Renew Home

Scaling Residential Demand Response by Prioritizing Comfort: Evidence from 25 Million Energy Shifts

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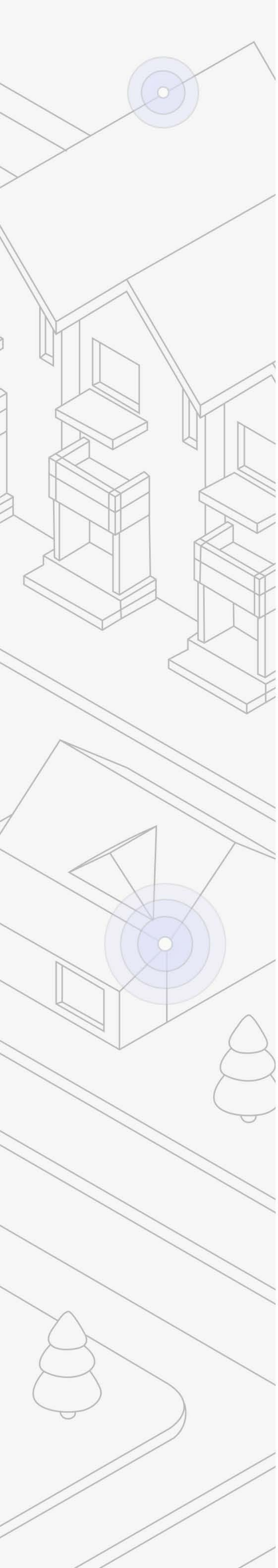

Product Introduction

Energy Shift Capacity: 4 GW of Flexible Capacity Ready to be Rewarded Now

Jeff Gleeson
CPO, Renew Home

As the United States continues to navigate a period of dramatic growth in electricity demand and rising consumer bills, it is critical that we create new ways for customers to take control of their energy use. Renew Home believes it should be much easier for people to lower their bills with savings and to earn money back for their contributions to the electric grid—all while always staying in control of their comfort and usage.

We offer Energy Shift as part of Nest Renew[1], with the simple goal of making it easier to prioritize cheaper or cleaner energy with small and subtle shifts in usage that are increasingly personalized such that they often go unnoticed. These shifts, when coupled with a Time-of-Use rate, resulted in an average of about $35 in summer savings[2] for participating California households.

These additional savings are not the only way that Energy Shift can help households. Thanks to these shifts running at scale, consumers' choices add to something very real: capacity at the size of a full power plant. In many places, adequate capacity is in short supply and utilities and regulators are willing to pay consumers when their actions help reduce peak demand.

In California, thanks to a flexible energy market, soon we will be able to share an additional $15 credit with consumers for linking their utility and opting in to smart summer cooling, bringing the total available savings for an average TOU household to $50 for the summer.[2]

We believe that Energy Shift can form the foundation of a new type of customer-centric energy program that makes it easy for customers to save and to earn money back—thanks to the benefits their collective savings actions provide to the grid; all without feeling uncomfortable from large temperature adjustments. For example, the accompanying white paper shows individual events delivered 380 MW of capacity via hundreds of thousands of thermostats working together, and similar impacts were delivered multiple days in a row.

Renew Home is ready to deploy this solution across the country, which we call Energy Shift Capacity (ESC), and thousands of households are choosing to enroll in Energy Shifts every week. These actions add up to 4 GW[3] of capacity across the United States. And these households deserve to be rewarded.

1. Renew Home, founded in April 2024, was spun out of Google. Renew Home operates Google Nest thermostat energy services, including Nest Renew and Rush Hour Rewards, on behalf of Google. Google, Google Home, Nest, Nest Renew, Nest Thermostat, Nest Learning Thermostat, Rush Hour Rewards, and the Google and Nest logos are trademarks of Google LLC.
2. Estimate based on a summer 2025 cooling season analysis of Nest Renew California TOU users that compared air conditioning runtime of TOU vs non-TOU users in the same postal code, assumed a 2.5 kW system size, a weighted average of common California TOU rates, and an average of 1.2 thermostats per household. The average cooling season savings estimate was $38.71.
3. See page 12 in accompanying white paper

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Executive Summary

Residential demand response (DR) programs play a growing role in providing demand flexibility to the U.S. grid today and are a proven way to address increasing capacity constraints [1,2]. The effectiveness of DR programs depends on enrolling and retaining large numbers of households, and rapidly growing enrollment can be a challenge [3].

Nest Renew, operated by Renew Home, is an opt-in service for Google Nest thermostats that can enable users to participate in daily Energy Shifts to reduce emissions, support the grid, and for users with Time-of-Use (TOU) rates, save money. Millions of Nest thermostat households have enabled Energy Shifts via a simplified enrollment process, and thousands of additional homes join every day.

Energy Shifts, which are primarily dispatched today based on emissions and TOU signals, are different from traditional residential DR because they use smaller, often shorter, personalized temperature adjustments (also referred to as offsets) that are generally around 1°F but can range between 0.5 and 2.0°F. These adjustments can vary depending upon learned user comfort preferences, local conditions, and other factors.

The analysis in this white paper focuses on quantifying the load impact potential of Energy Shifts' temperature offsets during summer peak demand conditions across the United States. To assess this potential, Renew Home incorporated hundreds of randomized controlled trials (RCTs) into the normal course of operations for Nest Renew's Energy Shifts. The RCTs comprised over 25 million energy shifts on 6.5 million thermostats across more than 5 million homes in 48 states.

To characterize the size of the resource available for reducing summer peak demand specifically, we identified a sample of 61 RCTs, conducted during summer 2025 that were representative of typical peak demand days. These events, encompassing 4.3 million Energy Shifts, were selected based on six criteria: weather, timing, duration, peak adjustment magnitudes, pre-conditioning, and sample group representation. All but one of these events spanned 2 hours.

Energy Shifts achieved nearly 80% of the load impact typically observed in traditional smart thermostat DR programs in the first hour of an event and nearly two thirds the impact across a two hour event. Due to the large-scale enrollments and substantial per-user impacts, Energy Shifts could provide larger aggregate value to the grid, complementing traditional residential HVAC DR programs, enabling a new opportunity for residential users to be rewarded for supporting the grid.

This study found Energy Shift load reduction averaged 0.82 kW per thermostat in the first hour and 0.58 kW over the full 2 hour event, nearly as large as standard thermostat demand response programs. We also estimated the total fleetwide load impact potential of Energy Shift by applying the RCT results to the full population of enrolled thermostats based on local climate data resulting in an aggregate peak day load reduction potential of 3.96 GW for the 5.2 million thermostats in the 4.1 million homes that met the criteria.

1. Methodology

Renew Home's presence in more than 5 million homes makes large scale randomized controlled trials (RCTs) feasible and routine for measuring the impacts of Energy Shifts. RCTs are the most rigorous method for measuring causal effects because random assignment provides an unbiased baseline of what would have happened in the absence of the Energy Shift events, eliminating selection bias and confounding factors [4]. RCTs are not often employed in other demand flexibility programs due to challenges with random treatment assignment, achieving sufficient sample sizes, and concerns about excluding a significant fraction of participants from events to form the control group.

Renew Home's scale turns RCTs into an everyday tool—often with control cohorts as small as ~1% while still maintaining statistical precision.[4] The use of RCTs also avoids the need for complex statistical evaluation methods or adjustments while providing results in near real time.

Analyzing RCT results is straightforward: subtract the average outcome of the control group from that of the treatment group. This calculation provides the net impact on HVAC runtime. The runtime is converted to units of energy (kWh and kW) using the method described in the adjacent text box. The steps in calculating the RCT results are illustrated in Figure 1 below.

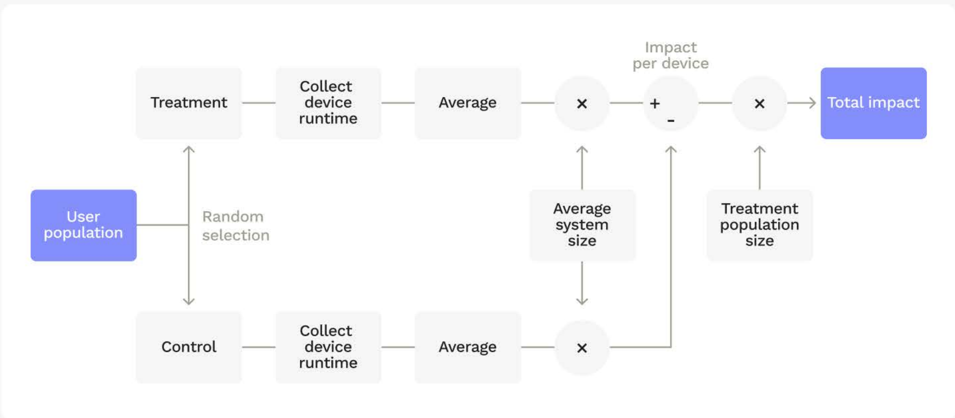
Converting Runtime Data into Energy Estimates

Thermostats report air conditioner runtime rather than energy use, but the energy use can be calculated by multiplying the runtime by the estimated connected load of the air conditioner. Based on AHRI shipment data on system sizes and DOE efficiency standards, the average residential air conditioner in the U.S. draws approximately 3 kW at rated conditions (95°F outdoor temperature). Rated power draw varies by system size (cooling capacity) and efficiency, while actual power at any given time depends primarily on operating conditions, especially outdoor temperature. In hotter climates and larger homes, systems tend to be larger, resulting in regional average power draws typically between 2 kW and 4 kW.

Renew Home has developed a method for estimating average air conditioner capacity and rated power draw using climate data and the number of thermostats per home. This approach aligns closely with available regional averages. When local empirical data are available—such as subsets of homes with both meter and thermostat data or from utility load studies—these data are used instead. For event-level analyses, power draw estimates are further adjusted based on outdoor temperature to reflect actual operating conditions [5].

Figure 1

Randomized Control Trial Logistics



4. The uncertainty from a RCT is a function of the actual sample sizes and not the fraction of the population included. Based on typical standard deviations of runtime during peak, the uncertainty is typically less than 0.10 kW per device for control groups as small as 100 devices.

1.1 Study Plan and Timeline

During the first six months after the company's founding in 2024, Renew Home began dispatching Energy Shift events and developed a structured framework designed to optimize event performance. By the end of 2024, Renew Home conducted a few early RCTs and performed limited testing of heating impacts. These early efforts helped establish operational processes and informed the design of subsequent large-scale experiments.

Spring 2025

The spring 2025 testing phase included extensive use of RCTs to explore a wide range of strategies for optimizing Energy Shifts with individual tests including as many as 15 treatment variations. Some issues and design options explored include:

- The impact of different peak temperature offsets
- The use of pre-conditioning prior to the event, including duration and temperature offset
- The persistence of impacts over time
- Innovative strategies to create desired load shapes over longer events such as varying offsets during the events and using multiple cohorts with different timing and parameters
- Customer dial turns that may indicate discomfort
- Personalization of event parameters based on home characteristics and customer preferences derived from thermostat data

During the spring 2025 season, Renew Home also demonstrated the ability to respond to utility requests and dispatch events targeted to service territories during requested peak periods. All events continued to be run as RCTs to maximize learning and maintain rigor. One of the early findings from the RCTs was that control groups can be fairly small and still provide accurate results—just a few hundred thermostats can provide load impact estimates within 0.05-0.10 kW per thermostat (about 10% of the typical impact).

Insights from this testing led to a more standardized event configuration that was dispatched repeatedly through the summer of 2025.

Summer/Fall 2025

In summer 2025, Renew Home began large-scale deployments of a standardized event configuration while continuing to run some variations for the ongoing refinement of strategies and personalization options.

By October 2025, Renew Home had conducted hundreds of RCTs encompassing more than 25 million Energy Shifts across more than 6.5 million thermostats in over 5 million homes. To characterize the size of the resource available to reduce summer peak demand, we identified the subset of RCTs that were most representative of what a summer peak day event would be:

Weather	Similar to a peak day, defined as having an outdoor temperature during the event within 5°F of the cooling design temperature for each geography
Timing	Typical peak hour start times were primarily 4PM or 5PM, but ranged from 2PM to 7PM if requested by an energy provider
Duration	The default event ran for 2 hours, but we included events from one to four hours if requested by an energy provider
Peak Offsets	Varied from 0.5°F-2.0°F depending on the event and personalization for each device. Most events had an average offset slightly larger than 1°F
Pre-Conditioning	Events were only included if they employed pre-cooling
Sample Size	Results were included if samples sizes were at least 2,000 thermostats in the treatment group and 500 in the control group to ensure representative results

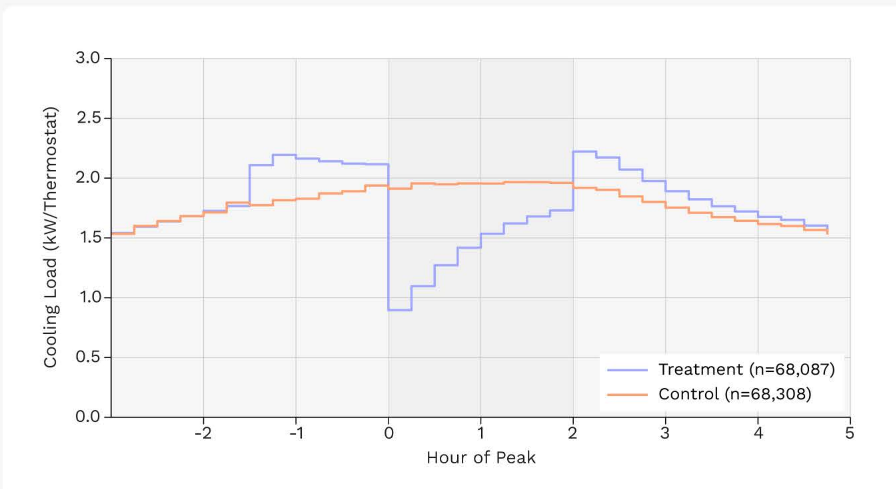
1.2 RCT Analysis Example

An example of an RCT analysis is instructive in showing the simplicity and precision that RCTs can provide. Figure 2 below shows the average loads of the treatment and control groups during the event period from shortly before to a few hours after the event by 15-minute interval. This example is from an RCT conducted in Pennsylvania from 5PM to 7PM on July 29, 2025 when the outdoor temperature averaged 92°F. The analysis used an estimated average air conditioner connected load of 2.76 kW.

Figure 2

RCT Example: Load Profiles for Treatment and Control Groups

Average Cooling Loads (kW/Thermostat)
Pennsylvania July 29, 2025 92°F



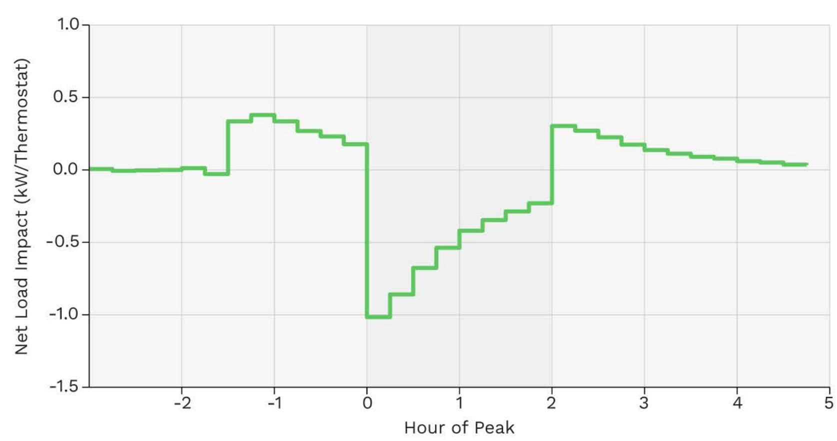
The plot shows that the treatment and control load profiles are indistinguishable prior to any ESC adjustments—which is expected given the large sample sizes in this example. RCTs with smaller samples will sometimes have small differences between the groups due to statistical noise, but even with control groups of just a few hundred thermostats, the noise will be small compared to the impacts, and the results will still be unbiased.

Figure 3 below depicts the net load impact across the event period which is simply the difference between the lines in the first plot. The increased loads from pre-cooling and the sharp drop as the peak begins are clear. The net load reduction erodes throughout the peak as homes start to warm to their new set point temperatures and begin cooling again (albeit at a lower rate).

Figure 3

Load Impact Profile: Example Event

Net Load Impact (kW/Thermostat)
Pennsylvania July 29, 2025 92°F



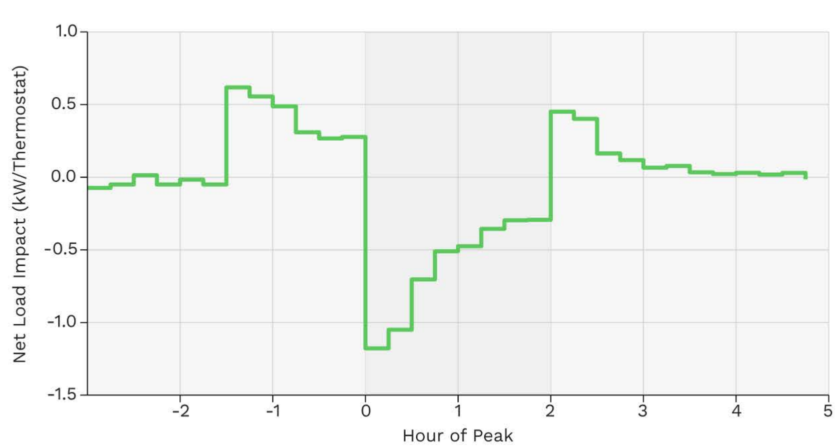
The post-peak period shows a fairly modest jump in load that tapers off over a period often as long or longer than the peak offset period. This fairly muted but long “snapback” period is due to the thermal capacitance of homes, which results in a longer period of increased loads as the mass of the home cools down slowly.

The prior example was from a larger regional test that used 50% control group fraction to allow for more detailed analyses of subsets. For production Energy Shifts, the control group is typically a far smaller fraction making results somewhat noisier. Figure 4 shows the results for an RCT in Louisiana where the control group is 10% of a smaller population of about 5,700 thermostats. The pre-event period shows some small differences between the groups and the profile looks a little noisier. But the net impact is still quite clear.

Figure 4

Load Impact Profile: Example with a Smaller Control Group

Net Load Impact (kW/Thermostat)
Louisiana September 2, 2025 89°F
Sample Size: Treatment = 5,128, Control = 579



2. Results

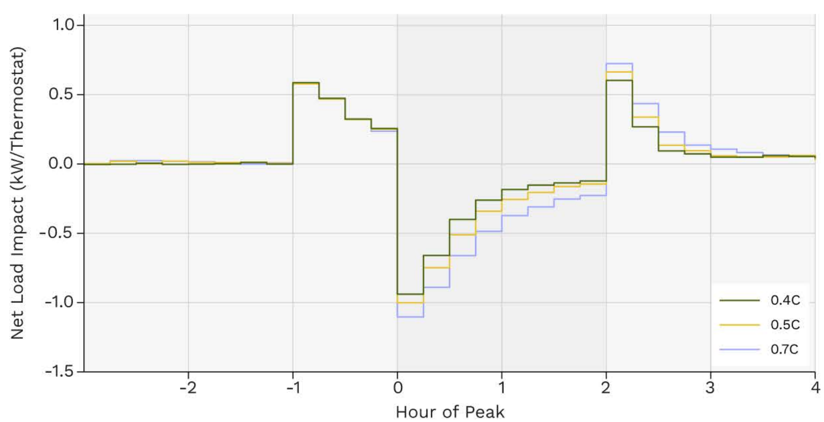
2.1 Early Testing and Exploration

The ability to dispatch many large scale RCTs with multiple treatment arms provided an opportunity to explore the impacts of many event configuration options in detail. For example, Figure 5 plots the net impact profiles for each of three randomly assigned treatment groups that differed only in the magnitude of the peak temperature offsets.

Figure 5

Test Results Comparing 3 Different Peak Temperature Offsets in Texas

ESC Load Impacts: 3 Different Offsets
Texas May 14, 2025



The three lines on the plot are indistinguishable from each other at 0 prior to the peak period, illustrating the strength of the RCT, and stay essentially identical during the hour of pre-conditioning, which was the same for all groups. At the start of the peak there are clear differences showing larger impacts for larger offsets.

The spring 2025 RCTs explored many Energy Shift configuration options ranging from pre-conditioning to personalization of offsets to load shaping from varying configurations across multiple cohorts. This early testing led to a more consistent event configuration which was deployed widely starting in July 2025 to different regions as heat waves occurred. Renew Home also started to collaborate with some utilities to run RCT events in their territories during requested peak periods.

2.2 Primary RCT Results

We applied the criteria described in the methodology section to identify RCTs that represented typical peak summer events in terms of weather, timing, configuration, and sample size. This process resulted in 61 RCTs that were conducted from 7/17/25 to 9/12/25 and included more than 4.3 million device shifts across 27 states. All but one event spanned 2 hours. Table 1 summarizes the key outcomes.

Table 1

Key RCT Results

	Average	Min	Max
Net Peak Load Reduction kW/Thermostat			
Load Reduction 2 Hour Average	0.58	0.30	0.71
Load Reduction Hour 1	0.82	0.41	1.00
Load Reduction Hour 2	0.34	0.16	0.47
Event Info			
Outdoor Temperature	90°F	82°F	102°F
Treatment Group Thermostats	71,361	2,392	678,251
Control Group Thermostats	31,408	579	131,189
Average Estimated AC Connected Load (kW)	2.9	2.1	3.5
Energy Use Impact kWh/Thermostat			
Pre-Cooling	+0.53	+0.32	+0.76
Peak	-1.15	-1.42	-0.60
Post-Peak	+0.40	+0.17	+0.56
Total	-0.22	-0.55	+0.01

Energy Shift reduced loads an average of 0.58 kW per thermostat during the two hour peak with an hour one average reduction of 0.82 kW. Impact varied with climate with hot and humid regions generally providing the largest load reductions. The appendix provides plots of the results for all 61 of these RCTs.

2.3 Repeatability and Consistency of Impacts

The RCTs provided strong evidence that the Energy Shift resource is remarkably consistent across events on similar days. A late July heat wave led to dispatches on 3 consecutive weekdays with similar weather and start times of 4PM the first 2 days and 5PM the last day. The plots below show the net load impacts for all 3 days plotted together for the Energy Shift events in Pennsylvania and Maryland. The load impacts are essentially identical across the 3 days, particularly during the peak period, indicating that Energy Shift can provide consistent and predictable load reductions.

Figure 6

Repeatability of Load Impact: 3 Events in Pennsylvania

Net Load Impact: 3 Consecutive Days With Events

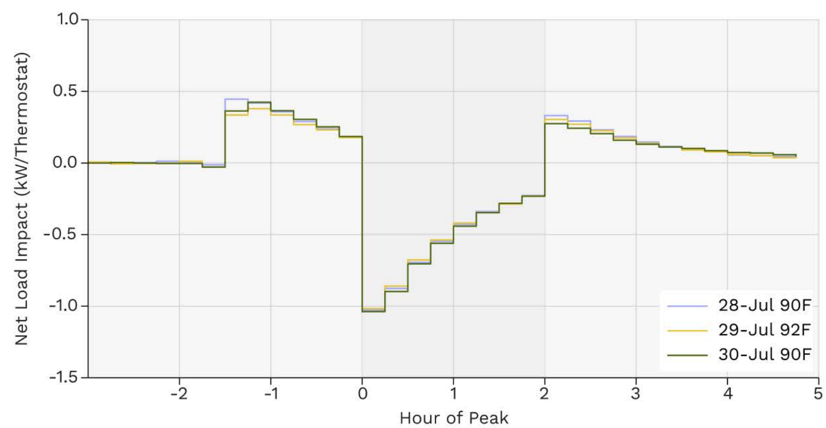
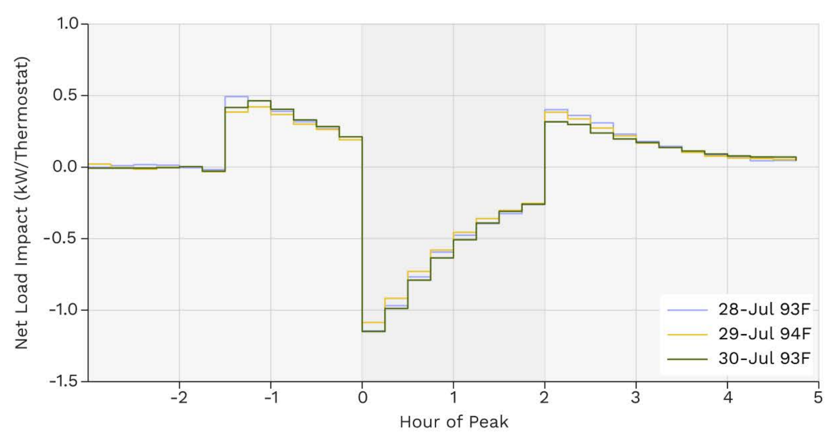


Figure 7

Repeatability of Load Impact: 3 Events in Maryland

Net Load Impact: 3 Consecutive Days With Events



The high level of repeatability across events on the same population suggests that Energy Shift impacts should be predictable based on weather, timing, climate (dry versus humid), and event configuration (pre-conditioning and peak offset). The similar shape of load impacts across different geographies (see appendix) further supports the idea of developing a reliable forecasting method. The RCTs run thus far have provided a solid basis for developing such an internal tool, and further refinement and validation will enable event partner facing forecasts.

2.4 Load Impact Persistence

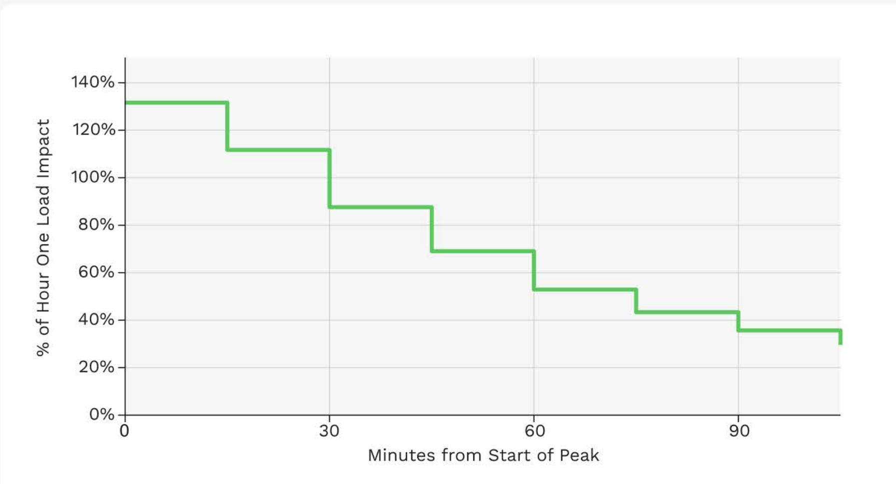
The load reduction provided by an Energy Shift starts out large because many air conditioners turn off if the home is cooler than the new, higher set point temperature. Homes warm up during the event and many reach their new set point temperature and resume cooling (although at a reduced level due to the more efficient set point). The smaller temperature offset used by Energy Shift compared to conventional DR means that the load reduction will degrade more rapidly as homes reach the smaller temperature offset more quickly.

This phenomenon is clear from the results previously reported—the average load impact in the second hour of an Energy Shift event averaged about 40% of the first hour impact. The plot below shows the average load impact by 15-minute interval as a percent of the hour one load impact for the 61 RCT events.

Figure 8

Net Load Impact Persistence

Average Across 61 RCTs



In the first 15 minutes, the load reduction averages 1.3 times larger than the hour one reduction but by the final 15 minutes of a two-hour event the impact is just 30% of the hour one average.

To address situations where more persistent or specific load impact shapes are valued, Renew Home has been experimenting with dispatching multiple cohorts of thermostats with varying timing and temperature offset patterns. These techniques can also serve to reduce post-peak snapback loads. There are typically some trade-offs involved in providing a desired load shape potentially either resulting in smaller average impacts or affecting offset duration and magnitudes. We expect to report in more detail about these approaches in the future.

2.5 Preconditioning, Snapback, and Energy Impacts

The early season testing, not reported here, found that pre-cooling of homes provided a significant boost in peak load reduction and can be designed to avoid an overall net increase in energy use from events by adjusting the offset and duration to specific event characteristics. The RCT results summary (Table 1) showed that Energy Shifts saved an average of about 0.2 kWh per event. That savings consisted of a 0.5 kWh usage increase from pre-cooling, a 1.1 kWh savings during the peak, and a 0.4 kWh increase from post-event recovery (just 0.25 kWh in the first post hour). As described in the Load Impact Persistence section, dispatches can be configured to further reduce the aggregate impact of snapback on the grid.

2.6 Comfort, Opt-Outs, and Personalization

Customer opt-outs are a common concern in traditional thermostat DR programs, because they are thought to drive impact degradation over the course of an event and be a signal of customer discomfort. To reduce opt-out rates, many program implementations have a “speedbump” that requires user confirmation when attempting to opt out during an event, and this is intended to keep users at the elevated cooling temperature for the duration of the event.

With typical offsets of 3-4°F, traditional DR tends to appeal to customers with flexible comfort preferences or those not home during events, limiting participation. Energy Shifts differ from traditional DR because they have smaller temperature offsets and present no user-facing speedbump when adjusting the temperature, and this leads to a more comfortable and natural experience for users.

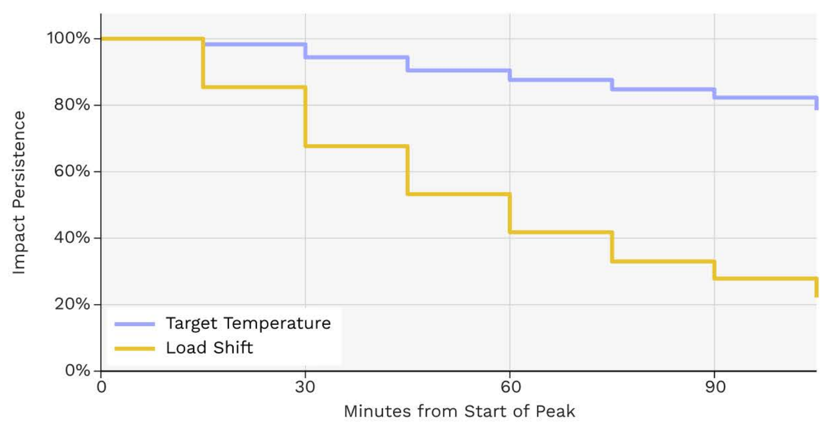
The RCT analysis assessed the impact of Energy Shifts on the frequency of customer opt-outs (i.e., thermostat adjustments / “dial turns” to cooler temperatures). We found a small net increase in hourly dial turn rates of about 4% during most events. The dial turn rates vary across customers and with time of day, weather, and temperature offset.

Renew Home views opt-outs as primarily an indicator of comfort and satisfaction, with only a modest effect on load impact. Figure 9 shows the persistence of target temperature offsets and load impacts, each compared to the first 15 minutes of the peak. The load impact declines by nearly 80% from the first 15 minutes to the final 15 minutes. The average target temperature offset (inclusive of manual adjustments) declines by just 20%. Clearly opt-outs are not the main factor reducing the load impact. Instead it’s the basic thermodynamics of homes—as homes reach the new offset temperature setting, the air conditioners turn back on (at a reduced rate).

Figure 9

Impact Persistence: Target Temperature vs Load Reduction

Pennsylvania July 28, 2025



2.7 Heating Impact Potential

Renew Home performed some limited testing of heating DR in the winter of 2024/2025 that included three consecutive RCTs during a polar vortex in the Southeastern U.S. beginning on January 22, 2025. The analysis focused on about 12,000 homes with heat pumps. Concerns have been raised by some utilities about whether DR events could cause increased customer energy use due to added use of inefficient auxiliary heating during pre-heating and/or post-event recovery. The analysis tracked both compressor and auxiliary backup heat runtime.

The analysis found an average load reduction of about 1.0 kW across the two-hour event. Overall heating energy use declined by about 1 kWh per thermostat including preheating through post-event recovery. Runtime was reduced for both the compressor and auxiliary heat (Google Nest thermostats have a special heat pump DR feature that works to minimize the use of aux heat during preheating and recovery). The impacts were largest on the coldest days.

The RCT was pooled across multiple test configurations run at once, and so these findings should be considered preliminary and may not represent ESC configurations going forward.

2.8 Comparison to Traditional Thermostat Demand Response

To provide a comparison to more traditional thermostat DR programs, we compiled event level data reported in 10 thermostat DR program evaluations [6-14]. We fit a linear regression model of hour one load impact to this data as a function of outdoor temperature and climate using separate models for dry and humid climates. We then applied this model to the RCT events to estimate the impact that traditional DR would have produced during these events. This analysis found that Energy Shifts provided about 79% of the load impact that traditional DR would have provided in hour one for these events (0.82 kW for Energy Shifts vs 1.04 kW for traditional DR).

Hour two load impact was estimated as a function of hour one load impact for traditional DR and then applied to the RCTs resulting in an estimated traditional DR local impact of 0.90 kW over 2 hours. The 0.58 kW found for ESC equals 64% of this traditional DR estimate. These results indicate that although Energy Shifts experience sharper reductions in load impact over time—which makes sense given the smaller temperature offsets—large enrolled populations can provide very large impacts, even larger than those of traditional DR.

2.9 Aggregate Resource

As described in the primary results section, the RCTs showed that Energy Shifts provided an average load reduction of 0.82 kW per thermostat in the first hour of the events and averaged 0.58 kW across two-hour events. These results covered a wide range of geographies and occurred during weather conditions similar to peak days, but extrapolating to specific regions (e.g., utility service territories) and nationally requires adjusting the results to local conditions.

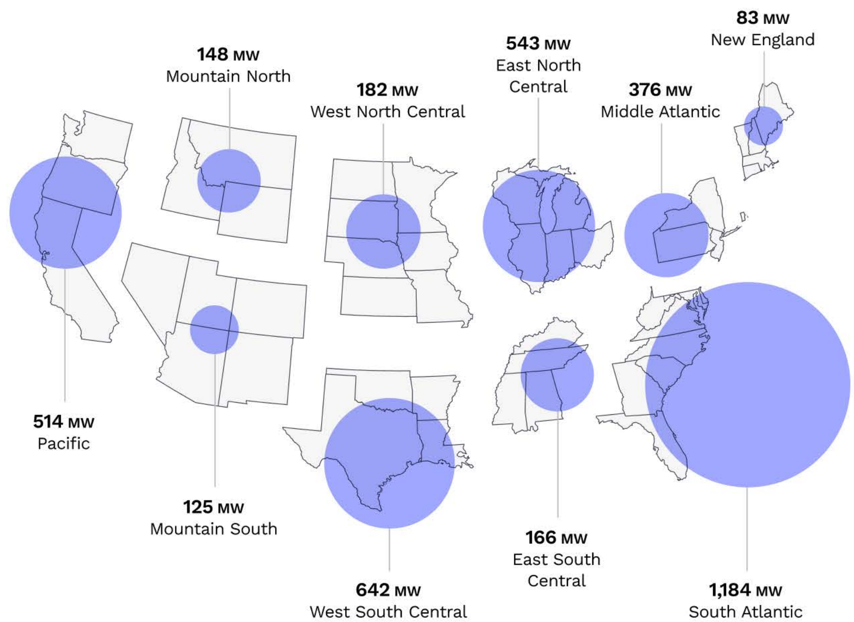
We estimated the load impact potential of Energy Shift at the zip code level by applying climate data to the statistical model developed for traditional DR impacts described in section 2.8 but scaled to the Energy Shift results. The result is an estimated national average 0.76 kW per thermostat for a one hour event, slightly less than the 0.82 kW average from the RCTs.

As of October 2025, there were 5.2 million thermostats in 4.1 million homes enrolled in Energy Shift, excluding those that are also enrolled in traditional DR programs. These thermostats are estimated to provide an aggregate peak day one hour load impact potential of 3.96 GW. This resource is about three times larger than the traditional thermostat DR resource for the Google Nest thermostat fleet in the US, which makes sense since ESC has more than three times as many thermostats enrolled as traditional thermostat DR.

Figure 10 shows the aggregate load impact potential by census division.

Figure 10

Map of ESC Summer Resource by Region



2.10 Impact on Independent System Operator (ISO) Loads

Renew Home dispatched some RCT events to entire grid regions—ISOs / RTOs (Regional Transmission Organizations). We realized that the aggregate load impact from our tests might be large enough to detect in the system load data published by the grid operators.[5]

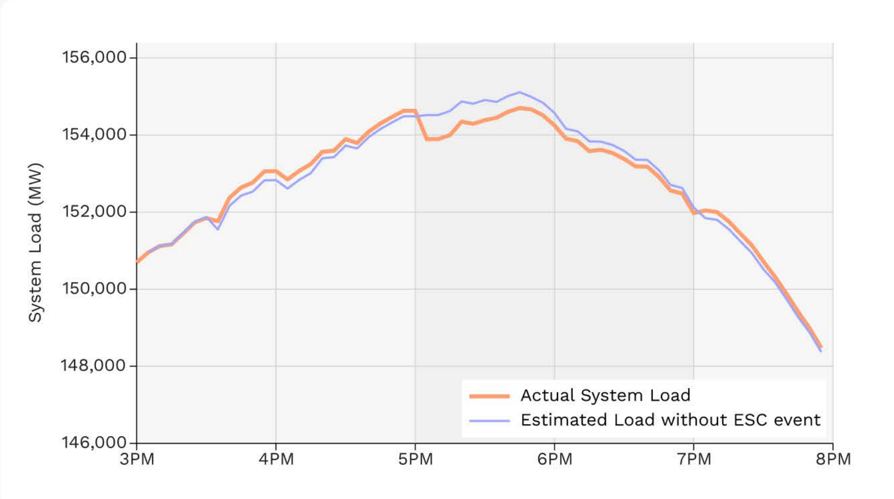
Figure 11 shows the impact of an ESC event on the PJM Interconnection (the largest RTO in the U.S. that serves 25 million homes). We dispatched Energy Shift events to half of the 1.1 million enrolled thermostats in the region on 3 consecutive days in July 2025. The plot shows the system load curve around the time of the July 29 event. The system load noticeably dips at the start of the event. The plot also shows the estimated load curve if the RCT results were added back to the load curve, which appears to align well with the actual curve. The load reduction from the RCT was estimated at 380 MW from 5-6PM which is about the size of the dip.

5. System load data were retrieved from https://dataminer2.pjm.com/feed/inst_load (PJM), https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/estimated-zonal-load (ISO New England) and https://www.gridstatus.io/datasets/ercot_standardized_5_min (ERCOT)

Figure 11

Impact of Energy Shift Test on PJM System Load

July 29, 2025



Based on these results, we designed a set of shorter 15-minute events during times where the load curve was expected to be smoother to improve the likelihood of being able to reliably detect impacts on the grid. We deployed a series of 15-minute events, without preconditioning, throughout Massachusetts (ISO-NE) and Texas (ERCOT) on multiple days between August and early October 2025 with a total of 9 events in Massachusetts and 23 events in Texas. We ran many events to increase the chances of having results for periods when the system load curve was otherwise smooth.

To estimate the impact on the system load, we fit a smoothed load curve using a 3rd order polynomial regression for the period from 30 minutes prior to 60 minutes after the event started but excluding minutes 0 to 30 that were expected to be impacted. These regression models were used to predict what the load would have been during the omitted event period, creating a counterfactual that could be used to estimate the net impact of ESC on the system load.

To create a more robust analysis, we only included periods where the load curve was smooth, which we defined as having a regression model R-squared value of at least 0.99. A total of 11 ERCOT and all 9 ISO-NE events met this criteria. The results are summarized in Table 2.

Table 2

Impacts on ISO Loads

Outcome	**ERCOT**	**ISO-NE (MA)**
Events	11	9
Thermostats Shifted (Average)	396k	110k
Outdoor Temperature	87°F	81°F
ESC Impact (MW)	338	30
Load Curve Impact (MW)	364	42

The system load curves showed similar but slightly larger impacts than the RCTs estimated. For ERCOT, the system load curve showed an average impact of 364 MW, which is 7% larger than the RCT estimate. For ISO-NE, the load curve impacts were 40% larger than the RCT estimates. Both results are within the bounds of statistical uncertainty. The apparent underestimation from the RCT results is not surprising because conservative estimates were used for air conditioner power draw.

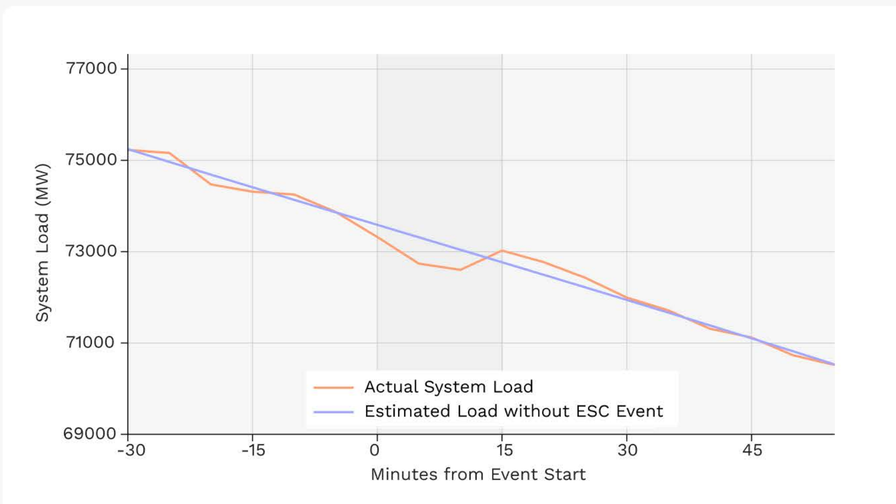
These findings help confirm the magnitude of the Energy Shift resource and that the RCT results are reasonable and valid. They also suggest that Renew Home's estimated power draw values are likely conservative.

Figure 12 shows two of the events that met the criteria for analysis and each shows a fairly clear dip in the system curve that coincides with the ESC event.

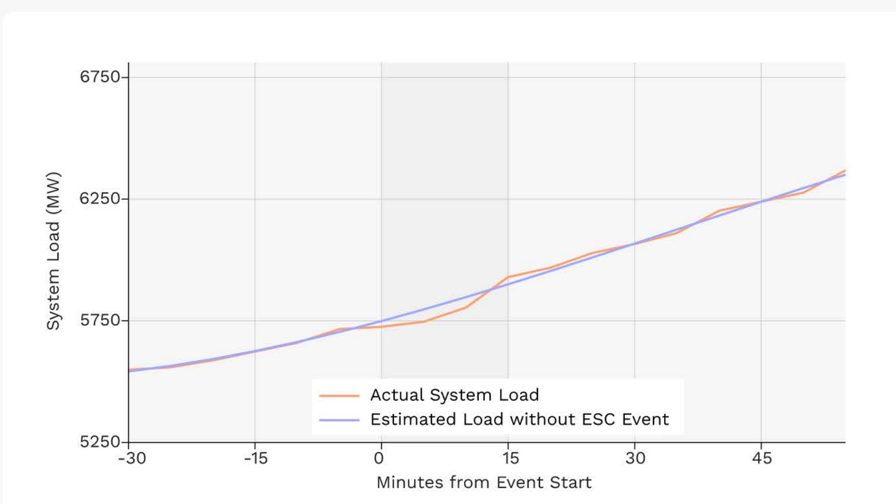
Figure 12

Impact of Energy Shift Tests on ERCOT and ISO-NE Grid Loads

ERCOT September 20, 2025 6:15PM RCT= -374 System Impact= -508



ISO-NE MA August 23, 2025 3:30PM RCT= -31 System Impact= -47



3. Conclusions

This study demonstrates that Energy Shifts constitute a large, reliable, and measurable grid resource. By leveraging a simplified enrollment process and a comfort-centric design using small, personalized temperature adjustments, Energy Shifts have quickly reached an enrolled fleet of more than 6 million thermostats. With an estimated 4 GW of one-hour summer peak capacity in the U.S. as of 2025, the scale of this resource could help relieve capacity constrained grids and increase the value of residential demand flexibility.

This analysis, grounded in hundreds of large-scale RCTs, quantifies the significant potential of this resource. During peak summer conditions, Energy Shifts delivered an average load reduction of 0.82 kW per thermostat in the first hour and 0.58 kW over a two-hour event. While this per-device impact is a little smaller than traditional DR programs, the very large scale of enrollment makes the aggregate resource far larger.

Critically, this resource is not just large; it is predictable and reliable. We observed nearly identical load impacts across consecutive-day heat wave events, demonstrating consistency. Furthermore, we validated our RCT-based estimates against actual system load data from major grid operators, confirming that the aggregate impacts are large enough to be clearly observed at the ISO level.

The Energy Shift model proves that residential demand flexibility can scale beyond highly-motivated customers to a mass-market solution that prioritizes user comfort, thereby engaging millions of households to support the grid. This study provides a robust, high-confidence quantification of this new resource, offering a powerful and proven tool for addressing grid capacity constraints.

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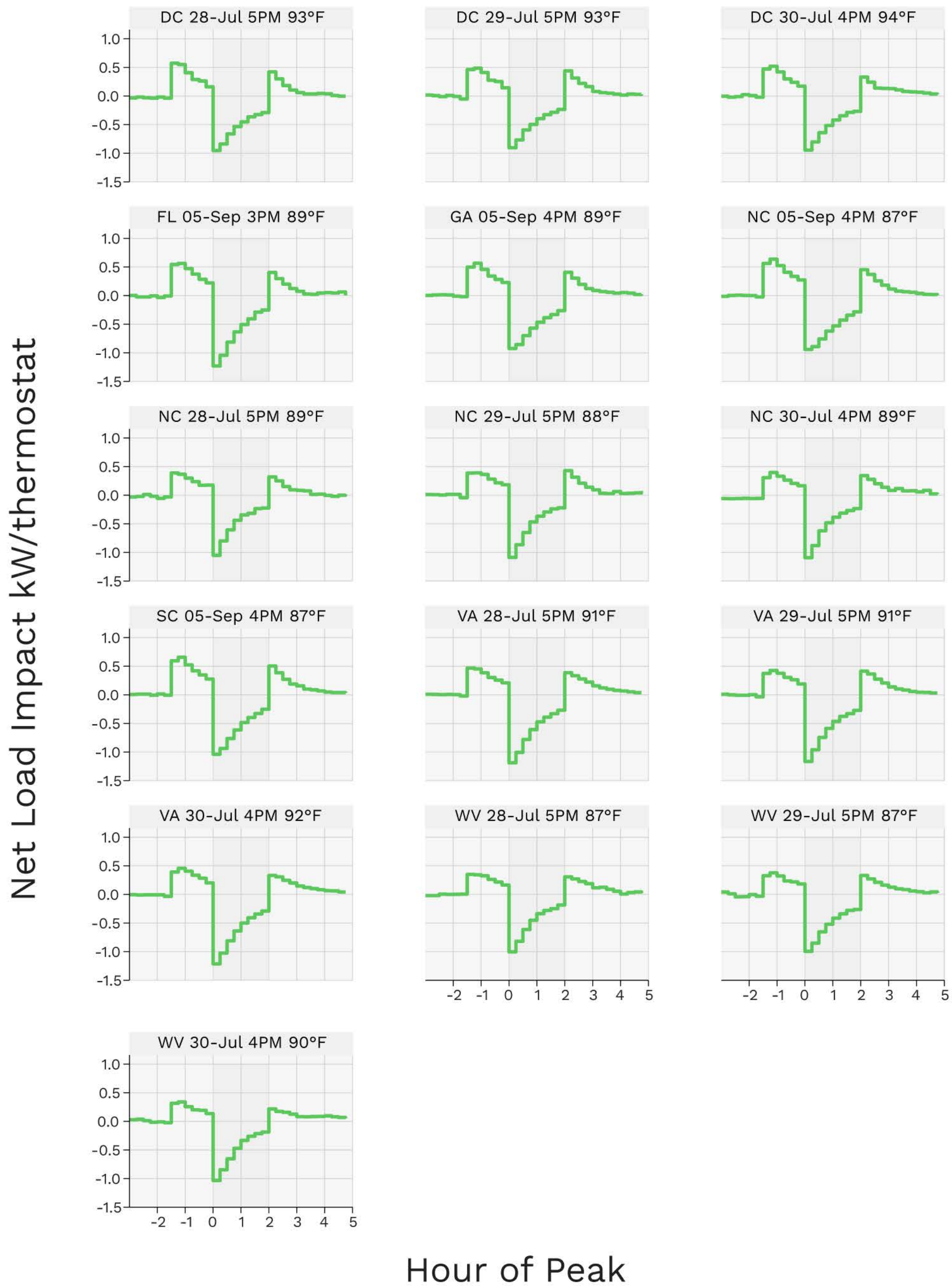
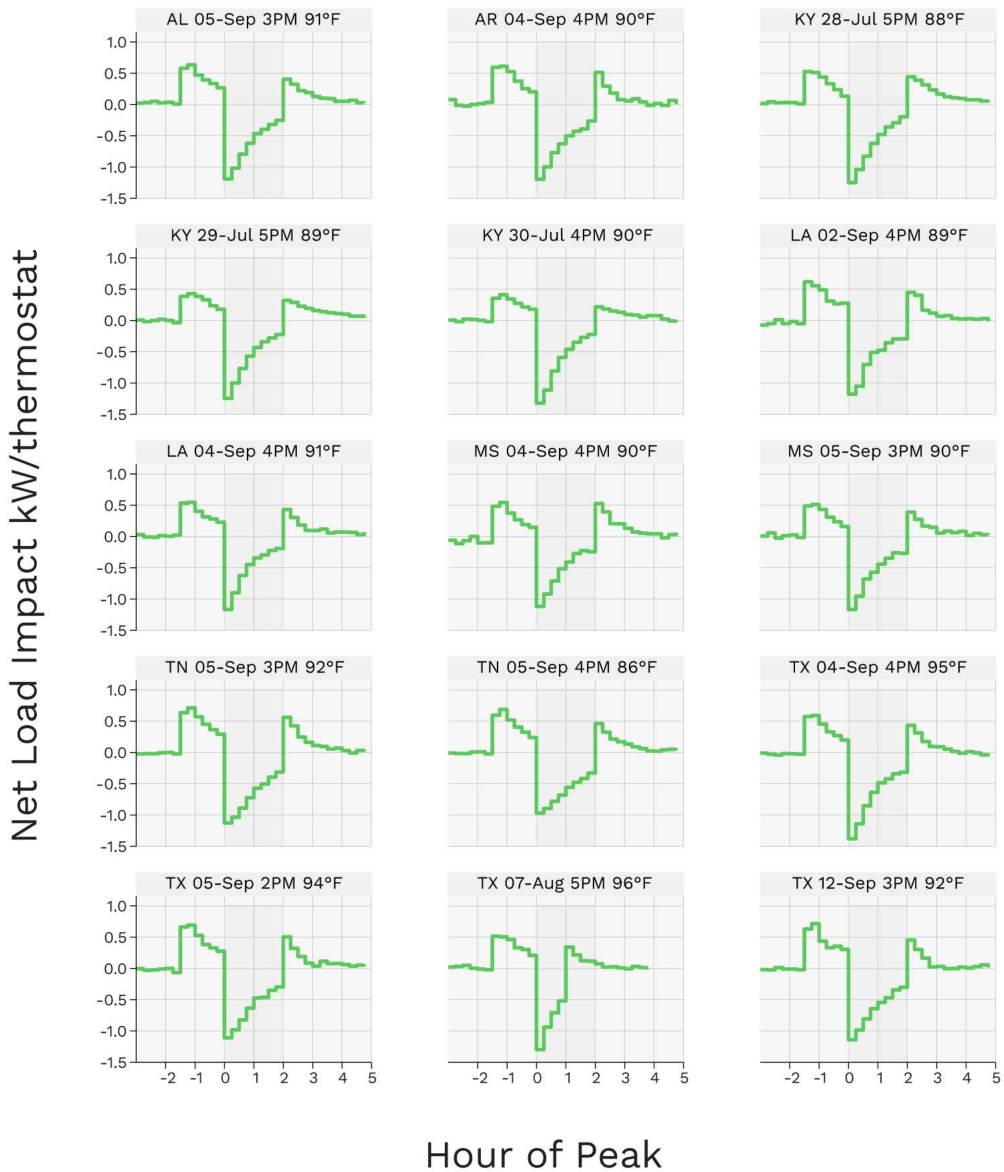
Appendix: Randomized Control Impact Plots

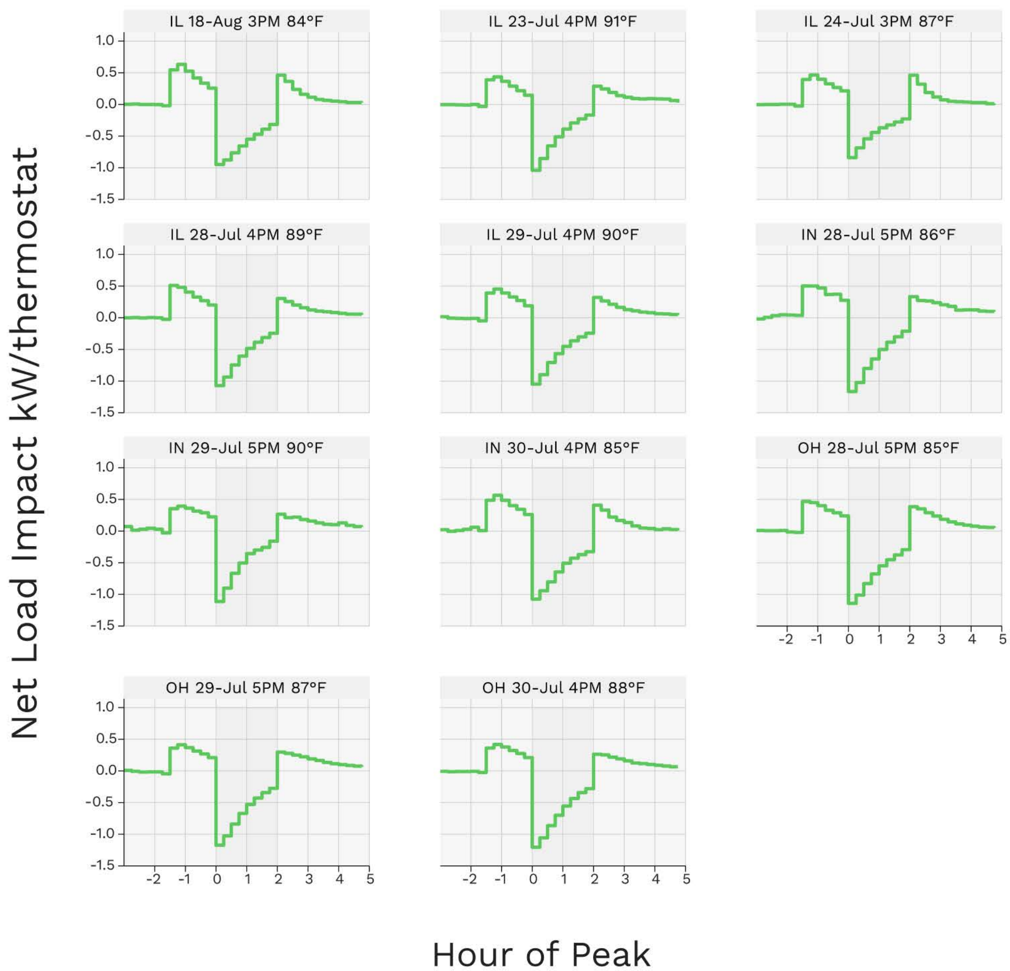
South Atlantic



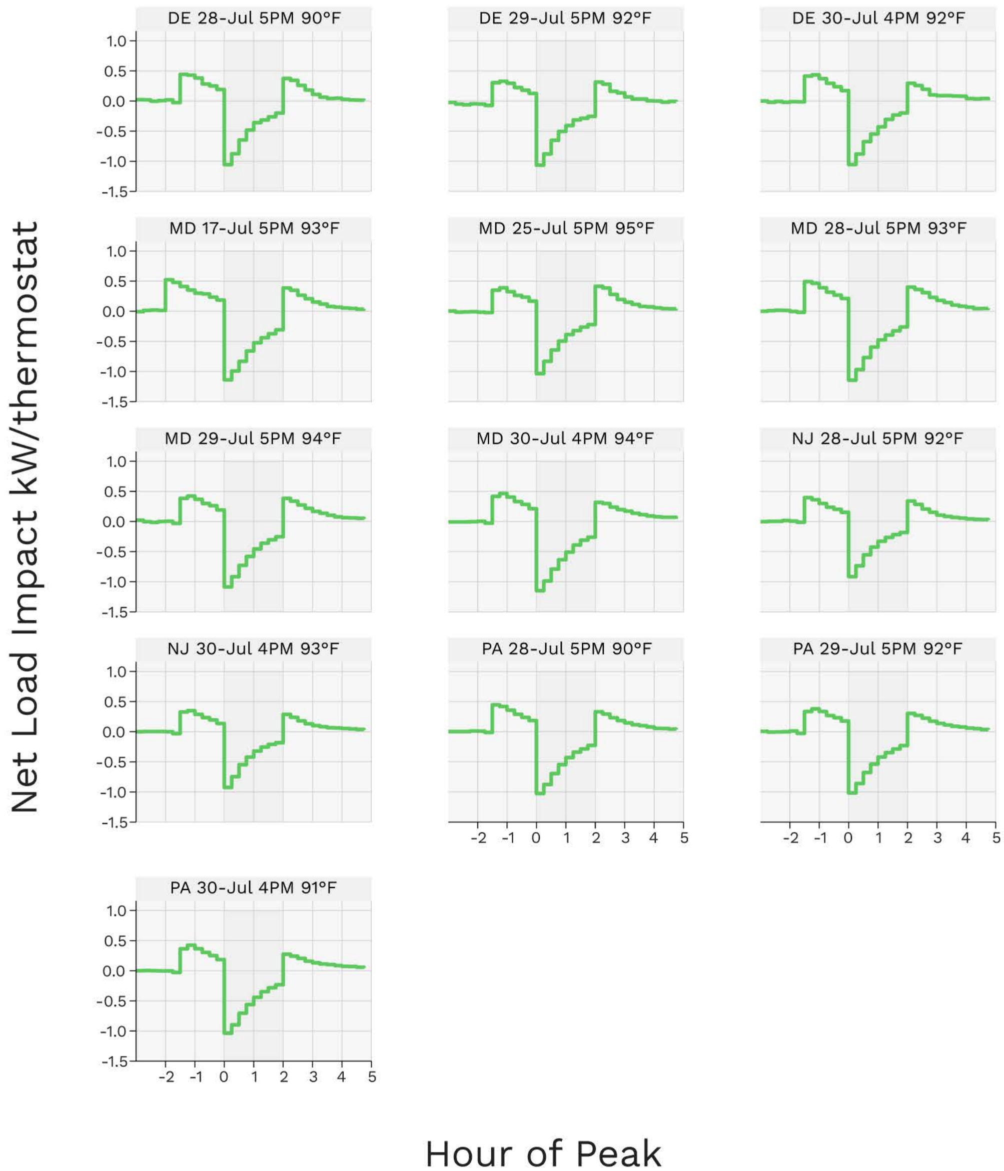
South Central



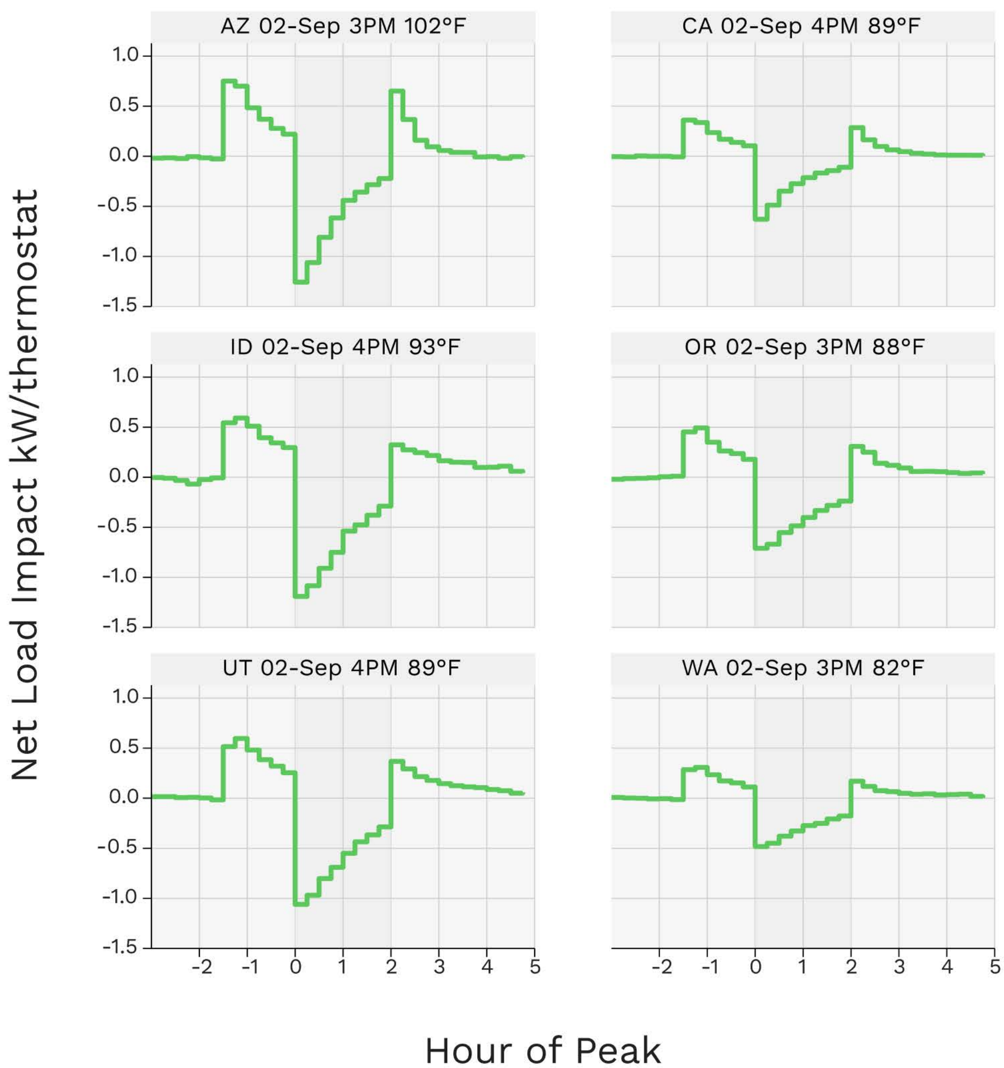
Midwest


IL 18-Aug 3PM 84°F
IL 23-Jul 4PM 91°F
IL 24-Jul 3PM 87°F
IL 28-Jul 4PM 89°F
IL 29-Jul 4PM 90°F
IN 28-Jul 5PM 86°F
IN 29-Jul 5PM 90°F
IN 30-Jul 4PM 85°F
OH 28-Jul 5PM 85°F
OH 29-Jul 5PM 87°F
OH 30-Jul 4PM 88°F
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2 -1 0 1 2 3 4 5
Net Load Impact kW/thermostat
Hour of Peak

MidAtlantic + DE, MD



West


AZ 02-Sep 3PM 102°F
CA 02-Sep 4PM 89°F
ID 02-Sep 4PM 93°F
OR 02-Sep 3PM 88°F
UT 02-Sep 4PM 89°F
WA 02-Sep 3PM 82°F
Net Load Impact kW/thermostat
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2
-1
0
1
2
3
4
5
Hour of Peak