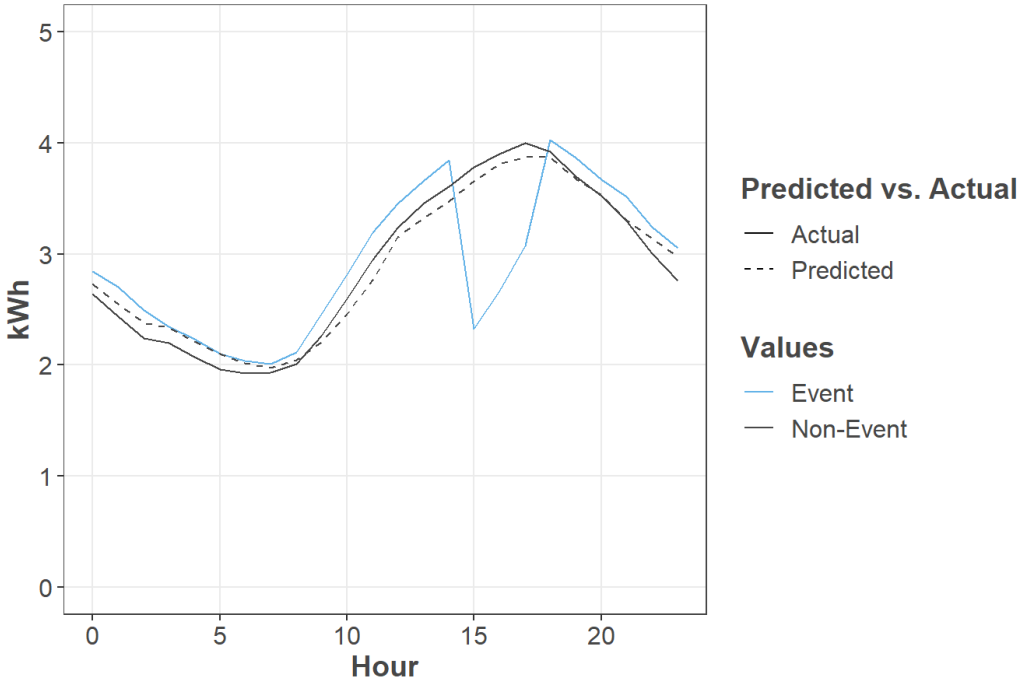


Figure 43. Residential DR Program: Nest Full-Population Event Model Fit

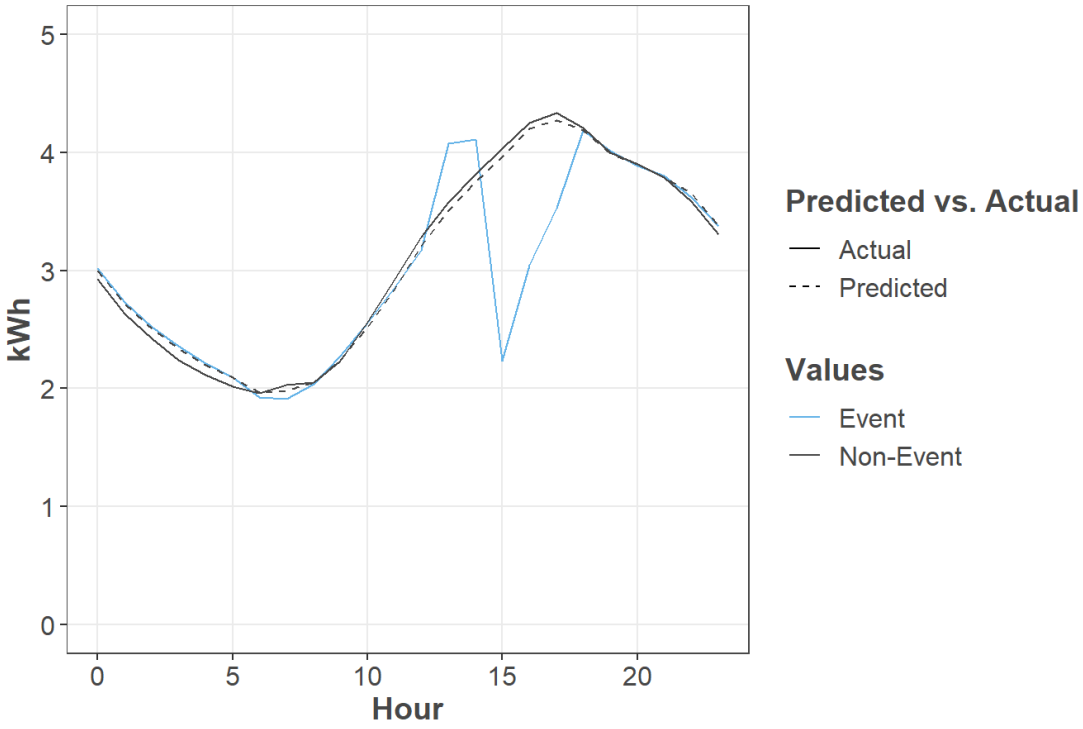


Figure 44. Residential DR Program: ecobee Resource Capability Model Fit

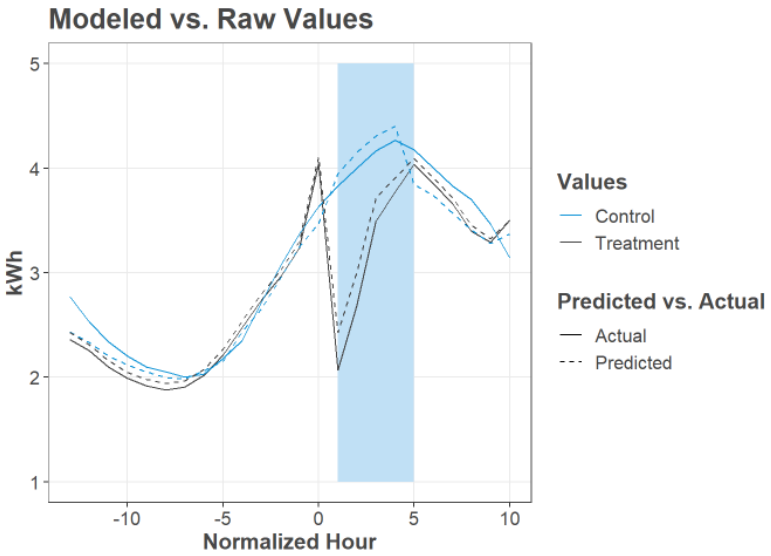


Figure 45. Residential DR Program: Sensi Resource Capability Model Fit

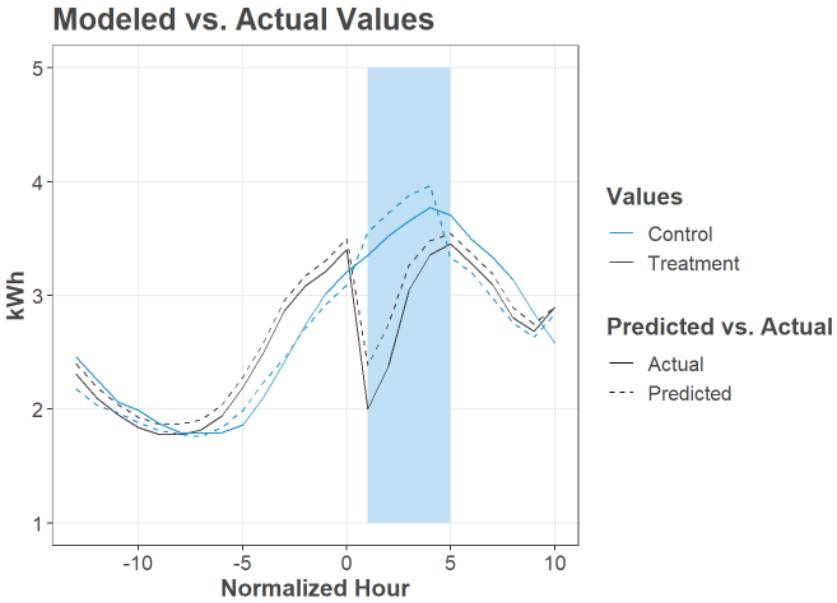
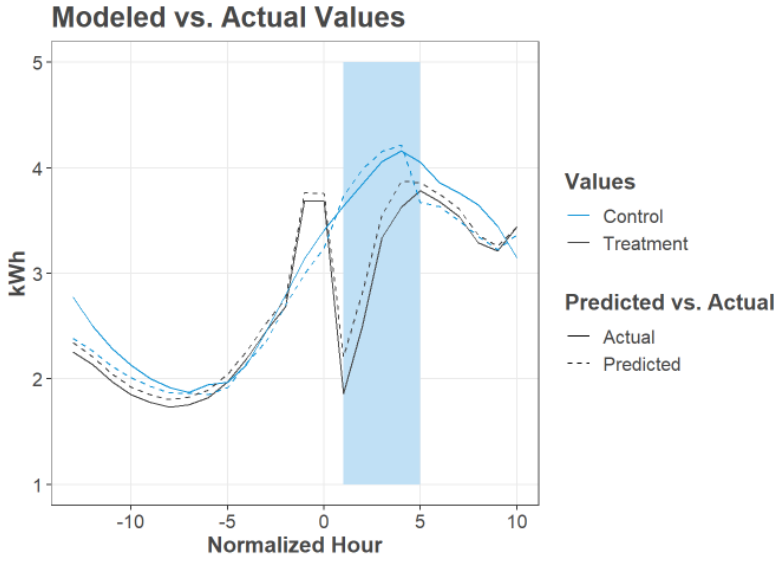


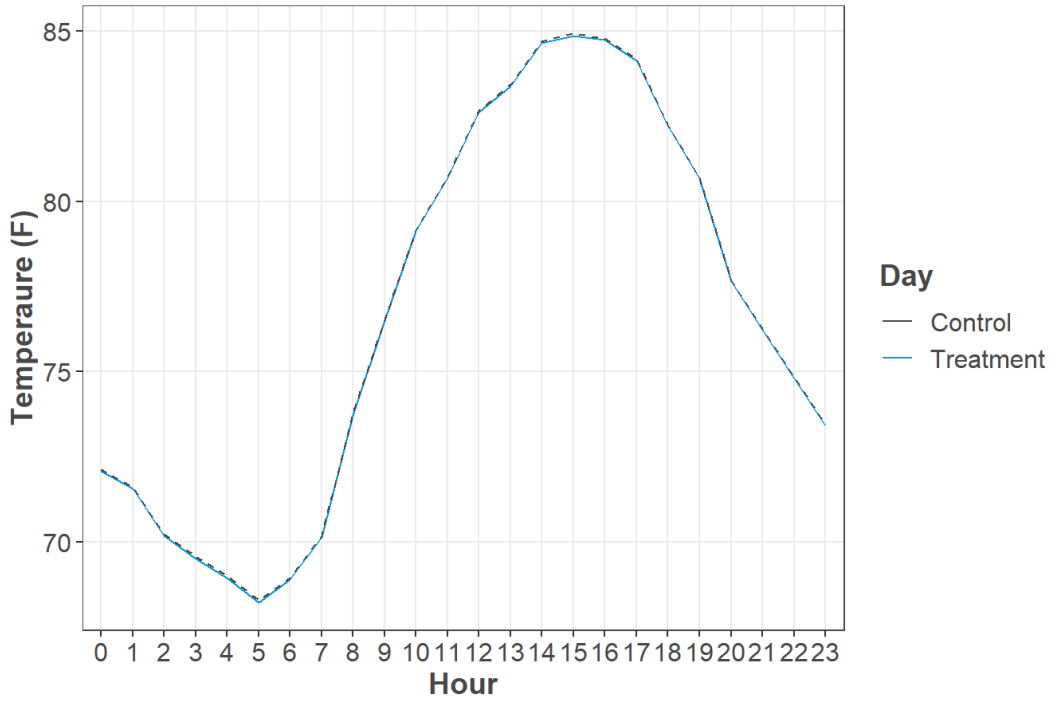
Figure 46. Residential DR Program: Nest Resource Capability Model Fit



NON-EVENT SENSI OPTIMIZATION MODEL EQUIVALENCY ANALYSIS RESULTS

Figure 47 compares average hourly temperature on treatment and control days to demonstrate equivalency in experimental assignment of the Sensi accounts into treatment and control for energy optimization purposes.

Figure 47. Residential DR Program: Non-Event Day Sensi Optimization Equivalency Analysis



NON-EVENT SENSI OPTIMIZATION MODEL SPECIFICATION AND OUTPUTS

MODEL SPECIFICATION

Equation 4 shows the model specification used to develop non-event optimization impacts for Sensi accounts.

Equation 4. Residential DR Program: Non-Event Day Sensi Optimization Model Specification

$$kWh_{it} = \alpha_i + \sum_{t=0}^{23} \beta_t \cdot \mathrm{Hour}_t + \sum_{H=0}^{23} \beta_{Ot} \cdot \mathrm{Opt}_i \cdot \mathrm{Hour}_t + \beta_{CDH} \cdot \mathrm{CDH}_{it} + \varepsilon_{it}$$

Where:

α_i = Account-specific intercept for account *i*

Opt_{it} = Indicator variable for account *i* in optimization mode at time *t*

$Hour_t$ = Set of 23 indicator variables of hours of the day

$Opt_{it} \cdot Hour$ = Interaction of the optimization indicator with hour of the day

CDH_{it} = Cooling degree-hours for time-period t (base 75 degrees Fahrenheit)

ε_{it} = Error term

The kW for each hour was summed to determine the kWh saving per day per-account, and then multiplied by the number of account days when the accounts were optimized to obtain the total kWh savings for the PY2023 event season.

MODEL OUTPUTS

Table 12 provides impact values for an average treatment day from the modeling efforts.

Table 12. Residential DR Program: Modeled Non-Event Sensi Energy Savings

Hour Beginning	Baseline Load (kWh)	Treatment Load (kWh)	Impact (kWh)	% Impact	Standard Error	Lower Bound (90%)	Upper Bound (90%)
0	1.55	1.65	-0.09	-6.0%	0.01	-0.10	-0.09
1	1.36	1.42	-0.06	-4.7%	0.00	-0.07	-0.06
2	1.21	1.24	-0.03	-2.3%	0.00	-0.03	-0.02
3	1.12	1.23	-0.11	-9.7%	0.00	-0.12	-0.10
4	1.07	1.13	-0.06	-6.0%	0.00	-0.07	-0.06
5	1.07	1.07	0.00	-0.4%	0.00	-0.01	0.00
6	1.16	1.11	0.06	4.9%	0.01	0.05	0.07
7	1.18	1.14	0.04	3.7%	0.00	0.04	0.05
8	1.17	1.14	0.03	2.4%	0.00	0.02	0.04
9	1.26	1.23	0.03	2.4%	0.01	0.02	0.04
10	1.40	1.38	0.03	1.8%	0.01	0.02	0.03
11	1.57	1.57	0.00	-0.1%	0.01	-0.01	0.01
12	1.76	1.73	0.04	2.0%	0.01	0.03	0.05
13	1.92	1.88	0.05	2.5%	0.01	0.04	0.06
14	2.08	2.02	0.06	2.8%	0.01	0.05	0.07
15	2.24	2.18	0.06	2.6%	0.01	0.05	0.07
16	2.41	2.31	0.10	4.0%	0.01	0.08	0.11
17	2.64	2.44	0.20	7.7%	0.01	0.19	0.22
18	2.56	2.40	0.15	6.0%	0.01	0.14	0.17
19	2.41	2.27	0.14	5.9%	0.01	0.13	0.15
20	2.28	2.12	0.16	7.1%	0.01	0.15	0.17
21	2.17	2.01	0.17	7.6%	0.01	0.15	0.18
22	1.96	1.82	0.15	7.5%	0.01	0.13	0.16
23	1.69	1.58	0.11	6.5%	0.01	0.10	0.12
Mean Hourly kWh	**1.72**	**1.67**	**0.05**	**2.9%**	**0.00**	**0.05**	**0.05**
Daily kWh	**41.26**	**40.06**	**1.20**	**2.9%**		**1.20**	**1.20**

Table 13 provides actual impacts for an average treatment day as observed in the cleaned AMI data.

Table 13. Residential DR Program: Actual Non-Event Sensi Energy Savings

Hour Beginning	Baseline Load (kWh)	Treatment Load (kWh)	Impact (kWh)	% Impact
0	1.55	1.65	-0.09	-6.0%
1	1.36	1.42	-0.06	-4.7%
2	1.21	1.24	-0.03	-2.3%
3	1.12	1.23	-0.11	-9.7%
4	1.07	1.13	-0.06	-6.0%
5	1.07	1.07	0.00	-0.4%
6	1.16	1.11	0.06	4.9%
7	1.18	1.14	0.04	3.7%
8	1.17	1.14	0.03	2.4%
9	1.26	1.23	0.03	2.4%
10	1.40	1.38	0.03	1.8%
11	1.57	1.57	0.00	-0.1%
12	1.76	1.73	0.04	2.0%
13	1.92	1.88	0.05	2.5%
14	2.08	2.02	0.06	2.8%
15	2.24	2.18	0.06	2.6%
16	2.41	2.31	0.10	4.0%
17	2.64	2.44	0.20	7.7%
18	2.56	2.40	0.15	6.0%
19	2.41	2.27	0.14	5.9%
20	2.28	2.12	0.16	7.1%
21	2.17	2.01	0.17	7.6%
22	1.96	1.82	0.15	7.5%
23	1.69	1.58	0.11	6.5%
Mean Hourly kWh	**1.72**	**1.67**	**0.05**	**2.9%**
Daily kWh	**41.26**	**40.06**	**1.20**	**2.9%**

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