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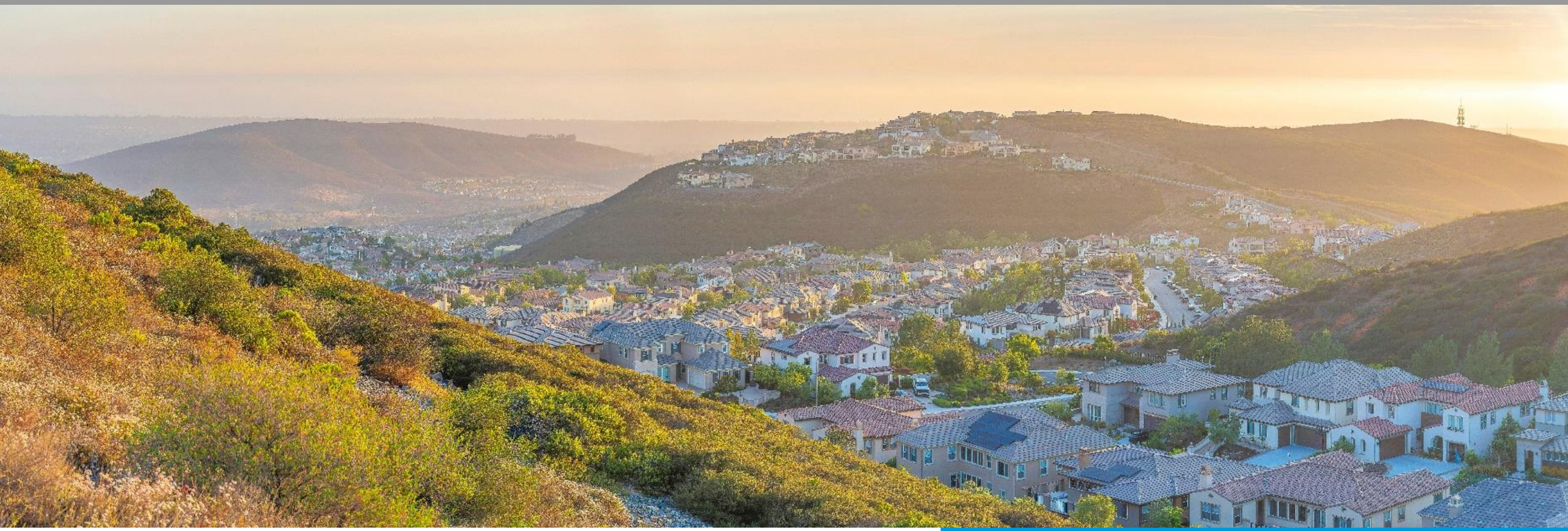
SCE SmartShift Rewards Program: Evaluation Status & Interim Findings through 2026 Q2



Prepared for Southern California Edison

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ABSTRACT

Through two alternating-treatment experiments, SCE's SmartShift Rewards program has demonstrated consistent ability to shift residential water-heating loads out of the 4 p.m. to 9 p.m. peak period. SmartShift reduced peak demand by approximately 30%, delivering average per-device peak reductions of 0.06 kW in Experiment 1 and 0.03 kW in Experiment 2. Participants are estimated to save roughly $20 annually on electric bills, in addition to program incentives.

Peak demand reductions are relatively small in Watts, however, since most of the devices are highly efficient, and most are also performing some load shifting through existing JA-13 programming. High customer set points, connectivity issues, and significant post-event "snapback" energy use also limit overall program benefits, as do barriers to initial program enrollments. Preliminary benefit-cost findings suggest the current per-device incentives and fees exceed the value of avoided energy and capacity benefits.

As of Q2 2026, the program had enrolled 482 devices with 434 applications pending. Participation remains concentrated among heat pump water heaters from a single manufacturer, all in single-family homes. Future enrollments and experiments aim to include CTA-2045-connected devices, electric resistance water heaters, multifamily and commercial customers, and additional manufacturers.

TABLE OF CONTENTS

1 Introduction 5
1.1 Overview of Current Program Status 6
1.2 Recommendations for 2026-2027 7
2 Summary of Impact Estimates 9
2.1 Experiment 1 9
2.2 SHPWH Operations outside of Experiment 1 10
2.3 Experiment 2 12
2.4 Experiment 2 Control Group Usage Patterns 14
2.5 Sensitivity of Impacts to Outdoor Temperature 16
3 Other Program Impacts 18
3.1 Customer Bill Impacts 18
3.2 Greenhouse Gas Impacts 18
4 Process Evaluation 20
4.1 Enrollments 20
4.2 Device Operations 21
4.3 Data Transfers 21
4.4 Connectivity 22
5 Benefit-Cost Analysis 24

Figures

Figure 1: Experiment 1 Treatment vs. Control Group Hourly Usage (Weekdays April – June) 9

Figure 2: Experiment 1 Average Set Points by Hour, Treatment vs. Control Group 10

Figure 3: Distribution of Midday Set Point Temperatures..11

Figure 4: Average Watts by Hour and Heating Type for the Orientation Period (No SmartShift) and Post-Orientation (with SmartShift)... 12

Figure 5: Experiment 2 Hourly Load Shapes by Algorithm (including Control Group)............................13

Figure 6: Watts by Control Algorithm, Heating Type and Hour in Experiment 2.................................. 14

Figure 7: Comparison of Hourly Loads in Experiments 1 and 2 (Devices in Both Experiments Only 15

Figure 8: Differential Impacts by Customer Group, Device Types, and Building Types 16

Figure 9: Bill Impact Calculator Summary 18

Figure 10: Summary of Greenhouse Gas (GHG) Reduction Estimates 19

Figure 11: Connectivity in Experiment 2 – Percent of Devices Missing Data by Day............................. 22

Tables

Table 1: Summary of results from Experiment 2...13

Table 2: Hypotheses Tested to Explain Low Peak Usage (4 – 9 p.m.) in Experiment 2 Control Group.... 15

Table 3: 2026 Q2 Pending and Completed Enrollments by Water Heater and Connection Type 20

Table 4: Current Per-Device Program Costs for SmartShift Rewards Program.................................... 24

1 INTRODUCTION

SCE's SmartShift Rewards Hot Water Program shifts peak electric loads via thermal storage and set point adjustments in electric water heaters. Participants are paid an incentive to allow daily load shifting, controlled remotely by the program implementer (Energy Solutions). SmartShift's base algorithm, where possible:

1. Increases set points by 10° from 2 to 4 p.m., for heat pump water heaters (HPWHs) with a thermostatic mixing valve (TMV)[1]
2. Drops the set point 10° below the normal set point from 4 to 9 p.m.
3. Resumes the normal set point/schedule from 9 p.m. on

Both heat pump water heaters and electric resistance water heaters can participate in the program, either via existing controls or with an installed third-party control device. The program will last 5 years, with an initial enrollment goal of 11,300 across single-family, multi-family, and small business customers. The program aims to provide a combined 2.89 MW of thermal storage/demand reductions during peak hours by 2027.

At this time, most of the water heaters in the program evaluated in referenced experiments are TECH Clean California participants in SCE territory. As an energy standard compliance requirement, these water heaters should have some schedule/optimization for an electric time-of-use (TOU) rate if they were installed after fall of 2023 (which includes most devices in the program).[2]

Demand Side Analytics (DSA) has been evaluating the SmartShift water heaters' performance using alternating treatment experiments, randomized controlled trials (RCTs) in which participants rotate through treatment and control (untreated) status by week. Measured outcomes for the evaluation include demand reductions (hourly kW), energy reductions (daily kWh), tank temperatures, reductions in greenhouse gas (GHG) emissions, and customer bill savings. Additional ongoing evaluation activities include participant surveys, a process evaluation, and a benefit-cost analysis.

This memo summarizes evaluation activities that occurred in 2025 through early 2026 specifically under experiments #1 and #2

[1] This is the desired schedule for smart heat pump water heaters connected via API. Other water heater and controller types may have less capability, including inability to increase the set points ahead of the peak hours. The current program HPWHs also cannot raise set points ahead of peak hours if they are normally set to 140° F.

[2] California Joint Appendix 13 (JA-13): https://www.energy.ca.gov/sites/default/files/2025-11/JA13_2025_Qualification_Requirements_HPWH_DM_ADA.pdf

1.1 OVERVIEW OF CURRENT PROGRAM STATUS

The DSA, Energy Solutions, and SCE teams completed two experiments for the SmartShift Rewards Hot Water program in 2025. On average the devices are saving 30% relative to the control group from 4 – 9 p.m. (0.06 kW in Experiment 1, 0.03 kW in Experiment 2 against lower baseline usage). Experiment 2 also showed daily energy savings of 0.19 kWh per device.

Based on the hourly savings we estimate that customers save roughly $20 per year on electric bills on average, not including additional incentives paid through the program ($50 up front, $5-$10 per month thereafter). SmartShift creates little GHG reduction, however, due to high energy use during the snapback period (after 9 p.m.) when solar power is no longer being generated.

As of April 2026, the program had enrolled 475 devices with an additional 436 pending applications. All devices in the experiments have been Smart Heat Pump Water Heaters from a single manufacturer (Manufacturer A throughout this report) connected via wi-fi, with all of these at single family homes.[3] Most of the HPWHs were purchased through the TECH program, and most participants are located in the San Jacinto valley.

Pending enrollments indicate future experiments may be able to include other targeted study categories including devices connected via CTA-2045, HPWHs from other manufacturers, and other areas in SCE's service territory. Future outreach will include electric resistance water heaters, TOU 5-8 customers, multifamily sites, and commercial sites. While these segments are expected to grow, few of these other device connection categories or device types were either enrolled or pending through the initial quarters of 2026.

Overall, the SmartShift Rewards program is growing and the shifting algorithm generates clear impacts at the expected times. However, the program faces challenges going forward including:

- **Small kW savings per device:** Generating savings over and above those created by 1) efficient heat-pump water heaters and 2) devices with JA-13 programming (which also optimizes energy use for a TOU rate, albeit with a simpler algorithm) is a challenge. Clear shifting at the expected times has only generated 0.06 kW and 0.03 kW in hourly savings (on average) in the first two experiments.
- **Program expansion:** The program is planned to scale significantly but currently has about 450 Manufacturer A HPWHs enrolled. Enrollment of other manufacturers, other areas (outside of San Jacinto), other customer segments (multi-family, small commercial) are expected for later in 2026.

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[3] Almost all of the devices to date are a similar model hybrid HPWH from Manufacturer A as well, and most have the same tank capacity (65 gallons).

- **Enrolling electric resistance water heaters:** There has been low enrollment in this segment to date, though much of the previous outreach relied on contact information from the TECH HPWH installations. Greater outreach to these customers is planned for later in 2026, however.
- **Initial device connections:** Energy Solutions has identified the required initial connections via Manufacturer A API/customer app are a significant barrier to participation (< 40% successful connections) and as such has pivoted to CTA-2045 connections going forward.[4]
- **Connectivity after successful initial setup:** Some devices in Experiment 1 were disconnected throughout the analysis period; this number increased further in Experiment 2.
- **Snapback energy usage:** SmartShift customers' highest daily usage comes from 9 to 10 p.m., though control group usage (which often includes an algorithm for JA-13) peaks during that hour as well. The high energy use decreases daily kWh impacts and GHG reductions.
- **High set points on devices:** The majority of the HPWHs have a normal set point of 140° F (mean = 134°, mode = 140°), which prevents use of Advanced Load Up (ALU is intended to raise set points by 10° in the hours leading up to 4 p.m., but not to exceed 140°). Devices set to 130° performed better in Experiment 1, suggesting potential for higher savings.
- **Cost effectiveness:** While costs in pilot programs are generally high, going forward many of the per-device costs, which will not be diminished as the program scales up, are too high relative to the benefits generated by the demand reductions and daily kWh savings

1.2 RECOMMENDATIONS FOR 2026-2027

Based on our ongoing evaluation activities, DSA offers the following recommendations for program operations in 2026-2027:

1. Expand knowledge of load shifting capabilities by including the following in Experiments 3 & 4:
    - CTA-2045 connections – these are currently the solution to initial connection issues and should be common in the program soon, so it will be important to verify their capabilities compared to the devices controlled via Manufacturer A API.
    - Additional months of the year – so far experiments have covered parts of April through June and October through early December).

[4] See Energy Solutions' presentation at the 2026 ACEEE Hot Water Forum, slide 14.

- Electric resistance water heaters – it is important to determine whether they have larger savings than HPWHs in order to assess the program's cost effectiveness. These devices are less efficient, so they may have larger loads to shift, but they also cannot store thermal energy via the Advanced Load Up.

- Other customer and device types as they become available: Other manufacturers and tank sizes, input voltage configurations, multifamily sites, small commercial sites, other parts of SCE territory, etc.

2. Prioritize marketing and connections for pending enrollments in the above categories so they can be included in experiments, allowing us to assess impacts and cost effectiveness for the program as a whole. Note that Energy Solutions has planned upcoming marketing for some of the segments, such as electric resistance water heaters, multifamily sites, and additional areas in SCE's service territory.

3. Consider requiring water heaters to be set to the manufacturer's guidelines in future program rules. These set points would be lower than 140° and enable Advanced Load Up (which will generally not exceed 140° for thermal storage).

4. Investigate the JA-13 programming implemented in program water heaters and how it compares to the currently reported data, which does not clearly reflect the JA-13 schedule-driven set point changes. A handful of non JA-13 water heaters in the program (with installations before October 2023) could be used for comparison to those installed after, which should have built-in TOU optimization per JA-13, and/or to assess improvements on contractors' ability to program JA-13 logic.

5. Update the SmartShift algorithm to limit to electric resistance heating after 9 p.m. to reduce snapback—this was tested in Experiment 2 but is not part of the current SmartShift algorithm.

6. Investigate all avenues to reduce costs in future program years. Some costs for pilot programs are heavily up-front or fixed costs that can be spread across more devices as the program scales up, but many of SmartShift's costs are per device (incentives, fees for API/DERMS/etc.) and will not be reduced simply though program expansion.

2 SUMMARY OF IMPACT ESTIMATES

2.1 EXPERIMENT 1

The SmartShift Rewards program is being evaluated using alternating treatment experiments, essentially a randomized controlled trial (RCT) in which participants alternate through weeks in the treatment and control groups. Energy Solutions has implemented the experiments under DSA's design and supervision, with DSA also performing the evaluation.

Experiment 1 lasted 9 weeks from April to June 2025 and included 163 devices (all the SmartShift participants to date that had completed their 1-month orientation period). Devices were divided into 4 groups with one acting as a control group in each week (no shifting).

Some data was removed from Experiment 1 due to implementation challenges, including a Manufacturer A service outage across multiple days. Cutover days, when schedules were switched, were also excluded. Despite this, the alternating treatment experiments still delivered precise impact estimates.

Figure 1 shows average hourly usage for the treatment and control groups in Experiment 1. Peak loads reduced were reduced by 0.06 kW per device (almost 30%) from 4 – 9 p.m. The load shapes also show the Advanced Load Up for some devices as well as large snapback usage after 9 p.m., though the control group also had its highest hourly usage from 9 – 10 p.m. as well.

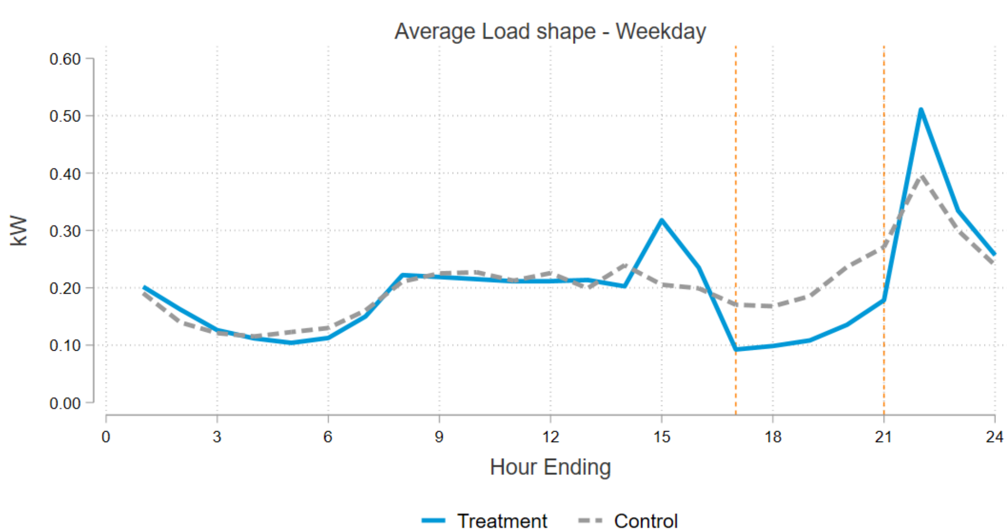

Figure 1: Experiment 1 Treatment vs. Control Group Hourly Usage (Weekdays April – June)

Note that during the load up period (2 – 4 p.m.), temperatures did not raise as much as expected (see Figure 2 below). Set points only increased by 3 degrees on average, versus a potential 10-degree increase in the program's shifting algorithm. This was due to the high prevalence of devices set to 140° F. The devices do not allow set points during advanced load up to exceed this threshold, so there is no scope for most devices to load up energy before the events, they simply drop their set points and use less energy during the peak hours.

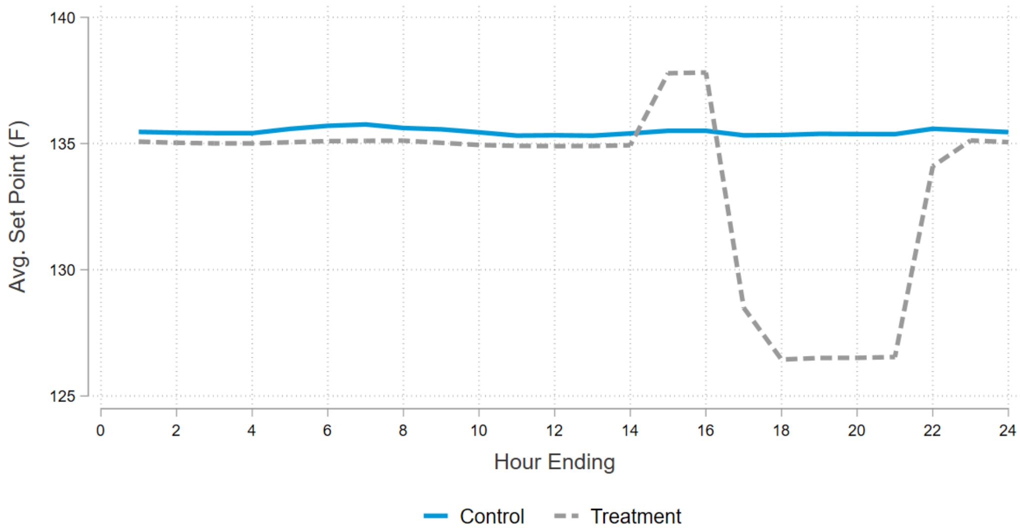

Figure 2: Experiment 1 Average Set Points by Hour, Treatment vs. Control Group

Since some devices had lower set points that enabled the advanced load up feature, we separately estimated impacts for these devices. Water heaters with normal, midday set points from to 121° to 130° (most of which were set to exactly 130°) saved 50% more than those set to 140°, though this was not statistically significant (p-value of 0.125). Water heaters set from 101 to 110° and 111 to 120°, of which there were many fewer devices, showed no difference in impacts from the devices set to 140°.

The control group load shape in Experiment 1 suggests that some devices had JA-13 programming that shifted load in response to TOU rates during the baseline period. JA-13 programming was not observable in the temperature set points reported via Manufacturer A API (Figure 2), but the pattern is evident in the power data (Figure 1). For more on the JA-13 programming in the devices, see further discussion below on Experiment #2.

2.2 SHPWH OPERATIONS OUTSIDE OF EXPERIMENT 1

We also analyzed data across several weeks before and after Experiment 1 (January – March and June – July 2025) to confirm the normal operations of the water heaters. Some findings from this data included:

- Similar shifting and load shapes both before and after the experiment: this implies impact estimates from experiments can be applied generally to SmartShift performance.
- Large snapback usage after 9 p.m., often using resistance heating instead of heat pump (consistent with what was observed in the experiment)
- Normal set points were also very high (most set to 140° with no daily schedule)

- Moderate load up before events (only a few degrees increase in the set point on average).

The set points have been of particular interest since they both increase energy use and, if set high enough, limit the use of the Advanced Load Up feature. Figure 3 below shows the distribution of normal (midday) setpoints for these devices, with similar distributions across Experiment 1, the weeks before/after Experiment 1, and Experiment 2 (mode of 140° and mean above 130°).

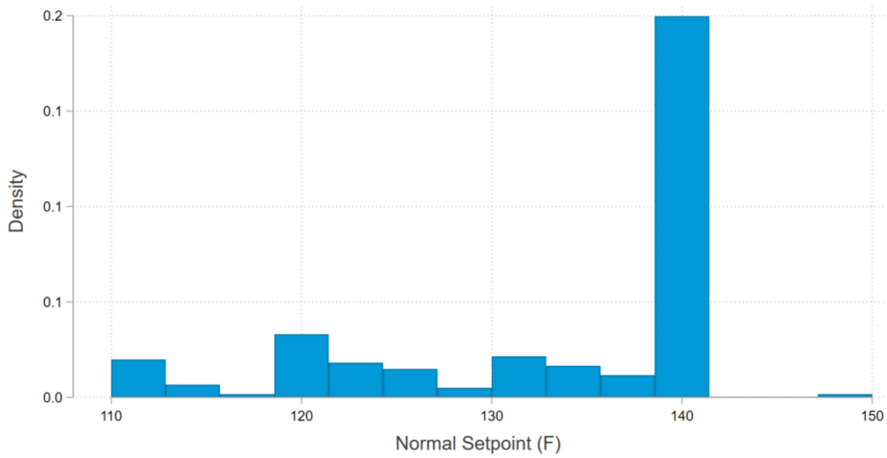

Figure 3: Distribution of Midday Set Point Temperatures

Figure 4 below reports both the power and heating type by hour during the non-experiment weeks. Two important features can be seen: First, during the orientation weeks (left panel), the power data indicates an underlying load shifting due to JA-13. The loads decrease from 4:00 to 5:00 p.m. (hour ending 17) and increase significantly from 9:00 to 10:00 p.m. (hour ending 22). Second, there is significant resistance heating used from 9:00 to 10:00 p.m. (hour ending 22) in both panels. In the Post-Orientation, with SmartShift in use, this is clearly snapback energy usage as the device tries to achieve the higher setpoint after the peak window has closed.

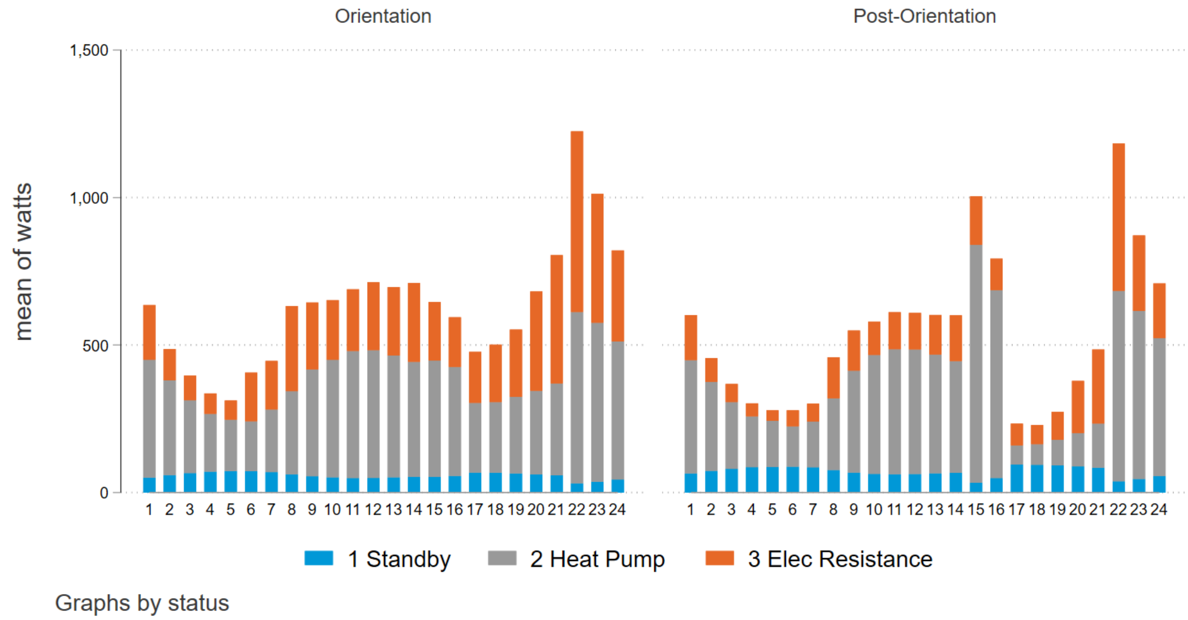

Figure 4: Average Watts by Hour and Heating Type for the Orientation Period (No SmartShift) and Post-Orientation (with SmartShift)

2.3 EXPERIMENT 2

The same experimental setup (an alternating treatment experiment) was used in Experiment 2. The key innovation was testing additional algorithms designed to reduce the high snapback usage seen after 9 p.m. in Experiment 1. Devices rotated through one of four algorithms (with the first two repeated from Experiment 1):

1. No SmartShift (Control Group)
2. Current SmartShift
3. Current SmartShift + run in heat pump-only mode from 9 p.m. to 12 a.m. (limiting the ability to use resistance heating in post-event period)
4. Extra hour of Load Up/Advanced Load Up (starting 1 p.m.) + setting in algorithm 3 above (SmartShift with limits on electric resistance post-event)

Energy Solutions implemented all four algorithms in rotations from October through December 2025 for 246 enrolled devices. Despite a successful implementation, many of the water heaters were disconnected from the Manufacturer A API throughout the experiment (about 25% of all devices). The experiment nevertheless yielded sufficient data for evaluation. All algorithms demonstrated the intended load shifting behavior, as shown in Figure 5:

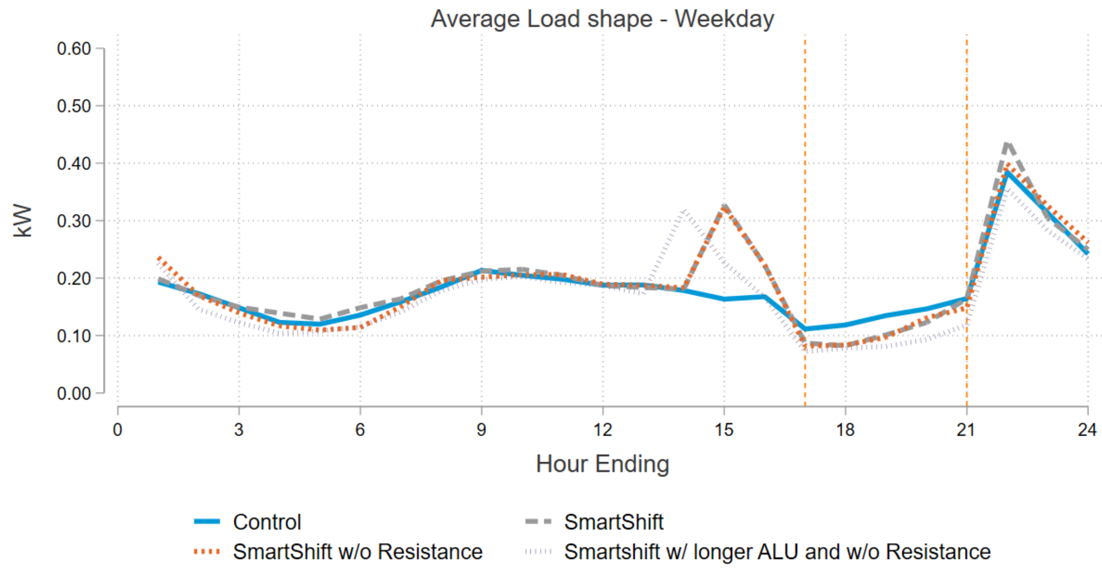

Figure 5: Experiment 2 Hourly Load Shapes by Algorithm (including Control Group)

Note that while much of the usage data only differs slightly by algorithm, there was clearly an earlier load up in the weeks with Algorithm 4, and the two algorithms with limited resistance heating from 9 – 12 did have lower kW from 9 to 10 p.m. than the base SmartShift algorithm.

Overall peak loads in Experiment 2 were again reduced on average by almost 30% (4-9 p.m.), but the kW impacts were smaller than Experiment 1 in terms of kW (0.03 kW vs. 0.06 kW in Experiment 1). This was driven by a lower baseline usage from 4 to 9 p.m., some evidence of JA-13 programming in the devices absent the SmartShift signals being sent. This implies many devices are shifting loads from 4 to 9 p.m., they just shift more with the SmartShift algorithm.

Full results for each algorithm are reported in Table 1 below, relative to usage in the control group:

Table 1: Summary of results from Experiment 2

Algorithm	Peak Load Impact	Total Daily Usage	Snapback Usage
2. SmartShift	-0.032 kw (significant)	-0.19 kWh (significant)	0.01 kw (not significant)
3. SmartShift w/o Resistance	-0.035 kw (significant)	-0.14 kWh (significant)	-0.01 kw (not significant)
4. SmartShift w/ longer ALU and w/o Resistance	-0.040 kw (significant)	0.05 kwh (not significant)	-0.02 kw (significant)

A focus in Experiment 2 was the use of resistance heating in the hours following the peak window (9 to 12 p.m.) As the devices try to recover the tank temperature, they may use resistance heat unless the programming limits this. The base SmartShift algorithm should restrict electric resistance heating from 9 to 9:30 p.m., while two additional algorithms (3 and 4 in the table above), restricted electric resistance from 9 to 12:00 a.m. **Error! Reference source not found.** below shows the watts used by heating type in each hour by experiment group. Hour ending 22 (immediately following the 4:00 to 9:00 peak window) has the highest usage in all cases. However, the base SmartShift algorithm used the most resistance heat in that hour, with the additional algorithms improving on this. Note that while the settings were intended to prevent electric resistance heating, it is still present for all algorithms, possibly due to user overrides or device settings that respond to very low tank temperatures.

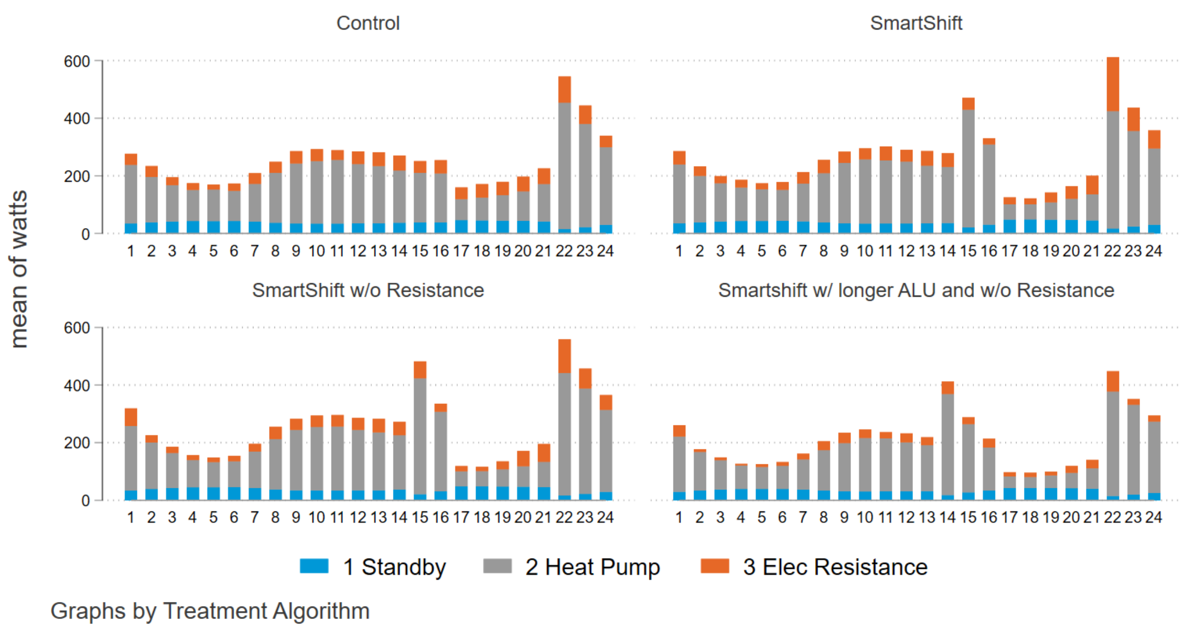

Figure 6: Watts by Control Algorithm, Heating Type and Hour in Experiment 2

As in Experiment 1, most devices were already set to the 140°F threshold for ALU, limiting potential program impacts. In Experiment 2, these high set points actually translated to daily kWh savings with SmartShift since there was little ALU but the set point was lowered for five hours.

2.4 EXPERIMENT 2 CONTROL GROUP USAGE PATTERNS

In Experiment 2, control group customers (with no SmartShift algorithm) showed significant load reductions from 4 to 9 p.m. Figure 7 illustrates the pattern, which was even more pronounced than in Experiment 1:

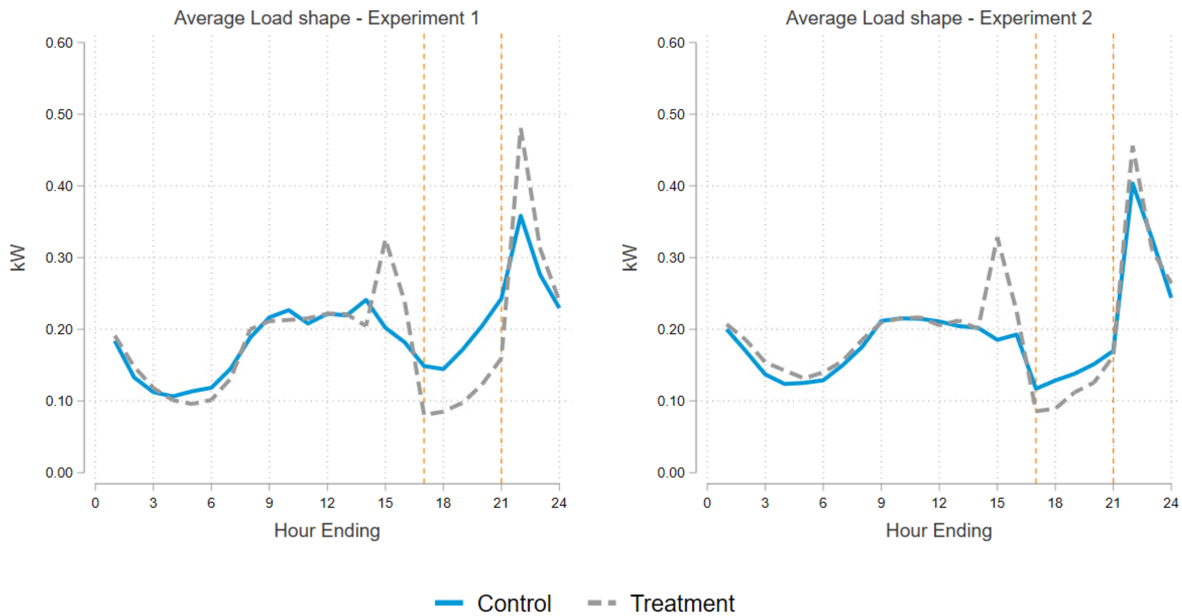

Figure 7: Comparison of Hourly Loads in Experiments 1 and 2 (Devices in Both Experiments Only

DSA, Energy Solutions, and SCE worked together to validate the control group data to ensure the control group was not inaccurate. Hypotheses for the observed data patterns we tested included:

Table 2: Hypotheses Tested to Explain Low Peak Usage (4 – 9 p.m.) in Experiment 2 Control Group

Hypothesis	Findings
Control weeks were actually receiving the SmartShift algorithm	Review of control week set points reveals primarily flat profiles on control days, indicating no shifting, while SmartShift weeks display appropriate setpoint adjustments at expected intervals. Not a likely explanation
Inaccurate power data due to data pulls	ES re-pulled data for a sample of sites, and DSA's review did not find significant discrepancies in energy or algorithms reported. Not a likely explanation
Inaccurate power data from Manufacturer A API	We found instances of constant temperature readings in the 5-min. data for extended periods, which are not feasible for water heaters. Removing these times from the power data did not significantly alter the control group's observed usage patterns. Not a likely explanation
Unique load shape in a concentrated geographic area	While this may explain distinctive load patterns, the Experiment 2 control group displays a greater drop during peak hours (when examining only customers involved in both experiments). Not a likely explanation
Presence of alternative load-shifting algorithms	JA-13 programming should be present in most of the SmartShift devices by rule, but there is little to no evidence of this in set point data on control weeks.

	Discussions with Manufacturer A staff indicate that many TECH installations of Title 24 compliant devices include a seasonally-variant JA-13 schedule. This schedule may explain why there are different response patterns between experiments in different seasons. Discussions with the PG&E WatterSaver and the Association for Energy Affordability (AEA) suggest that the Manufacturer A devices do perform JA-13 load shifting via set point changes, but that these set points are not reported in the API.[5] Further, Manufacturer A made updates for some devices identified as non-TOU-optimized in August of 2025, which could explain differences between Experiment 1 and Experiment 2 control groups, with sharper load shifting in the control group in Experiment 2.

2.5 SENSITIVITY OF IMPACTS TO OUTDOOR TEMPERATURE

We evaluated how outdoor temperature affects program impacts, which can be useful in estimating annual GHG reductions and customer bill impacts. Regression tests found no significant change in impacts across different temperatures, however. While the average kW from 4 – 9 p.m. increases in cooler weather, overall impacts (the difference between SmartShift and control group usage) remained unchanged. This is illustrated below in Figure 8, with declining slopes in each group as the temperature increases (meaning lower energy use at higher outdoor temperatures), but the gap between the treatment and control groups is not a function of the temperature:

Figure 8: Differential Impacts by Customer Group, Device Types, and Building Types

Variable	Estimated Impacts – Experiment 1	Too little variation in Experiments 1&2 – To be estimated in later experiments
Equity groups (CARE, FERA, etc.)	Same impact as other participants	-
Set point before load up	More peak savings for water heaters set to 130° (possibly 50% more, but not statistically significant).	No difference in impacts for water heaters set to 120°, but sample size small
Manufacturer	-	All Manufacturer A
Tank size	-	Most were 65 gallons
Thermostatic mixing valve (TMV)	-	Present for all devices

[5] Meeting notes from July 8, 2026. TECH Clean California documentation lists Manufacturer A water heaters installed under the JA-13 rules (which should apply to all installations after October 2023) will operate in Heat Pump Only mode at 110°. See TECH documentation at https://frontierenergy-tech.my.site.com/contractorsupport/s/article/Time-Of-Use-Installation-Requirement

Variable	Estimated Impacts – Experiment 1	Too little variation in Experiments 1&2 – To be estimated in later experiments
JA-13 programming	-	Should be present for nearly all based on TECH install date[6]
TOU rate	-	All TOU 4-9 (we excluded 4 TOU 5-8 customers)
Electric resistance water heaters	-	None enrolled
Multifamily sites	-	None enrolled
Small commercial sites	-	None enrolled
Communication Protocol (Unitary Controller vs. CTA-2045)	-	These will be included in Experiment 3 (likely summer 2026)

[6] Some devices installed after October 2023 that are intended to have JA-13 programming do not, but we cannot distinguish these in the data. Manufacturer A has worked to increase the number with performing TOU schedules, however.

3 OTHER PROGRAM IMPACTS

3.1 CUSTOMER BILL IMPACTS

Using the estimated hourly impacts from Experiment 1, we estimated annual bill impacts for customers based on their TOU rate (TOU-D 4-9 and TOU-PRIME), equity status, and usage levels. We are currently updating the estimates to include Experiment 2 impacts, which were smaller in terms of kWh from 4 – 9 p.m. but also featured significant decreases in total daily kWh. Based on Experiment 1 impacts, customers saved roughly $20 per year from SmartShift operations, not including additional payments from their enrollment incentive ($50) and their monthly participation incentive ($5 to $10 depending on equity status).

The basic steps in building our bill calculator are summarized below:

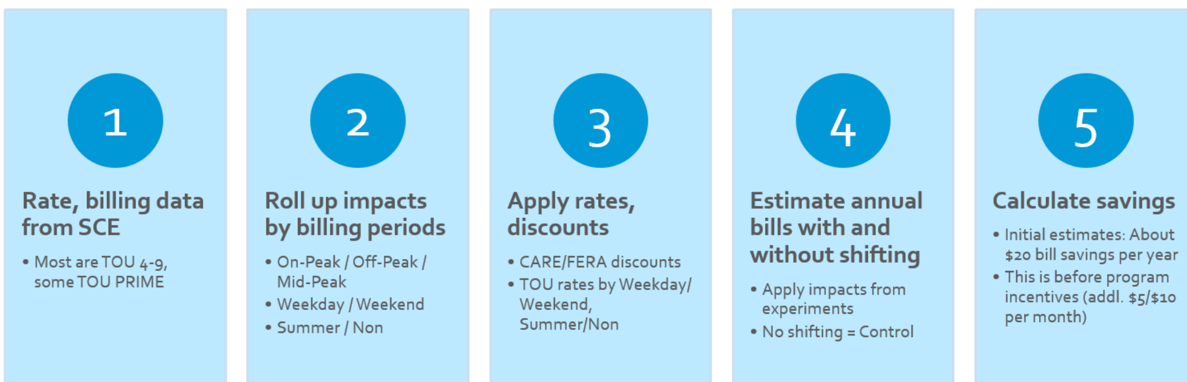

Figure 9: Bill Impact Calculator Summary

3.2 GREENHOUSE GAS IMPACTS

We also applied the hourly impacts to hourly GHG reductions per MW reported in the California Avoided Cost Calculator (ACC). Unfortunately, while the modest load up that SmartShift sees from 2 to 4 p.m. does take advantage of clean solar generation, the significant snapback usage after 9 p.m. largely erases the savings from 4 to 9 p.m. We will continue to evaluate this for Experiment 2 and subsequent experiments, possibly with seasonal estimates if outdoor temperatures show any influence on program impacts in the future. Figure 10 below gives an overview of how the GHG reduction estimates are calculated for the program. Note that the “smoothed” GHG emissions values are average values from the 2024 California ACC by month, day type (weekday/weekend), and hour:

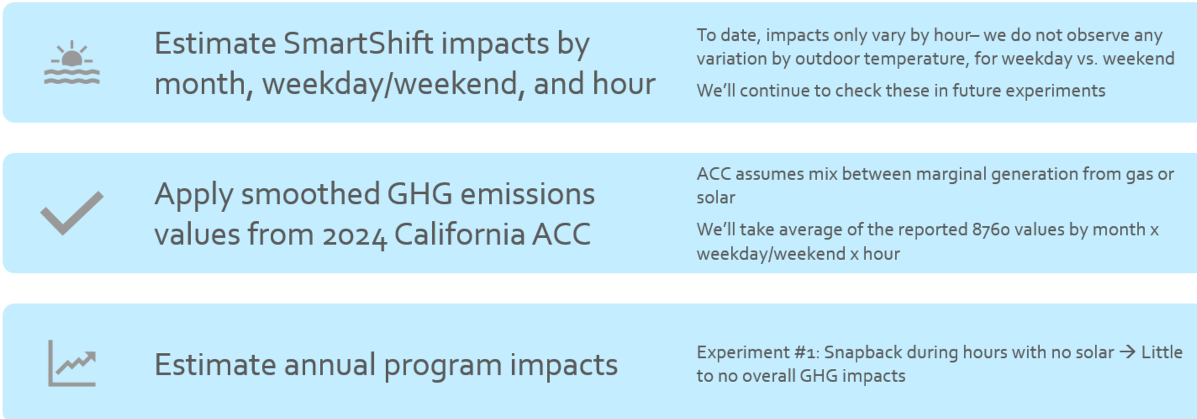

Figure 10: Summary of Greenhouse Gas (GHG) Reduction Estimates

4 PROCESS EVALUATION

4.1 ENROLLMENTS

The most recent enrollment data from Energy Solutions (as of 5/26/2026) is shown in Table 3 below. The program is approaching 1,000 completed applications and 500 completed enrollments:

Table 3: 2026 Q2 Pending and Completed Enrollments by Water Heater and Connection Type

	Water Heater/Connection Type			
	HPWH: CTA-2045/Cellular	HPWH: Wi-Fi	Electric. Resistance	Total
PENDING	308	119	7	**434**
Manufacturer A	280	119	2	401
Manufacturer B	27	-	2	29
Manufacturer C	-	-	2	2
Manufacturer D	1	-	-	1
Don't Know	-	-	1	1
ENROLLED	72	410	-	**482**
Manufacturer A	65	410	-	475
Manufacturer B	7	-	-	7
Total	**380**	**529**	**7**	**916**

Most enrollments have come from TECH participants in SCE territory, who, beginning in 2025, are required to join a load shifting program. Previously, there were less than fifty enrollments, with applications increasing sharply in early 2025. The large number of pending enrollments has been a challenge, however.

Energy Solutions has recently been focusing on these initial connections to the program, with significant user errors and other issues when connecting via the Manufacturer A API (which also requires a smartphone app, a strong Wi-Fi connection, and some user inputs to complete registration). Recent enrollments are instead being set up with CTA-2045 controllers that plug in to their water heaters and communicate via cellular signal.

Most enrollments to date are still Manufacturer A smart HPWHs. There are currently very few pending participants with electric resistance water heaters, and none enrolled. Recruiting for multifamily and commercial sites is not yet underway so there are no participants in those categories.

DSA has planned a waterfall analysis in 2026 to analyze the steps at which prospective participants drop out. This would include all pending and enrolled customers, including any drop outs after enrollment/participation. However, it is clear that many stay in the "pending" status for long stretches as Energy Solutions seeks to remedy issues with applications and connections.

4.2 DEVICE OPERATIONS

As detailed in the Experiment 2 results, the SCE and DSA teams have significant remaining questions on the how the water heaters in the program operate with respect to the signals sent for SmartShift, JA-13 programming, and other settings entered by users or contractors. While the 5-minute power and temperature data from the experiments provides rich data on the devices, there appear to be additional signals and settings that are not reported. In some cases, the received data is incorrect (e.g. the reported values for power, set points, and tank temperatures do not seem plausible in concert).

To this end, the SCE EM&V team coordinated a call with Manufacturer A representatives to discuss a number of questions on device operations, including manufacturer settings, changes in the devices over time, and how the various control signals interact in a program like SmartShift Rewards. Some key findings included:

- JA-13 settings vary by season and TOU rate.
- Manufacturer A itself does not control units through JA-13. HPWH installers set up JA-13 programming by selecting from a pre-set list of TOU schedules by utility and rate. In many cases, these are selected not simply to match the customers' utility/rate, but to maximize comfort or reduce callbacks for the installers.
- Firmware updates are rare and no changes to deadband or control processes would be expected. All devices would be updated at the same time, although this intervention is rare. Each unit effectively operates with its own firmware based on manufacture date and unit type.[7]

Further discussions with the PG&E WatterSaver and AEA teams suggest that while firmware updates are rare, software updates are in fact quite common and can directly impact the JA-13 schedules. TECH program documentation also indicates that Manufacturer A's algorithm for JA-13 TOU optimization is to drop set points to 110° during peak hours, though this cannot be observed in the set points reported via API.[8]

4.3 DATA TRANSFERS

For this evaluation, significant coordination is required across multiple parties to share required data. Beyond the connectivity questions highlighted above, the process essentially entails data from the

[7] Meeting notes from April 23, 2026
[8] Meeting notes from July 8, 2026

DERMS provider to Energy Solutions (the program implementer). From there, necessary data flows to either SCE or DSA (the evaluator).

Data from the water heaters is generally high quality in that it is device-level (rather than whole home) with a frequency of roughly five minutes for power (kW), tank temperature, and set point. The volume of data quickly becomes large with these frequent reads, however. For the first two experiments, Energy Solutions needed to manually download .csv files individually by device and month for each data series and transfer these via SharePoint to the SCE and DSA teams.

Energy Solutions has since been able to add DSA and SCE teams to the API, enabling greater visibility into the data and automation of data transfers. Note that this is not a standard feature offered by The DERMS Provider to clients and had to be arranged separately.

4.4 CONNECTIVITY

While Energy Solutions is working to improve the initial connection of devices upon enrollment, an ongoing issue in the experiments has been the day-to-day connectivity of devices to Wi-Fi to transmit data. Note that while newer customers may have cellular connections, to date we believe devices in the experiments were connected via wi-fi to the Manufacturer A API. Figure 11 reports the number of water heaters in Experiment 2 that reported no data in a given hour for more than 75% of the day (separately by experimental group):

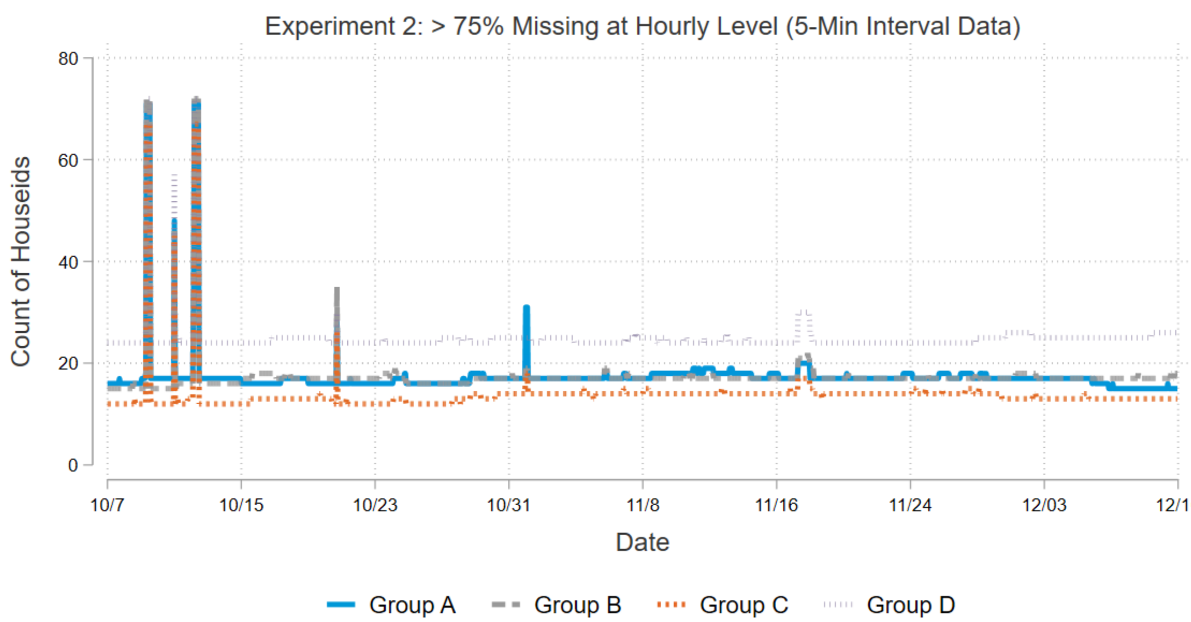

Figure 11: Connectivity in Experiment 2 – Percent of Devices Missing Data by Day

Each group had 15 to 25 water heaters disconnected throughout the experiment, making up over 25% of the water heaters in the experiment. Outside of experiments, these devices may continue shifting on a normal SmartShift schedule, but we cannot observe this in the power data as it is missing. Note that in this context, disconnections could occur due to a disconnection from the Wi-Fi/cellular signal, a disconnection from the Manufacturer A API, or a disconnection of the Manufacturer A API from the DERMS platform.

So far in the evaluation, the only measure of device connectivity available has been missing power reads, which we interpret as disconnections. We have added to this a set of observations that seem to be backfilled by the Manufacturer A API: in some instances, the reported tank temperature remains constant for multiple hours, which should not be possible with normal heat loss through the jacket. We thus interpret these reads as incorrect (including power data over the same intervals) and flag the devices as disconnected.

The SCE and DSA teams will continue to investigate connectivity issues in 2026, including the flow of signals from The DERMS Provider to the devices and the flow of data from devices back to The DERMS Provider at the following steps:

- Device to/from Wi-Fi or cellular networks
- Device to/from Manufacturer A API or CTA-2045 module
- Manufacturer A API or CTA-2045 to/from The DERMS Provider

This will, at minimum, require access to the DERMS Provider's API to obtain full 5-minute data for all devices and all time periods (most of the current data is only from experiments 1 and 2, with no reads since the end of experiment 2).

In addition, the DERMS Provider's system can generate a report of all devices online at a given point in time. Going forward, we plan to write scripts to run this report hourly and build a time series of connectivity measured directly, rather than an implied connectivity that we have used to date.

5 BENEFIT-COST ANALYSIS

The CEDARS Cost Effectiveness Tool (CET) and other EE cost effectiveness tools do not apply to SmartShift, nor do DR cost effectiveness tests. Programs with daily shifting can generate savings during peak hours but may generate little to no aggregate energy savings over the year. For this reason, we have developed a framework to apply hourly impacts from SmartShift to values from the 2024 California Avoided Cost Calculator to test for cost effectiveness.

We calculate benefits based on the 2024 ACC, including values for either TRC and SCT benefits (with or without values for GHG emission reductions). Hourly ACC values are multiplied by the program's impact per customer and the total number of customers.[9] In the future, these will incorporate variations in impacts by customer type, device type, and other factors. As with the GHG emission impact estimates, we smooth the ACC values by taking average values across month, day type (weekday/weekend), and hour (720 unique values per year).

Costs were gathered from SCE and Energy Solutions and applied following the methodology used in the CET. We also consider both average and marginal costs for new participants, since initial program costs may be substantial, while ongoing expenses could decrease over time.

Early results indicate that cost effectiveness will be a challenge for SmartShift since so many of its costs are per device. These per-device costs will not scale with the number of enrolled devices and cannot be spread out over the entire program as a fixed cost would. Furthermore, while the program produces clear benefits, they are relatively small in magnitude due to the efficiency of the HPWHs as well as the presence of shifting for TOU rates due to JA-13 programming.

Table 4: Current Per-Device Program Costs for SmartShift Rewards Program

Cost	Enrollment Incentive	Monthly Incentives (summed to annual)	Other Per-Device Operation Fees
One time or recurring?	One time	Recurring	Recurring
Amount	$50	Equity: $120 per year Others: $60 per year	$30-35 per year

Table 4 above reports the main per-device program costs. Manufacturer API connections can be replaced by CTA-2045 connections, but the program estimates those to be $130 to $150 per device. Taken together, these per-device costs alone are greater than the avoided costs that the program is generating annually, before considering any administrative costs.

[9] 2024 Distributed Energy Resources Avoided Cost Calculator. California Public Utilities Commission October 2, 2024 Version 1b available at: https://www.ethree.com/public_proceedings/energy-efficiencycalculator