Opinion Dynamics

2022 FLEX ALERT MARKETING, EDUCATION AND OUTREACH EFFECTIVENESS STUDY

PERFORMANCE ANALYTICS ASSESSMENT

FINAL REPORT
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I. EXECUTIVE SUMMARY

This report presents results from the Performance Analytics component of the 2022 Flex Alert Marketing, Education & Outreach (ME&O) Effectiveness Study conducted by Opinion Dynamics to evaluate the performance of the expanded Flex Alert ME&O campaign in meeting its stated objectives and program performance metrics. The 2022 campaign expanded upon the 2021 campaign to include marketing of the new residential Emergency Load Reduction Program pilot (ELRP), which uses the customer-facing name of Power Saver Rewards (PSR). The campaign slogan, "The Power is Ours to prevent outages with Flex Alerts,"[1] highlights the campaign's focus on preventable power outages, compared to non-preventable outages such as a Public Safety Power Shut offs (PSPS). Further, the objectives of the 2022 campaign were to build awareness of Flex Alerts, build awareness of ELRP, and notify Californians when a Flex Alert event was happening.[2]

I.I METHODOLOGY

The evaluation team conducted customer research and load analysis to provide insights into customer behavior changes in response to the Flex Alert ME&O campaign.[3] The analysis combined customer usage data, load shapes,[4] and survey data to understand which customers reduced usage during Flex Alerts and why customers did or did not achieve load reductions. By linking customer usage and survey data, the evaluation team identified barriers to action that can be addressed through modifications to the marketing campaign, as well as customer targeting and messaging recommendations for reaching and motivating more customers during future campaigns. The findings from this analysis are based on the following research activities conducted following the 2022 campaign year:

- **Fielding of a post-event season survey to understand the drivers and barriers to action during Flex Alerts.** Over 2,700 customers speaking English or Spanish, including both the general population and those enrolled in PSR, responded to the survey, which achieved a 5.5% response rate.
- **Creation and segmentation of individual load shapes of survey respondents to identify customers with load to reduce during critical hours and to characterize those customers based on their load profiles and unique characteristics.** The analysis leveraged hourly AMI data that was processed to represent discretionary load, or load associated with active electricity consumption behaviors, and was normalized to represent the proportion of each customer's daily total discretionary usage that occurred within each hour. We used an algorithm to group (or "cluster") customers with similar energy consumption patterns on a typical summer weekday, with a focus on load available during the 4:00 p.m. to 9:00 p.m. resource adequacy (RA) window.
- **Analysis of customer usage data to segment customers based on the load reduction achieved in response to Flex Alerts.** We developed customer-specific load reduction estimates for Flex Alert events using IOU-specific baseline methodologies. Each customer's performance was evaluated for every Flex Alert event hour in the season and was measured based on the load reduction achieved relative to the customer's baseline load (i.e., percent load reduction). Customers were assigned to the low-, medium-, or high-performance grouping based on their average performance across all hours and events in the season.

[1] Energy Upgrade California. "Flex Alerts." Accessed May 22, 2022. https://energyupgradeca.org/flex-alert.

[2] Discouraging the use of back-up generators (BUGs) during Flex Alerts was also an original objective for the 2022 campaign but was discontinued by the CPUC in October 2022.

[3] The load analysis was conducted at the customer level using AMI data and included both an assessment of hourly energy usage patterns on summer non-event days and an analysis of performance compared to a customer-specific baseline during Flex Alert events.

[4] Load shapes depict customer energy consumption patterns over a 24-hour period based on hourly AMI data.

I.2 SUMMARY OF RESULTS

Table 1 summarizes key campaign challenges that Opinion Dynamics identified as part of this study and recommended strategies that can be tested to address these challenges. This table is referenced in the conclusions and recommendations that follow.

Table 1. Flex Alert Challenges and Campaign Strategies

Focus Area	Description of Challenge	Strategies to Test
1	**The heat is uncomfortable**	▪ **For customers with air conditioning:** Educate customers on pre-cooling as a two-step action and highlight that they can take one or both steps (e.g., pre-cooling, increasing the temperature during events) based on what works with their schedule. ▪ Educate customers on techniques for keeping their home cool while reducing reliance on air conditioning during the event (e.g., closing shades during the hottest part of the day, using fans, limiting activity). ▪ Encourage customers to leave the home when it is safe and viable. ▪ Offer energy-reducing actions that customers can take to contribute without affecting the temperature of the home.
2	**It is difficult to control the actions or use of other household members**	▪ Highlight how families and roommates can participate in Flex Alerts together. ▪ Conduct outreach with a variety of age groups (e.g., through schools, youth, or senior centers). ▪ Consider leveraging social media platforms popular with younger generations (e.g., Tik Tok).
3	**Health concerns in the household**	▪ Continue to prioritize safety. ▪ Highlight energy-reducing actions that do not affect the temperature of the home and encourage customers to take these actions if it is safe to do so.
4	**Has solar**	▪ Help customers understand how their solar generation period corresponds with the typical Flex Alert event period. ▪ Help NEM customers without a battery understand how they can contribute to the event by sending more excess solar generation back to the grid than on a typical day. ▪ Encourage customers to participate in the second half of the event once solar generation wanes. Consider framing NEM customers as "reinforcements" who can step in when other customers are becoming hot and tired. ▪ Consider also testing non-traditional messaging (5).
5	**Does not resonate with traditional campaign messaging (i.e., California identity, climate change, energy efficiency)**	▪ Consider messaging that focuses on the benefits of participation to the individual, the household, one's family and friends, or the local community ▪ **For PSR participants:** Emphasize how they can reduce their energy bills by participating in events. Consider providing feedback on event performance to help customers understand the impact of their actions early in the season.
6	**Perceived or actual limited opportunities to reduce or shift load given systems or already low usage**	▪ Highlight the ease of making small and temporary reductions to energy use available to all households, such as unplugging appliances and turning off lights. ▪ Encourage small but consistent actions to increase confidence and form habits. ▪ Encourage customers to take multiple actions on event days and provide examples of combinations of actions.
7	**Customer is already reducing their load during events but could do more**	▪ Suggest higher impact actions, such as turning up or shutting off the air conditioning during events, alongside educating customers on supportive actions, such as pre-cooling the home. ▪ Encourage customers to take multiple actions on event days and provide examples of combinations of actions.

Below, we provide additional commentary on the study conclusions and the strategies suggested in the table above.

- **Conclusion:** Awareness and understanding of Flex Alerts is high and is not a significant driver of event performance. While there are differences between higher and lower performers in terms of where they get information about Flex Alerts (e.g., social media, TV commercials, local news coverage), these differences likely reflect variation in information consumption preferences and are unlikely to drive performance. However, there are opportunities to improve customers' understanding of the appropriate timeframe for taking action, - both in general and for specific action types.
  - **Recommendation:** Continue to emphasize the typical event window (4:00 p.m.–9:00 p.m.) across all Flex Alert messaging, employing a wide variety of traditional and digital media channels to reach the most customers.
  - **Recommendation:** Help customers understand event-day behaviors that should occur outside event hours including pre-cooling the home before the event to increase comfort and shifting actions such as the use of major appliances and charging of electronic devices before or after event hours.
- **Conclusion:** Most survey respondents reported participating in Flex Alerts on the majority of event days, and this is supported by the performance data, suggesting that customers have the interest and ability to reduce their load in support of Flex Alerts. High performers more consistently reduce their electric load than do low and medium performers, demonstrating that consistent actions lead to higher performance.
  - **Recommendation:** Consider using A/B experiments to test messaging that focuses on taking actions consistently and building Flex Alert routines or habits. For example, provide sample routines that highlight habits such as pre-cooling the home before the event, enjoying a low-cook dinner and household game night during the event, and running the dishwasher after the event is complete. The campaign can also consider messaging and tips specific to a given type of event day, such as a weeknight event, holiday event, or event on a weekend evening. Weeknight event tips can focus on behaviors associated with typical weekday routines (e.g., cooking dinner, completing chores). In contrast, holiday and weekend messaging might include tips associated with staying cool outside the home (e.g., having a cookout, going to a pool or movie theater).
- **Conclusion:** Awareness of PSR bill credits is low. Over half of respondents did not recall whether they received a bill credit. Although high-performing customers were more likely to recall receiving a bill credit than other customers, among high performers half were still unsure whether or not they received a credit, suggesting that bill credits were not an effective tool for motivating most PSR-enrolled customers to reduce their energy usage during Flex Alerts in summer 2022.
  - **Recommendation:** Consider conducting outreach to increase awareness of PSR enrollment, the program structure, and the benefits of participation to motivate participation in Flex Alerts among this group.
- **Conclusion:** There is a lot of variation in the load customers have available to reduce during Flex Alerts. However, our analysis suggests that event performance is more strongly driven by motivation and interest in participation than by available load. Although some customers reported that their household's already-low energy use is a barrier to event participation, we find that, on average, low performers tend to be the highest energy users, even though they reduce their load the least during Flex Alerts.
  - **Recommendation:** Consider strategies to appeal to high-opportunity customers—those who currently achieve low to medium performance but have moderate to high load reduction potential. Consider strategies for customers who find the heat uncomfortable (1), have difficulty controlling the actions of other household members (2), face health concerns in the household (3), have solar (4), or do not resonate with traditional campaign messaging (5) (Table 1).
- **Conclusion:** Engaging low performers is critical given that their households use about 11% more energy during non-event day RA window hours than high performers. Due to their higher average energy consumption these customers have the potential to make meaningful contributions to Flex Alert campaign performance. While the typical low performer reduces their energy consumption for some events, their load reductions tend to be small.

- **Recommendation:** Focus on building an understanding of the importance and relevance of Flex Alerts using messaging that is engaging to those customers who find the heat uncomfortable (1), face health concerns in the household (3), do not resonate with traditional campaign messaging (5), or have perceived or actual limited ability to shift load (6) (Table 1). Help customers build interest and confidence in participating by taking small, achievable actions.
- **Recommendation:** Using these strategies, the IOUs may consider conducting targeted outreach with PSR-enrolled customers to improve their performance with a focus on older customers, those with health conditions, with natural gas service, or on a CARE rate.

- **Conclusion:** Medium performers are already consistently exhibiting their willingness and ability to reduce their load during Flex Alert events. Given their relatively high energy consumption, many medium performers could contribute more, and their increased contributions would be meaningful to the campaign given that most customers are in the medium performance group.
  - **Recommendation:** Promote self-enrollment in PSR, combined with incremental additional efforts compared to those taken during previous events, to incentivize and motivate customers to improve their performance. Consider strategies for customers with children in the home (2) or for increasing contributions (7) (Table 1).
- **Conclusion:** High performers tend to be very motivated, have many electric end uses despite living in smaller homes with lower consumption overall, and face few barriers to participation. Encouraging high performers to continue taking consistent and effective actions is critical to the campaign's continued success.
  - **Recommendation:** Continue marketing through channels that reach high performers, such as social media, and continue to emphasize the importance of doing one's part in the Flex Alert events for the state of California and to support energy efficiency and the climate. Suggest a wide range of end uses for load shedding and shifting, including strongly discouraging EV charging during events, running electric appliances before or after the event, and reducing cooling load.
  - **Recommendation:** Using these strategies, the IOUs may consider conducting targeted outreach with PSR-enrolled customers to maintain their performance with a focus on younger customers, those living in multifamily dwellings, customers on EV rates, and customers engaged with social media messaging from their utility, CCA, or other organizations that provide Flex Alert and PSR messaging throughout the state.

2. INTRODUCTION

In 2012, the CPUC established Energy Upgrade California (EUC) as the brand for Statewide Marketing, Education, and Outreach (SW ME&O) activities to increase ratepayer awareness of energy efficiency, demand response, and distributed generation and to offer ways for consumers to manage their energy use better. The marketing firm, DDB, designed and managed the EUC campaign from 2017 through 2021. Beginning in 2021, the CPUC shifted the focus of SW ME&O to a Flex Alert paid media campaign to encourage Californians to reduce their energy use when electricity demand is predicted to outstrip supply. With the release of CPUC Decision 21-12-015 in 2022,[5] the Flex Alert paid media campaign was also required to promote the new residential ERLP, which uses the customer-facing name of Power Saver Rewards (PSR).

2.1 OVERVIEW OF THE STATEWIDE MARKETING, EDUCATION, AND OUTREACH PROGRAM

PROGRAM DESCRIPTION

The objectives of the 2022 campaign were to build awareness of Flex Alerts, build awareness of ELRP, and notify Californians when a Flex Alert event is happening.[6] The campaign slogan, "The Power is Ours to prevent outages with Flex Alerts,"[7] highlights the campaign's focus on preventable power outages, compared to non-preventable outages such as a Public Safety Power Shutoff (PSPS).

Key campaign stakeholders for the 2022 campaign included the CPUC, California Independent Service Operator (CAISO), and the three electric IOUs: Southern California Edison (SCE), Pacific Gas and Electric (PG&E), and San Diego Gas and Electric (SDG&E). Furthermore, DDB was a key stakeholder serving as the campaign implementer. DDB's team included the public affairs firm, DDC, and the media communication agency, Optimum Media Direction (OMD). DDC engaged CBOs as campaign partners with the goal of reaching core customer groups who are typically harder to reach, including low-income, rural and agricultural, multicultural, and senior residents, as well as residents living with disabilities. DDC also distributed media assets designed by DDB for the general public and IOU customers to CBOs to share with their networks. OMD, which shares the same parent company as DDB, was responsible for executing the digital media assets.

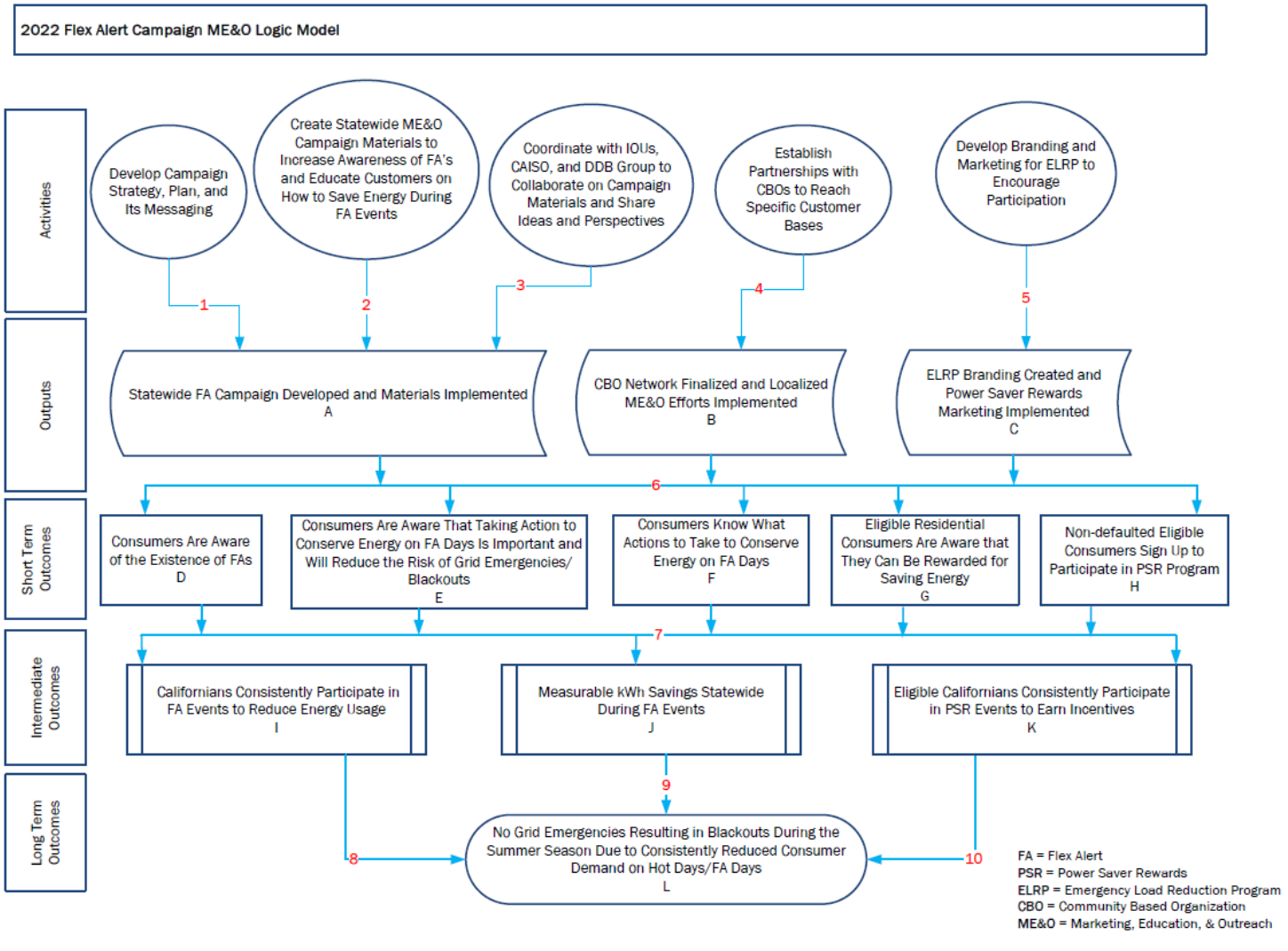
Due to privacy restrictions around customer data, stakeholders decided that DDB would be responsible for statewide Flex Alert marketing efforts. At the same time, the IOUs would develop and implement their own direct-to-consumer PSR strategies. This split the larger campaign into two components: statewide Flex Alert marketing and PSR marketing. DDB, in coordination with DDC and IOUs, developed some PSR materials for CBO and IOU distribution, respectively. Figure 1 provides a visual depiction of the program's theory of change in achieving desired outcomes.

[5] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M428/K821/428821475.PDF

[6] Discouraging the use of back-up generators (BUGs) during Flex Alerts was also an original objective for the 2022 campaign but was discontinued by the CPUC in October 2022.

[7] Energy Upgrade California. “Flex Alerts.” Accessed May 22, 2022. https://energyupgradeca.org/flex-alert.

Figure 1. 2022 Flex Alert Campaign Program Theory Logic Model



DDB utilized multiple marketing channels throughout the campaign, including:

- Television and radio ads focused on the general and Hispanic markets
- Outdoor digital and print placements
- Newspapers
- Paid search on Google and social media (Facebook, Instagram, and Twitter)[8]
- Multiple digital channels, including displays, videos, streaming audio
- SMS texts to Californians across the state, using available records
- Various partnerships (Nextdoor® and CBOs)

[8] All product or company names that may be mentioned in this publication are tradenames, trademarks, or registered trademarks of their respective owners.

Campaign assets were designed for the general market in English and the multicultural market in Spanish, Chinese, Vietnamese, and Korean. Figure 2 includes examples of key campaign assets used to promote awareness of Flex Alerts and PSR and to notify Californians when an event is called.

Figure 2. 2022 Campaign Assets

Throughout the 2022 campaign period, 11 statewide Flex Alerts were called, with 10 occurring back-to-back. On one of the event days, CAISO also issued an Energy Emergency Alert 3 (EEA 3), the highest alert level, which signals that the grid operator is "unable to meet minimum reliability reserve requirements" and notifies utilities to prepare for outages. Californians reduced their demand following the EEA 3, and the grid operator did not order utilities to institute rotating power outages.[9]

CAMPAIGN METRICS

Table 2 outlines the approved core metrics and associated measurement approaches for assessing the effectiveness of the campaign.

[9] See http://www.caiso.com/Documents/Grid-Emergencies-History-Report-1998-Present.pdf and http://www.caiso.com/Documents/Emergency-Notifications-Fact-Sheet.pdf for further information.

Table 2. Flex Alert and PSR Metrics

Metric	Measurement Approach
FAMILIARITY Objective: Increase Flex Alert and PSR recognition through awareness and familiarity	
Unaided Awareness	% of Californians who are aware of Flex Alerts Unaided % of Californians who are aware of PSR Unaided
Aided Awareness	% of Californians who are aware of Flex Alerts Aided (% of Californians who have heard of the Flex Alert name) % of Californians who are aware of PSR Aided (% of Californians who have heard of the PSR name)
	% of Californians who are aware that a Flex Alert has been called after alert
	% of Californians who are aware of the actions they can take to save energy during Flex Alerts
Flex Alert/Power Saver Familiarity	% of Californians who correctly associate Flex Alerts with goal (unaided and aided) % of Californians who are aware of PSR with goal (unaided and aided)
UNDERSTANDING Objective: Increase understanding of the reason behind the need to take action during Flex Alerts	
Understanding of the Connections Between Grid Conditions and Flex Alerts	% of Californians who correctly answer a series of True/False statements that make connections between heatwaves, electricity supply, and power outages % of Californians who are able to pick out the correct definition of a Flex Alert % of Californians who are able to select the correct definition of PSR
BACK-UP GENERATORS (BUGs) [a] Objective: Discourage the use of BUGs	
Likelihood to Use BUGs	% of Californians who currently own a BUG % of Californians who do not own a BUG but are considering purchasing one in the near future
INTENT TO ACT AND BEHAVIOR CHANGE Objective: Increase intent to sign up for PSR (when not already enrolled) and to take action during a Flex Alert	
Likelihood to Take Action During a Flex Alert	% of Californians who are extremely likely to temporarily reduce their electricity use during times of high demand (the Flex Alert)
	% of Californians who would be likely to take the specified Flex Alert actions featured in the campaign (we would assess this for respondents that are signed up for Flex Alert and respondents overall)
Likelihood to Sign Up	% of Californians who have signed up/intend to sign up for the PSR program with their IOU
Action	% of Californians who took one or more of the specified Flex Alert actions featured in the campaign

[a] Discouraging the use of backup generators (BUGs) during Flex Alerts was also an original objective for the 2022 campaign but was discontinued by the CPUC in October 2022.

2.2 EVALUATION OBJECTIVES

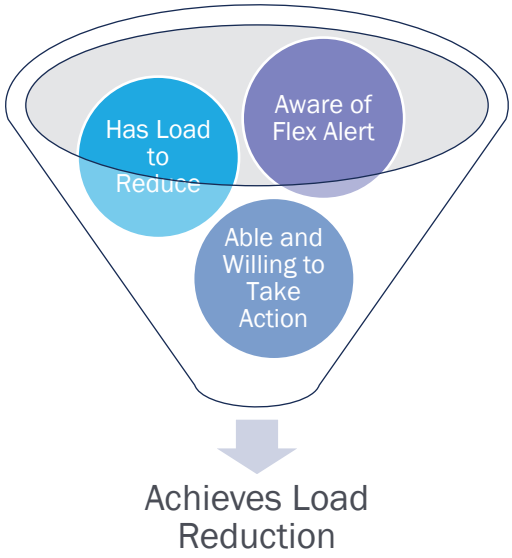
This report covers Performance Analytics, a subtask of the 2022 ME&O evaluation with the objective of explaining the "why" behind event performance. We explore customer responses to the Flex Alert ME&O campaign and identify behavioral triggers and barriers to action that can inform customer targeting and messaging moving forward. Findings around the effectiveness of the Flex Alert ME&O campaign against key metrics, the stakeholder engagement process, and the contributions and effectiveness of CBOs supporting the campaign were summarized in previous deliverables.[10]

[10] Opinion Dynamics. *2022 Flex Alert Marketing Education, and Outreach Effectiveness Study.* Internal document, public draft currently under review with the CPUC.

3. EVALUATION METHODOLOGY

While analysis of customer usage data during Flex Alerts is the most accurate measure of customer behavior change, it only tells us how many customers reduced their usage; it does not tell us why or why not. To address this, the evaluation team combined results from a post-event season survey, a customer load shape clustering analysis, and a customer performance analysis to assess customer responsiveness to Flex Alert ME&O campaign events. By bringing all this information together for a sample of customers, the evaluation team explored a wide variety of contributing factors when it comes to a customer's engagement with and performance in relation to the Flex Alert ME&O campaign (Figure 3).

Figure 3. Flex Alert Customer Engagement Contributors and Outcome



The evaluation team conducted a performance assessment for the same customers who also completed the post-season survey to identify the customer characteristics and actions associated with load reduction.[11] In addition, the evaluation team analyzed those customers' everyday load patterns to understand their potential to reduce load during events. We also identified the barriers to action for customers who did not reduce load. The results contextualize why some customers changed their behavior and others did not during Flex Alerts. Our analysis included customers enrolled in PSR to allow the evaluation team to assess the potential differential effects of marketing received by each group and differences in their underlying customer and household characteristics.

3.1 POST-EVENT SEASON SURVEY

The evaluation team fielded a survey with residential customers following the 2022 event season to gather retrospective information on the season. The survey covered some of the same topics included in the monthly Flex Alert tracking surveys, such as customer awareness and understanding of Flex Alerts, and more deeply explored actions taken during Flex Alerts and reasons for not taking action. The survey was fielded with a general population sample of customers who could be exposed to Flex Alert messaging and customers enrolled in PSR. We explored the following research questions:

[11] Though we estimated the amount of load reduction during Flex Alerts for a sample of customers, this study is not an impact evaluation of Flex Alerts. Rather, this analysis seeks to understand the customer characteristics, drivers, and barriers associated with Flex Alert behavior change.

- Are customers aware of Flex Alerts?
- Do customers recall Flex Alert marketing messages?
- What actions do customers report taking during Flex Alerts?
- What are the barriers to customers taking action?
- What motivates customers to take action?

The survey responses were tied to actual customer-level event performance and customer load shapes. Table 3 contains a summary of the survey fielding approach and outcomes.

Table 3. Flex Alert Post-Event Season Survey Fielding Summary

Metric	Result
Target Population	▪ Flex Alert: Californians who could be exposed to Flex Alert messaging in summer 2022, excluding customers enrolled in demand response programs ▪ PSR: Customers enrolled in PSR as of summer 2022
Sampling and Stratification	Stratified random sample by IOU and general population/PSR enrollment
Available Languages	English and Spanish
Fielding firm	Opinion Dynamics
Fielding dates	March 4 – March 27, 2023
Number of completed surveys	2,744
Response rate	5.5%
Average survey length	18 minutes
Survey outreach mode	E-mail
Survey mode	Online
Respondent incentive	$10 e-gift card

The survey instrument is provided in Appendix A.

3.2 CUSTOMER LOAD SHAPE CLUSTERING

We constructed household load shapes for all surveyed customers to understand load reduction potential during Flex Alerts better. Given that not all customers have load to reduce during the resource adequacy (RA) window, gaining insight into the characteristics of customers and the barriers to action among customers who do have load to reduce will help improve the campaign moving forward. To complete this exercise, we developed average summer weekday load shapes for each survey respondent using data from 2022 non-event days. We used an algorithm to group (or "cluster") customers with similar energy consumption patterns on a typical summer weekday. The evaluation team conducted this analysis on data first pre-processed to represent discretionary load, or load associated with active electricity consumption behaviors. Discretionary load is calculated by subtracting the daily minimum hourly usage (kW) from each hourly usage value for each customer to estimate the load available for shifting.[12] We also normalized the discretionary load so that each hour's load value represents the proportion of the day's total discretionary usage within that hour. By clustering on relative as opposed to absolute usage values, we could better isolate customers with a high

[12] Jin, Ling, Anna Spurlock, Sam Borgeson, Daniel Fredman, Liesel Hans, Siddarth Patel, and Annika Todd. "Load shape clustering using residential smart meter data: a technical memorandum." *Lawrence Berkeley National Laboratory* (2016).

proportion of their load occurring during the RA window. Finally, we categorized the resulting clusters based on the amount of load available for shifting or shedding during the 4:00 p.m. to 9:00 p.m. RA window.

More details on the clustering analysis methods are provided in Appendix B.

3.3 CUSTOMER PERFORMANCE ASSESSMENT

Using AMI data for each survey respondent, we developed customer-specific load reduction estimates to identify customers who reduced their usage during Flex Alerts. Each IOU provided documentation of the methodology they used to calculate performance in Flex Alerts for those customers enrolled in PSR. The evaluation team used these IOU-specific baseline methodologies to calculate customer-specific load reduction estimates for all customers in the corresponding IOU.[13] Unlike the clustering analysis, load reduction estimates were calculated based on total load, not just discretionary load. We aggregated the hourly load reduction estimates for each customer to arrive at an average per-event load reduction for each customer. Customers who increased their load during any event hour had their load impact for that hour set at 0%. Finally, we analyzed each customer's performance across all event days to understand their average load reduction for the season. We assigned each customer to a low-, medium-, or high-performance grouping based on their seasonal average load reduction.

Due to the variation in load reduction potential across customers and the goal of understanding marketing effectiveness across various customer groups, we elected to measure performance based on the amount of load reduction achieved relative to the customer's baseline load (i.e., percent load reduction). This methodology allowed us to assess the effectiveness of the messaging equitably across customers, whether the amount of load available for them to shed or shift was relatively large or small. In our analysis, a customer with higher typical energy consumption (e.g., a large home with many electric end uses) would need to shift a **larger** total amount of load (kW) to achieve the same percent load reduction and be classified as a high performer than would a customer with lower typical energy consumption.

We combined the customer-level performance results with IOU customer data and survey responses to understand:

- The demographic and household characteristics of low, medium, and high performers
- Drivers of event performance including:
  - Awareness and understanding of Flex Alerts and PSR events
  - Actions taken during events
  - Reasons for taking or not taking actions

More details on the performance analysis methods are provided in Appendix C.

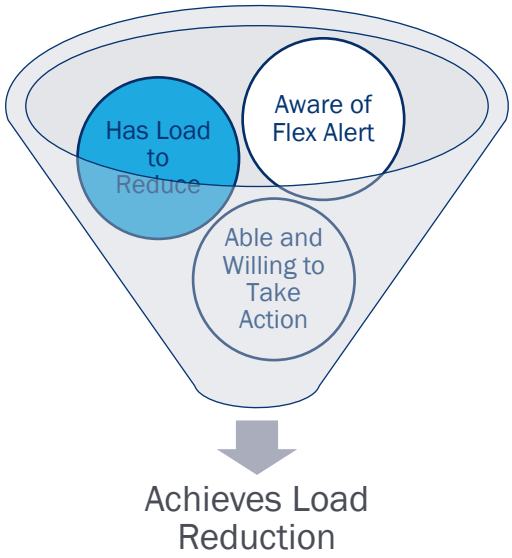
[13] Given the difference in methodology between IOUs, we do not recommend using these results to make comparisons between the performance of customers served by each IOU.

4. FINDINGS

4.1 POTENTIAL TO REDUCE LOAD DURING FLEX ALERTS

This section focuses on how much load customers have available to reduce or shift during Flex Alerts, which is a key component of customer engagement with Flex Alerts (Figure 4).

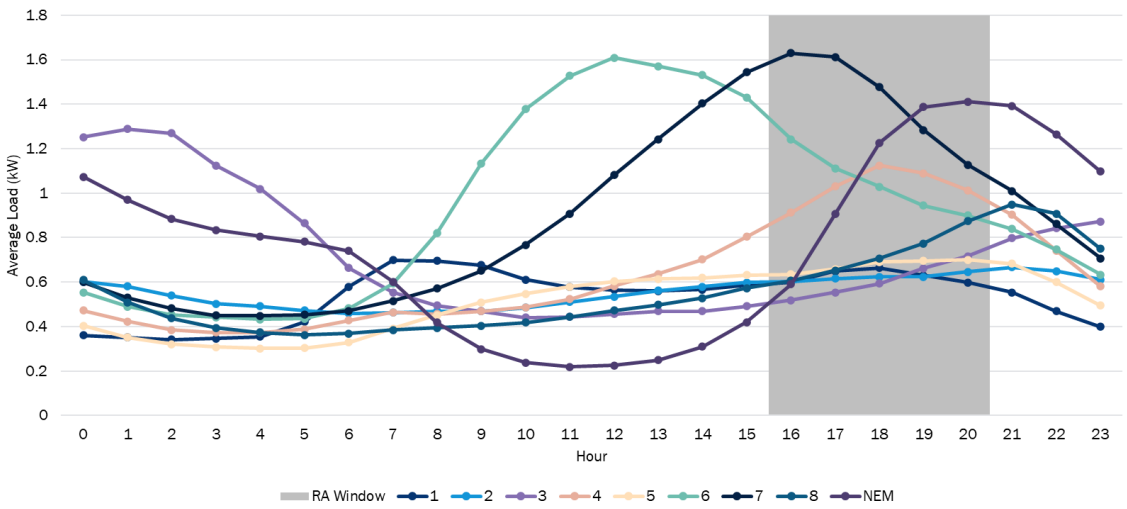
Figure 4. Flex Alert Customer Engagement Contributors – Has Load to Reduce



Our clustering analysis found that customers have a wide range of energy consumption patterns with varying load throughout the day as well as during the RA window when Flex Alerts occur. Figure 5 illustrates the average non-event weekday load shape for each of the nine clusters identified through this analysis.[14]

[14] We elected to assign all customers with net energy metering (NEM) status to their own cluster, rather than allowing the clustering algorithm to assign them, due to their highly distinct and variable load patterns as compared to non-NEM customers. This is discussed further in Appendix B.

Figure 5. Average Weekday Load Profile for All Clusters



Note: Although the clustering analysis was conducted using discretionary load, the values depicted are based on average total load.

Each cluster was categorized as having low to high potential to reduce load during the RA window based on the average hourly load between 4:00 p.m. and 9:00 p.m., which ranges from 0.63 kW for Cluster 3 to 1.48 kW for Cluster 7. We also explored the percentage of the customer's daily load occurring during the RA window as opposed to other parts of the day, which ranges from 18% for Cluster 3 to 32% for Cluster 4 and Cluster 7. This metric represents the potential load available for shifting from the RA window to another time in the day. Both metrics are summarized in Table 4.

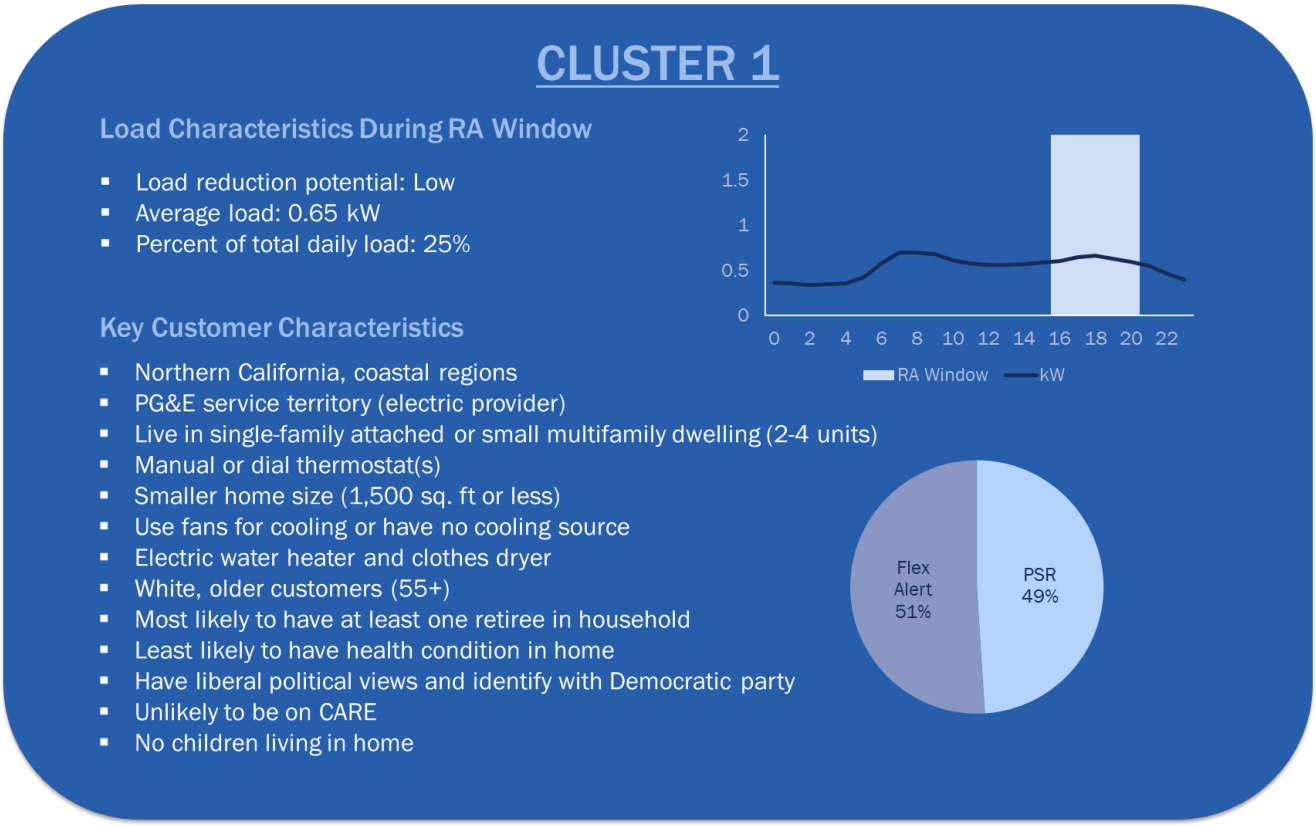
Table 4. Cluster Load Metrics

Cluster	Load Reduction Potential	Average Load During RA Window (kW)	Average Proportion Load in RA Window (%)
1	Low	0.65	25%
2	Low	0.64	23%
3	Low	0.63	18%
4	High-Moderate	1.07	32%
5	Low-Moderate	0.70	26%
6	High-Moderate	1.09	23%
7	High	1.48	32%
8	Low-Moderate	0.75	26%
NEM	High	1.17	30%
All Clusters		**0.96**	**28%**

Note: Although the clustering analysis was conducted using discretionary load, the values depicted are based on average total load.

Next, we examined the housing, demographic, and attitudinal characteristics of the customers in each cluster to provide additional context for why certain clusters have higher or lower load reduction potential during Flex Alerts and insights into the enabling factors and barriers each cluster may experience when participating. While each cluster is made up of a variety of customers, with their unifying factor being the similarity of their energy consumption patterns and resulting load profile, we sought to identify the characteristics that are unique to the customers in each cluster or that make the cluster stand out from the others (i.e., characteristics these customers are more or less likely to display compared to the customers in other clusters). Figure 6 through Figure 14 illustrate the key characteristics of each cluster. Appendix B. contains more details on the housing and demographic characteristics that vary between clusters.

Figure 6. Cluster 1 Profile



Note: Pie chart represents percentage of customers in each cluster enrolled in PSR ("PSR") or not ("Flex Alert").

Figure 7. Cluster 2 Profile

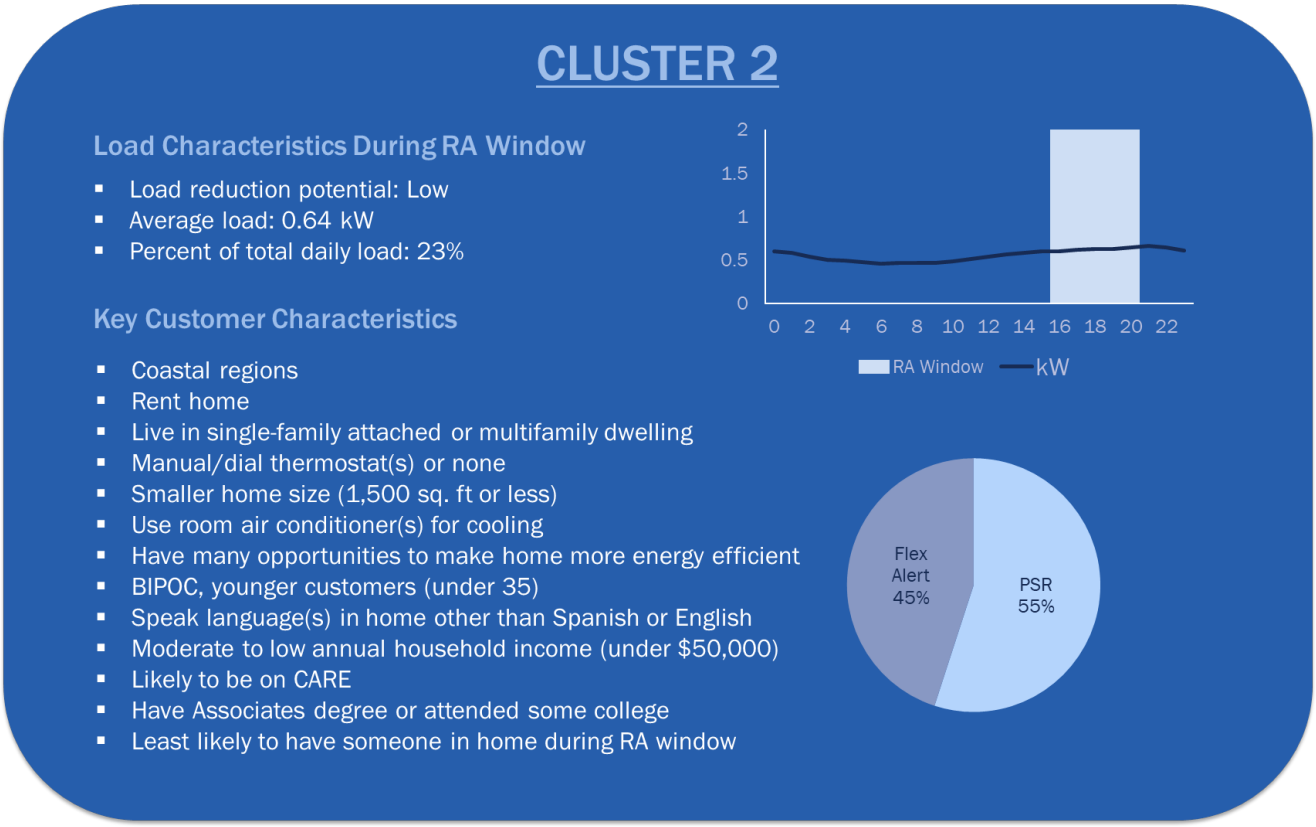


Figure 8. Cluster 3 Profile

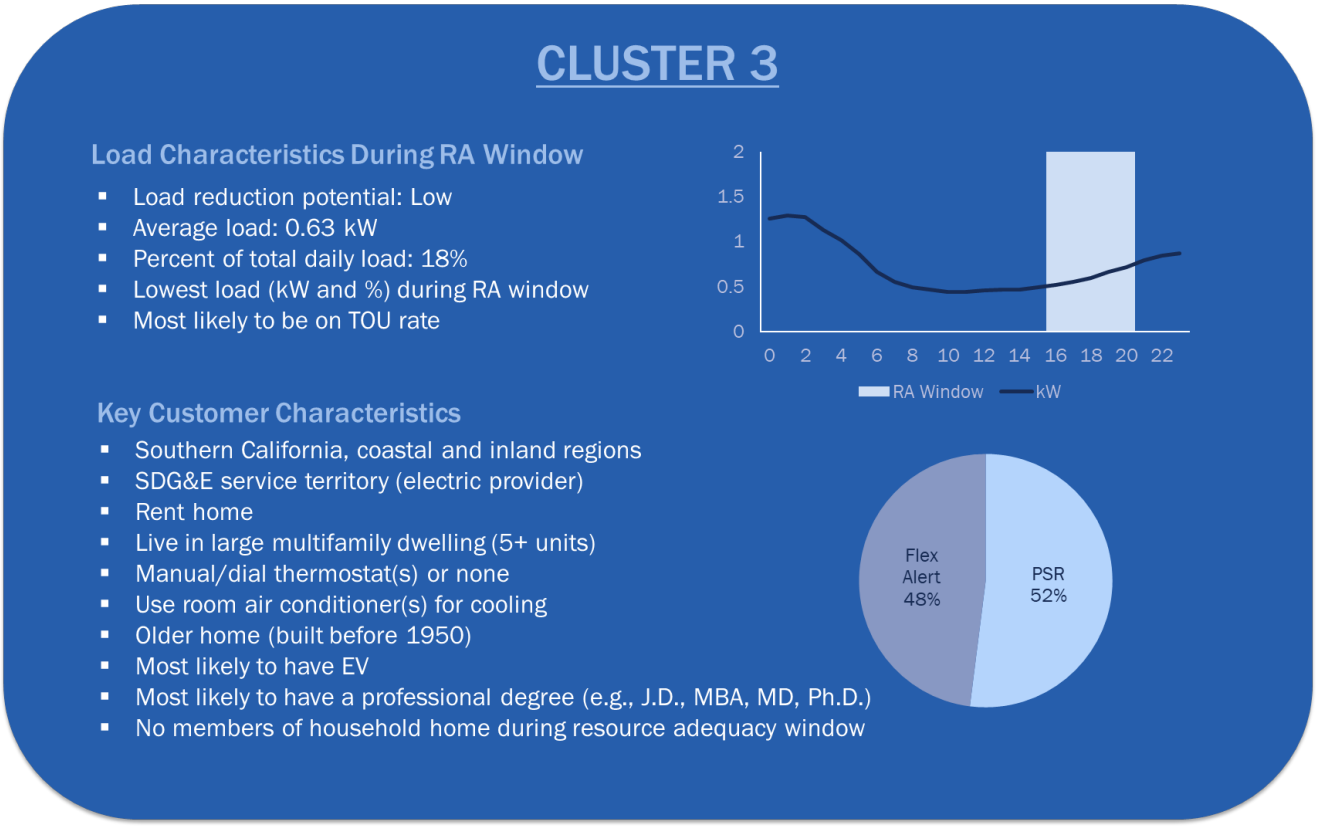


Figure 9. Cluster 4 Profile

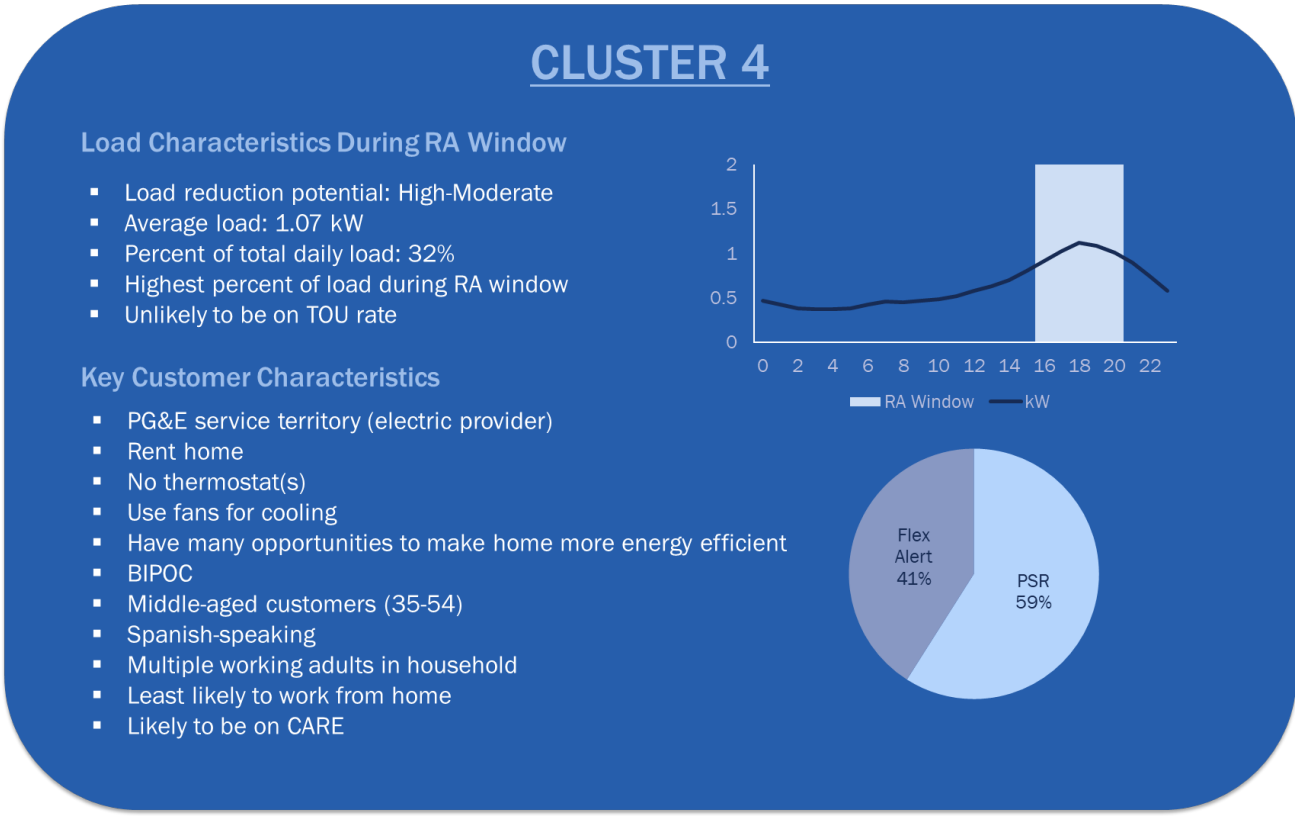


Figure 10. Cluster 5 Profile

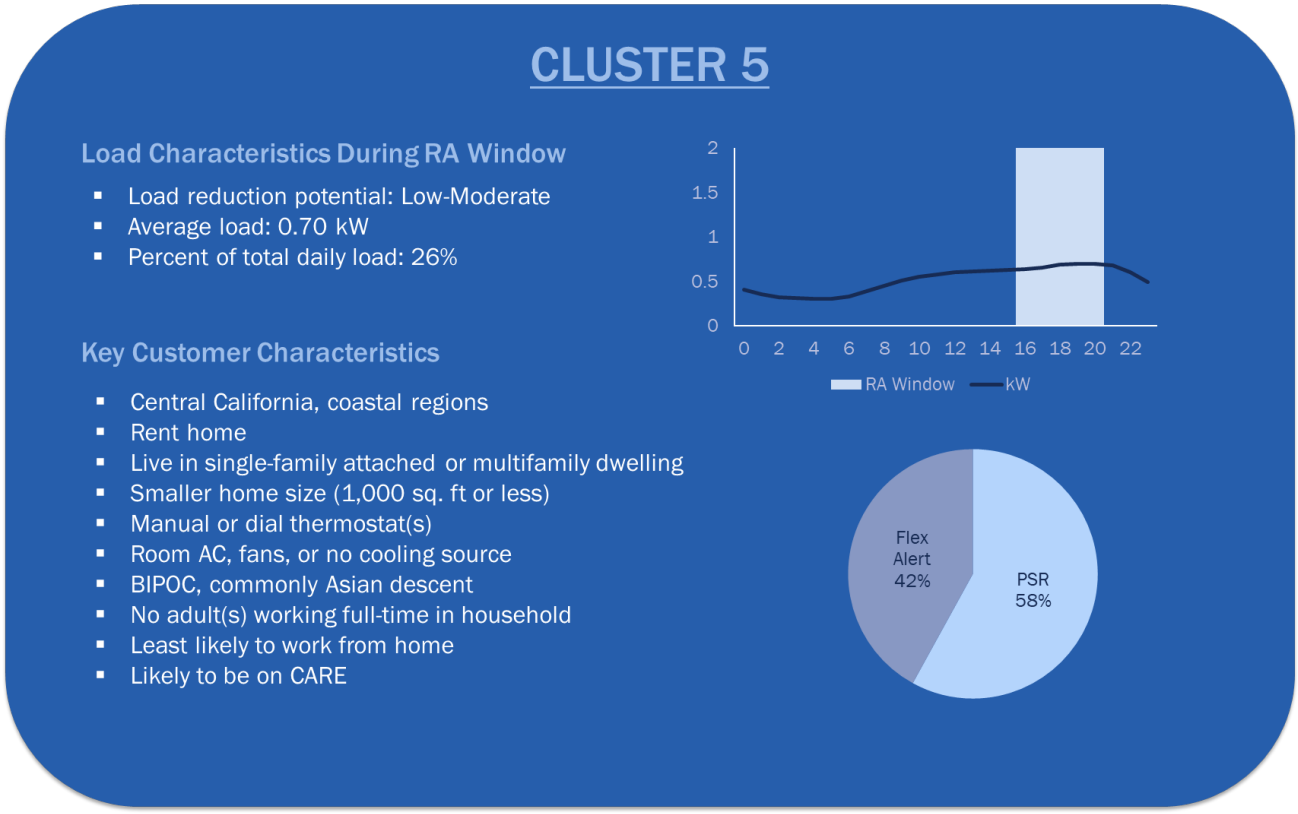


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Figure 11. Cluster 6 Profile

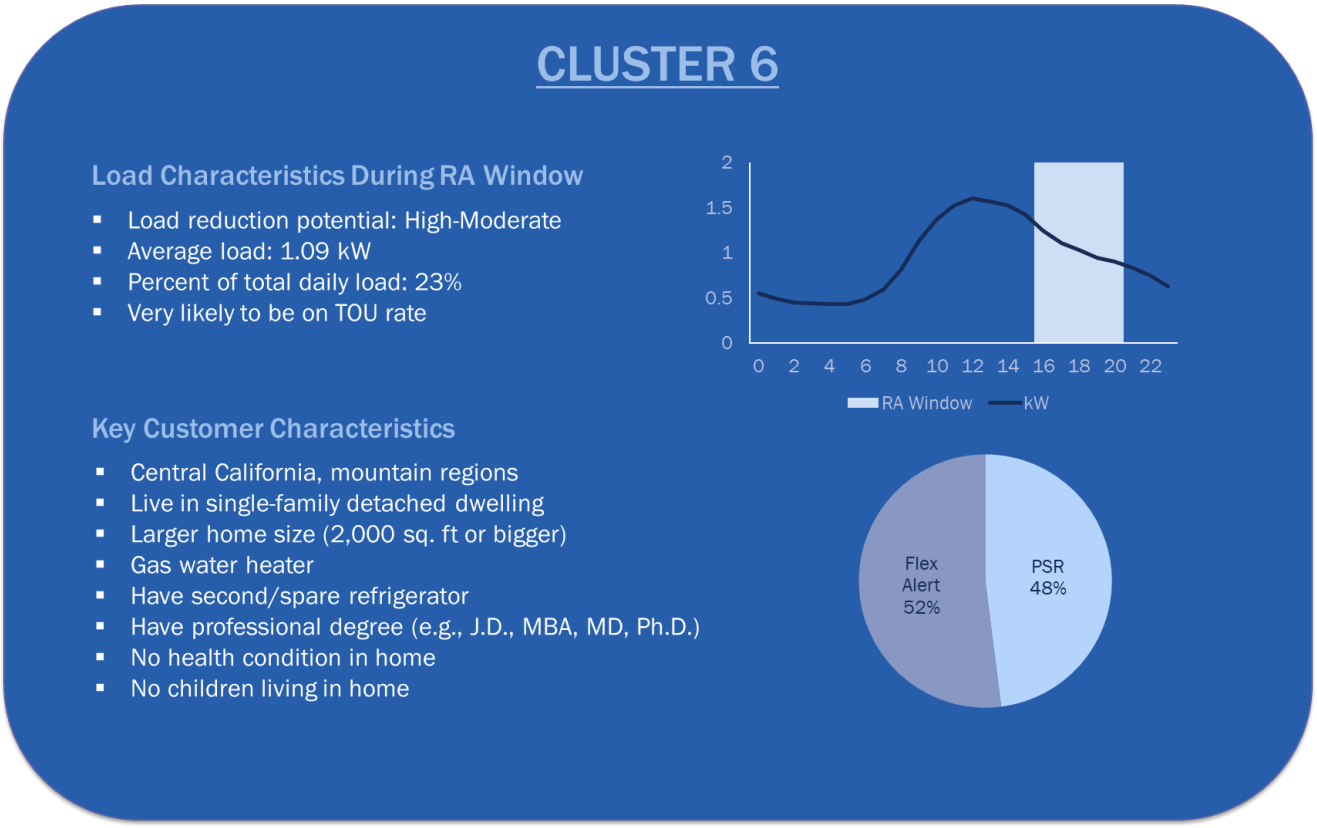


Figure 12. Cluster 7 Profile

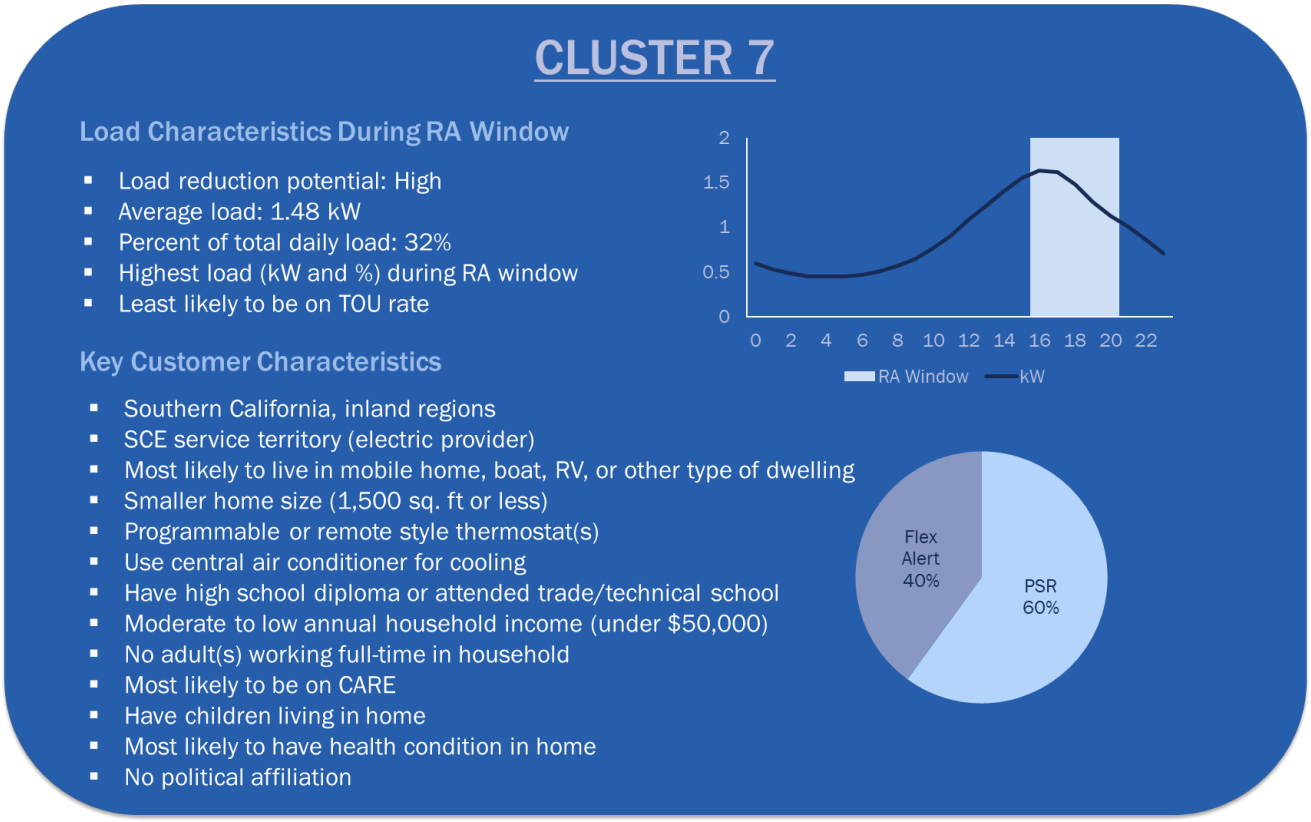


Figure 13. Cluster 8 Profile

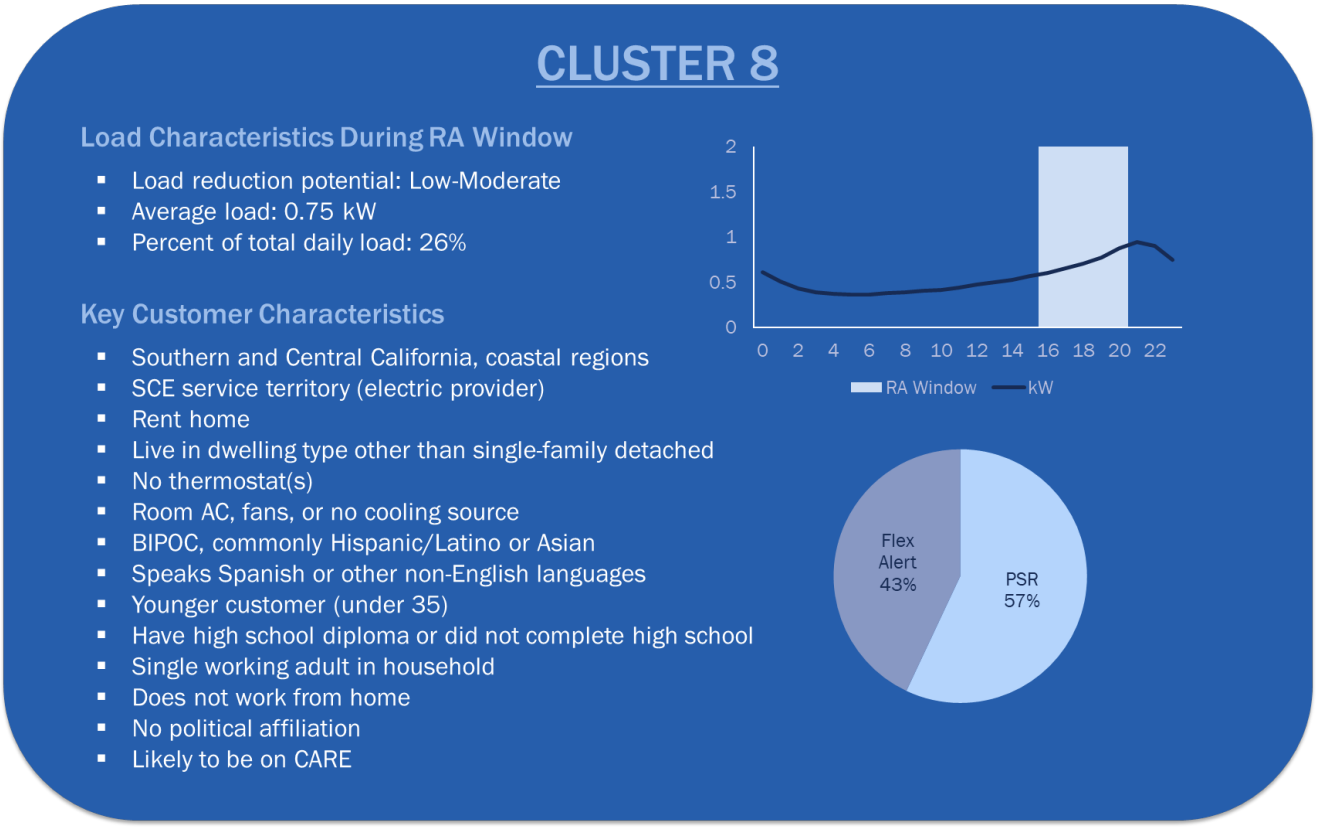
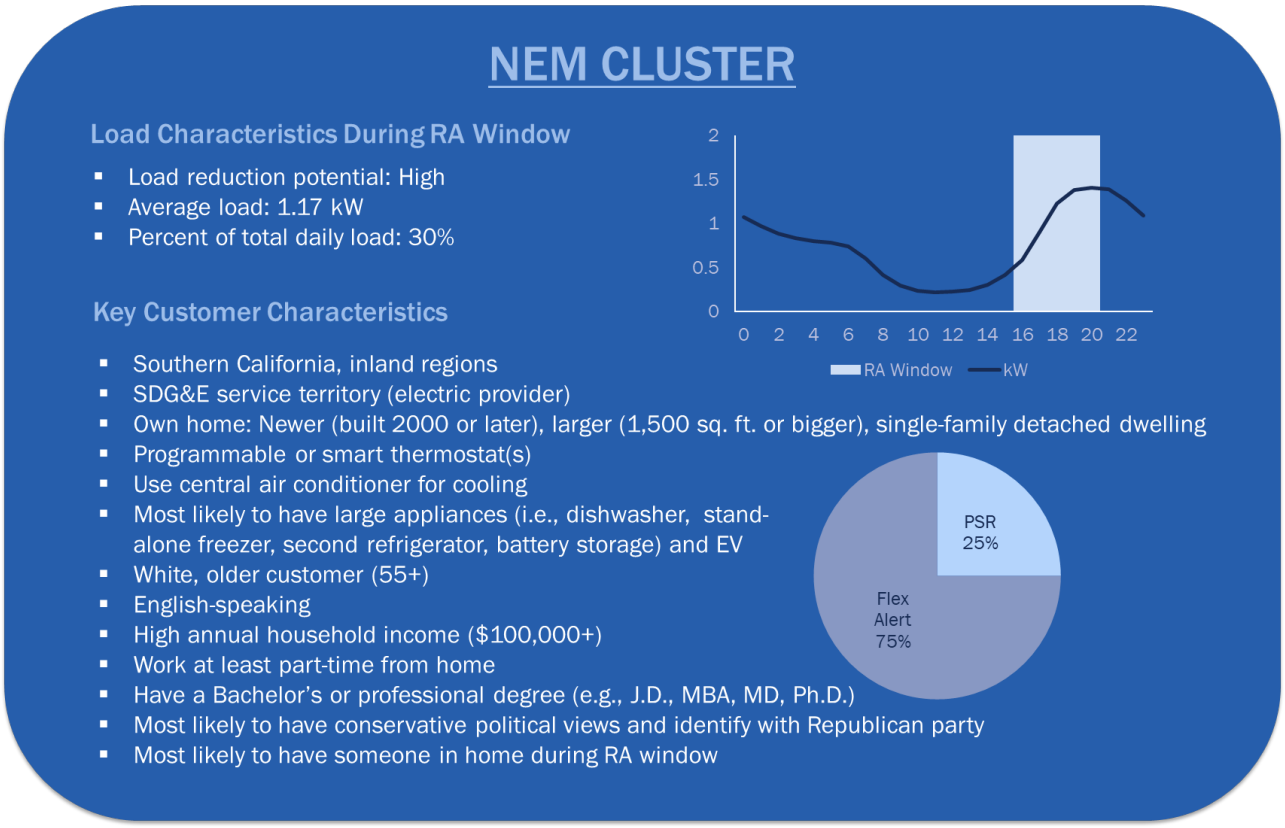


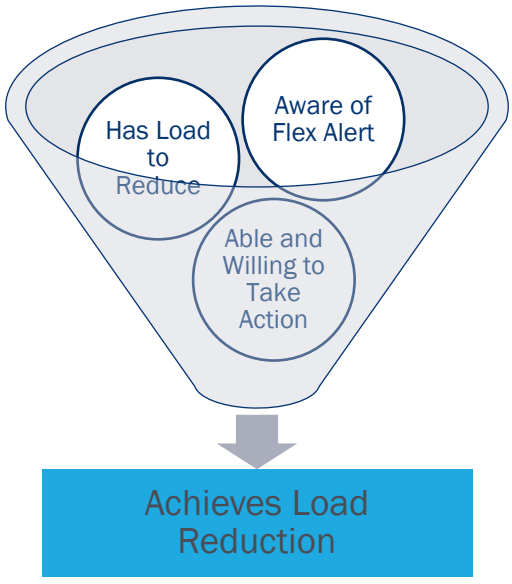
Figure 14. NEM Cluster Profile



4.2 PERFORMANCE DURING FLEX ALERTS

This section focuses on customer performance during Flex Alerts (Figure 15). Following the discussion of performance, we will discuss drivers of performance, including awareness, types of actions taken, motivators, and barriers.

Figure 15. Flex Alert Customer Engagement Outcome – Achieves Load Reduction



Leveraging the IOU-provided baseline methodologies, the evaluation team estimated an average per-participant, per-event load reduction during Flex Alerts of 20% of baseline load, representing an average of 0.33 kW. Based on their average percentage of load reductions across all events in the season, each customer was classified as a low, medium, or high performer. Performance groupings were defined based on standard deviations from the mean percent load reduction, where the medium-performance group is anyone who performed within one standard deviation above or below the mean percent performance value for the season. The resulting thresholds for each level are defined in Table 5.

Table 5. Performance Classification Thresholds

Category	Load Reduction Relative to Baseline (%)		
	Minimum	Mean	Maximum
Low	0%	4.53%	6.96%
Medium	6.97%	17.60%	32.78%
High	32.81%	43.44%	90.63%
All	**0%**	**19.87%**	**90.63%**

Low performers had an average load reduction of 5% (0.08 kW), whereas high performers reduced their load by 43% (0.60 kW) on average (Table 6).[15]

Table 6. Average Load Reductions

Performance Level	Average Load Reduction (%)	Average Load Reduction (kW)
High	43%	0.60
Medium	18%	0.32
Low	5%	0.08
Total	**20%**	**0.33**

Note: Average load reduction (kW) values are provided as a reference point. However, there is significant variation within each group since performance classifications were made based on percentage load reduction.

The distribution of load reductions overall and by performance level is presented in Figure 16. Because of the way that performance was classified, most respondents (73%) were in the medium-performance category, with fewer in the low- (12%) and high-performance (15%) categories. The high-performance category has a long tail, suggesting that a small number of customers take extreme measures to reduce their usage drastically during the event.

[15] Performance values and the associated metrics do not reflect load increases (negative performance). These values have been zeroed for the purposes of this analysis.

Figure 16. Performance Distribution

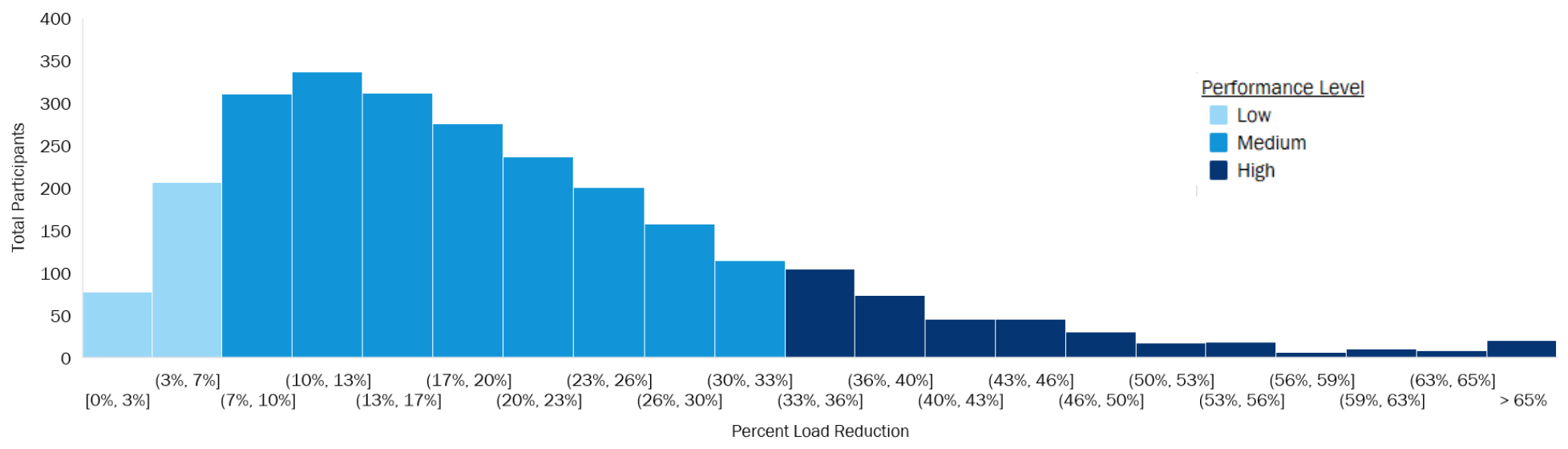
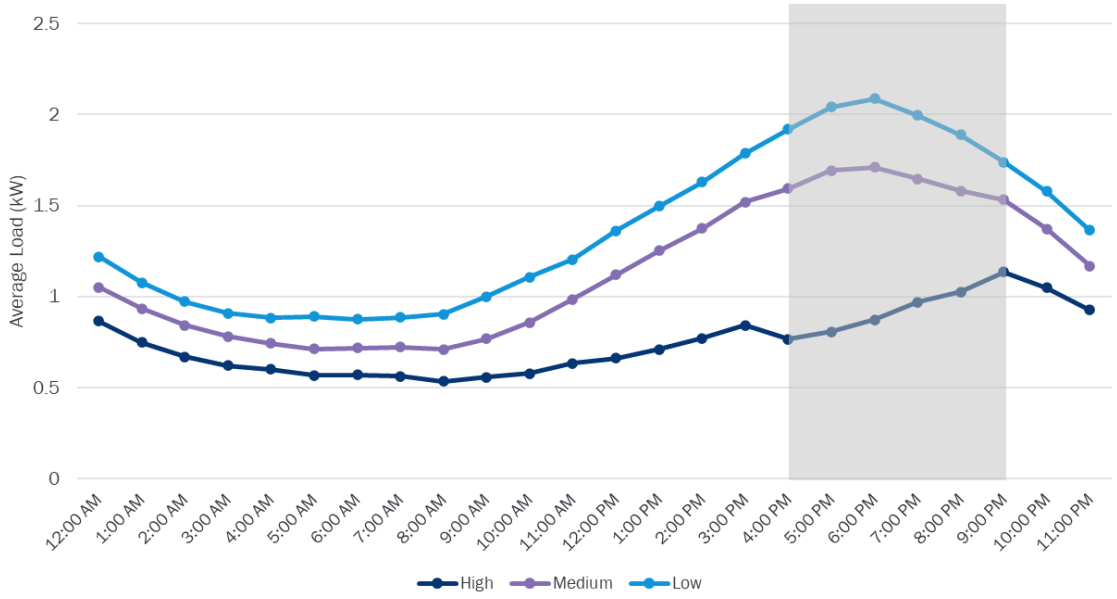


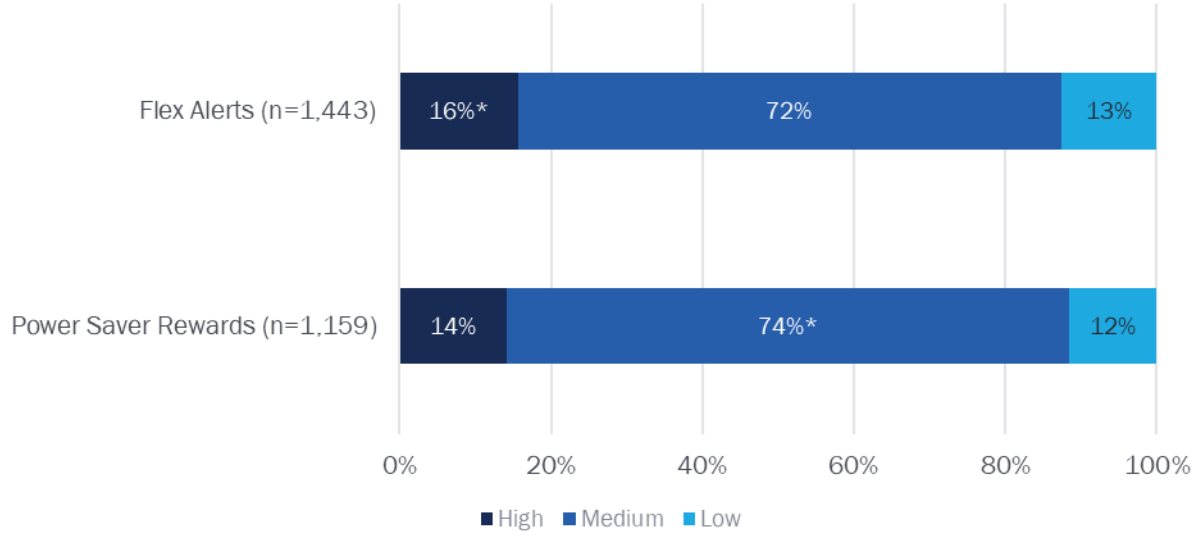
Figure 17 shows the average event day load shapes for each performance level. High performers achieved the highest percentage and actual load reductions even though, on average, their consumption was lower than the other groups throughout the event day. Despite their relatively smaller load profile, high performers demonstrated a clear reduction in load during Flex Alerts. Medium performers exhibited moderate consumption throughout the event day and had a smaller, but still visible, response to events. Low performers had the highest consumption throughout the day, especially during events where their response to Flex Alerts was nearly imperceptible. The trend of higher energy consumption among low performers and lower energy consumption among high performers was not limited to event days. On average, low performers had 11% higher load during RA window hours on summer non-event days than high performers (0.99 kW versus 0.90 kW).

Figure 17. Event Day Load Shapes by Performance Level



When we consider load reduction as a percentage of baseline load, performance was similar between Flex Alert and PSR customers, with Flex Alert customers performing slightly better. On average, PSR customers reduced their load by 19% and Flex Alert customers by 20% during events. The distribution of Flex Alert and PSR customers in the high-, medium-, and low-performance groups was similar. However, Flex Alert customers were slightly more likely to be in the high-performance group. In contrast, PSR customers were slightly more likely to be in the medium-performance group (Figure 18). The actual load reductions were also slightly higher for Flex Alert than PSR customers (on average 0.35 kW vs. 0.31 kW, respectively). This suggests that the average Flex Alert customer is slightly more responsive to events than the average PSR customer.

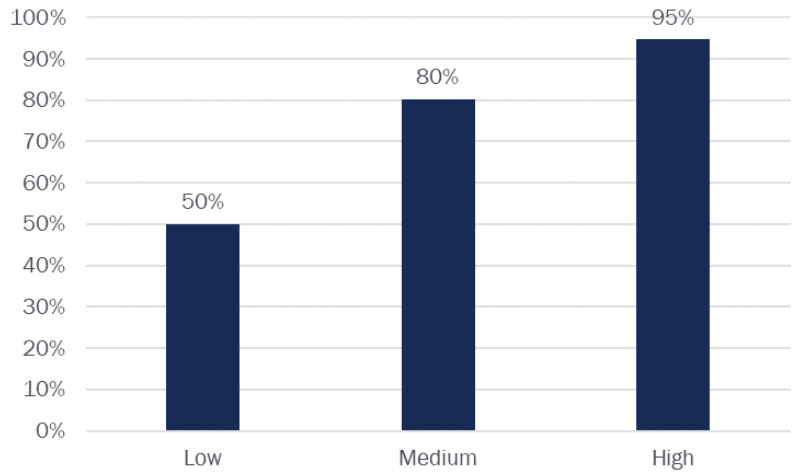
Figure 18. Distribution of Flex Alert and PSR Customers by Performance Group



*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).

Across performance groupings, our analysis demonstrates that customers are able and willing to participate in events, even if they reduced their load less than they could or only took action for some Flex Alerts. Survey respondents commonly self-reported participating in all eleven (29%) or eight to ten (24%) events in summer 2022. Twenty-eight percent of respondents either self-reported participating in no events or said they were unaware of the events altogether. The performance analysis results with AMI data suggest slightly more consistent participation than the self-reported data, with the average customer reducing their load in 79% of the events and only 9% of customers reducing their load in less than half of the events.[16] Virtually all customers in our sample reduced their energy usage in at least one event, based on the performance assessment. High performers were more consistent at reducing their load than low performers, suggesting that encouraging consistent participation is one way to increase performance (Figure 19).

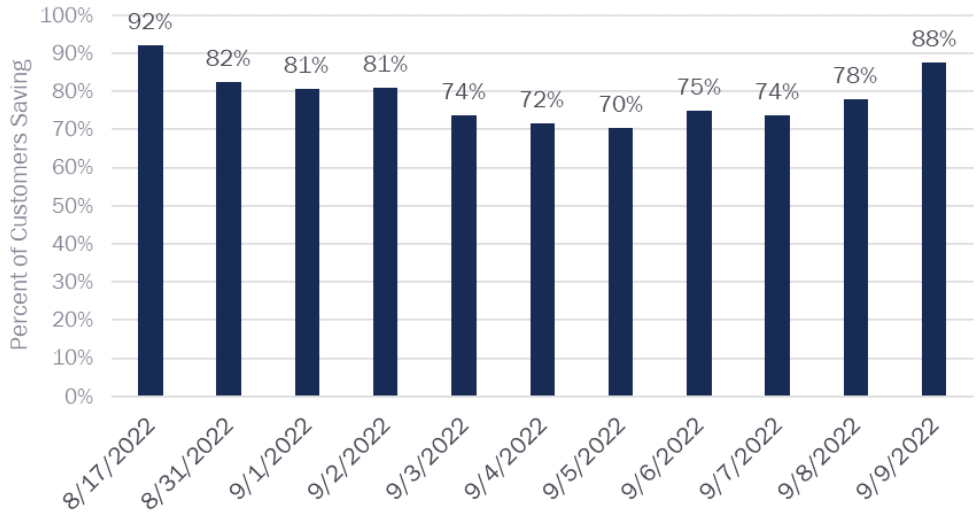
Figure 19. Percent of Events with Load Reductions by Performance Level



[16] While it is surprising that actual performance would exceed self-reported performance, this may be the result of some portion of customers making small, unintentional reductions to their load during events. Alternatively, customers may have no longer recalled their actions when completing the survey.

The summer 2022 event season was unique because Flex Alerts were called on 11 consecutive days.[17] One hypothesis is that customers may have experienced fatigue and become unable or unwilling to take action on later event days. As part of our analysis, we explored trends in performance both in terms of the percentage of customers reducing their load each day and the average load reductions each event day. We found that the highest percentage of customers (92%) reduced their load on the first event day (August 17, 2022). The second highest was on the final event day (September 9, 2022), when 88% of customers did. While the majority of customers participated on every event day, fewer did so on the event days in the middle of the consecutive event series, with a noticeable drop in participation after the fourth event (Figure 20).

Figure 20. Percent of Customers with Load Reductions by Event



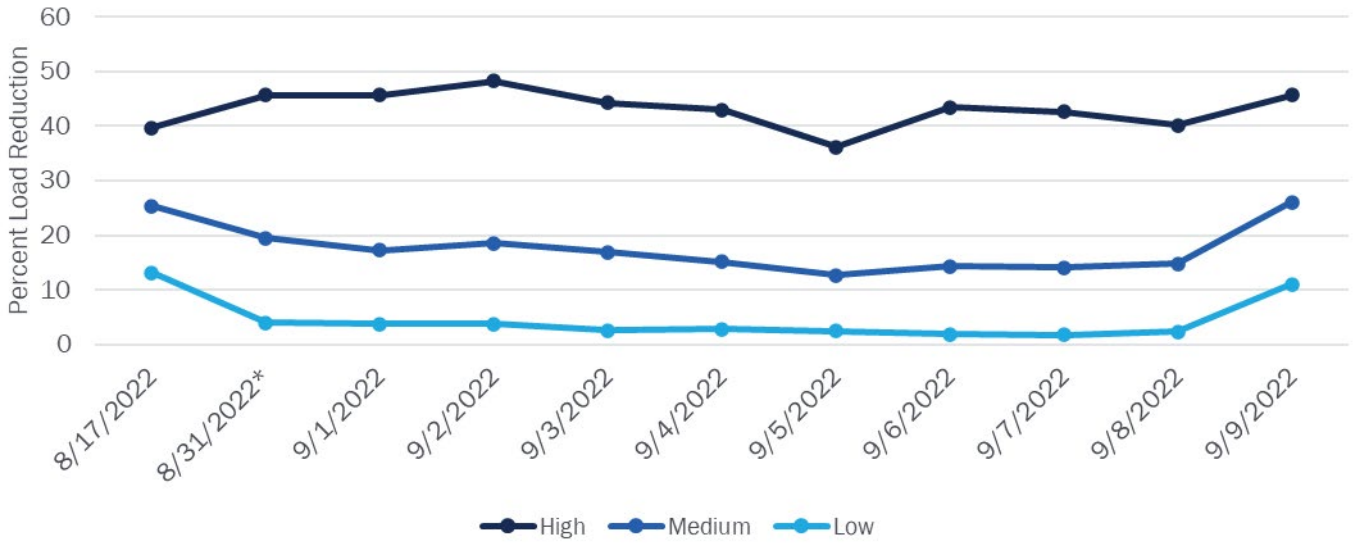
Similarly, we found that overall performance was best on the final event day (September 9, 2022), when the average customer saved 27% of their baseline load.[18] The next best performance was on the first event day (August 17, 2022), when customers saved an average of 26% of their baseline load. Performance was lowest for event days seven (September 5, 2022) through ten (September 8, 2022). While these trends generally hold across performance levels, there are a couple of notable differences. For high performers, performance increased slightly from the first to the second event, suggesting improved awareness or a learning effect among this group. In contrast, low and medium performers performed higher for the first than for the second event. Their average performance plateaued from the third event until the final event on September 9, 2022, suggesting these customers were more likely to become fatigued.[19] High performers exhibited the most noticeable performance decrease for the September 5, 2022, holiday event, suggesting this event was more difficult for them to respond to than the others (Figure 21).

[17] PSR events were called on ten out of eleven days. Performance was not calculated for PSR customers for the August 31, 2022, event as this was only called for Flex Alerts.

[18] We hypothesize that this may be due to different messaging, being on a day of the week (Friday) when routines are more malleable, or a feeling that "the end is in sight." However, it is also possible that the higher performance observed is a result of deterioration in the baseline. Because the baseline leverages usage data from prior non-event days and there were many consecutive events, events later in the series rely on baseline data farther away from the event itself as compared to early events.

[19] We conducted a sensitivity analysis in which we analyzed performance based on just the first two event days and found that customers achieved higher average performance than they did across all events combined (25% vs. 20% load reduction). However, there is also greater variation in performance on the first two event days as compared to all days combined. Because of this greater variation, if we had classified performance based on just the first two events days, there would be more customers in both the low and high performance groups. This could indicate that while some customers suffer from fatigue when there are many Flex Alert events, other customers are able to learn from earlier events to improve their performance.

Figure 21. Load Reduction by Event Day and Performance Level



Note: PSR customers are excluded from performance calculations for 8/31/2022 as no PSR event was called.

Our analysis suggests that customers across performance levels have the ability and potential to take effective actions to reduce their load during Flex Alerts; however, some customers may be able to reduce their load further or participate more consistently. To better understand who these customers are and how to reach them, we assessed typical and differentiating characteristics of low- and high-performing customers. High-performing customers tend to be younger, more educated, have higher incomes, and live in newer, smaller homes. They tend to be accustomed to taking energy efficiency actions through their participation in a time-of-use rate and have plenty of opportunities to shift their energy usage since they are most likely to have modern electric appliances and are most likely to own electric vehicles (Figure 22). Low-performing customers tend to have older household members who may be retired or have health conditions, to be low or moderate income, and to live in older, larger homes. Despite overall high electric usage on average, they tend to have gas appliances and are more likely than the other performance groups to lack air conditioning, which may limit their opportunities for shifting load. These customers also tend to have more conservative political views and feel a lack of empowerment in controlling their energy use (Figure 23). We further explore drivers of and barriers to performance in the next section.

Figure 22. Key Characteristics of Customers in High-Performance Group

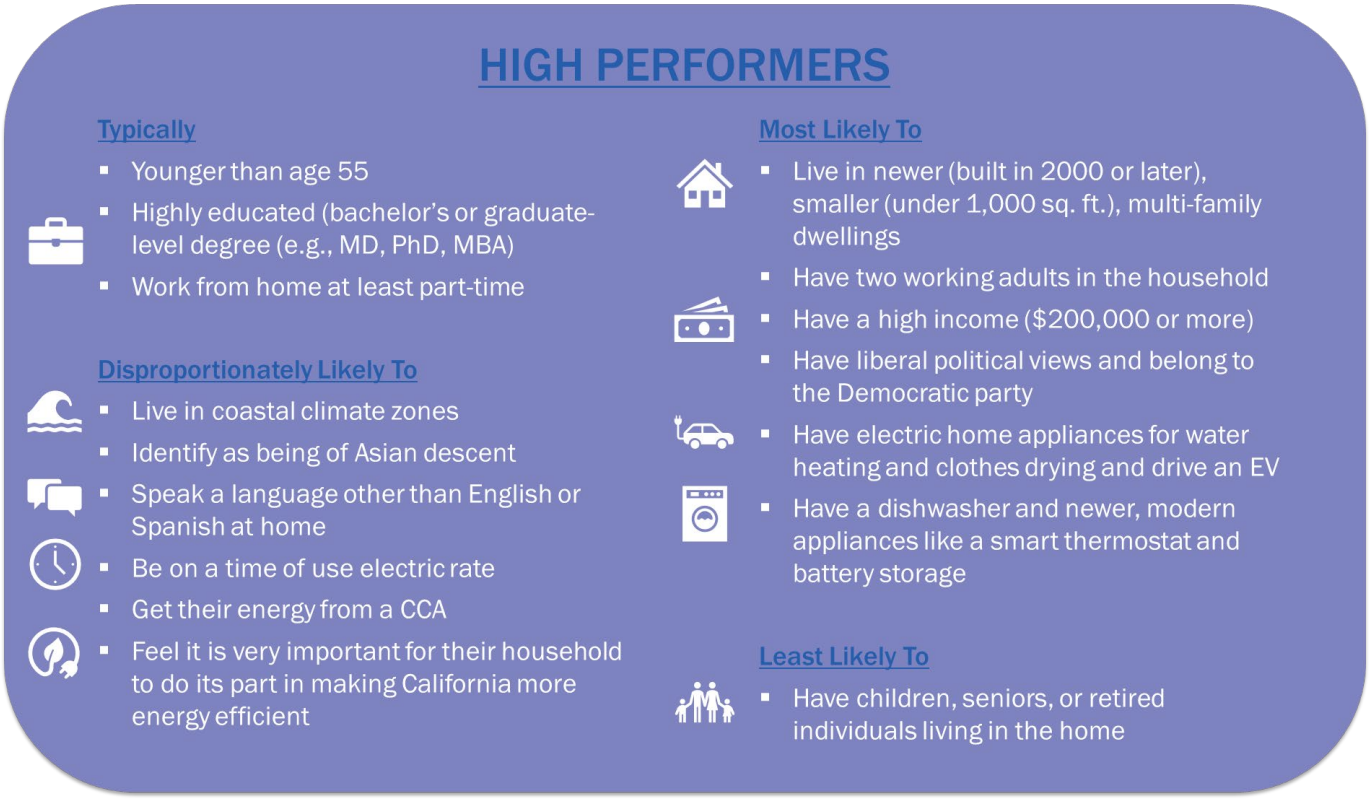
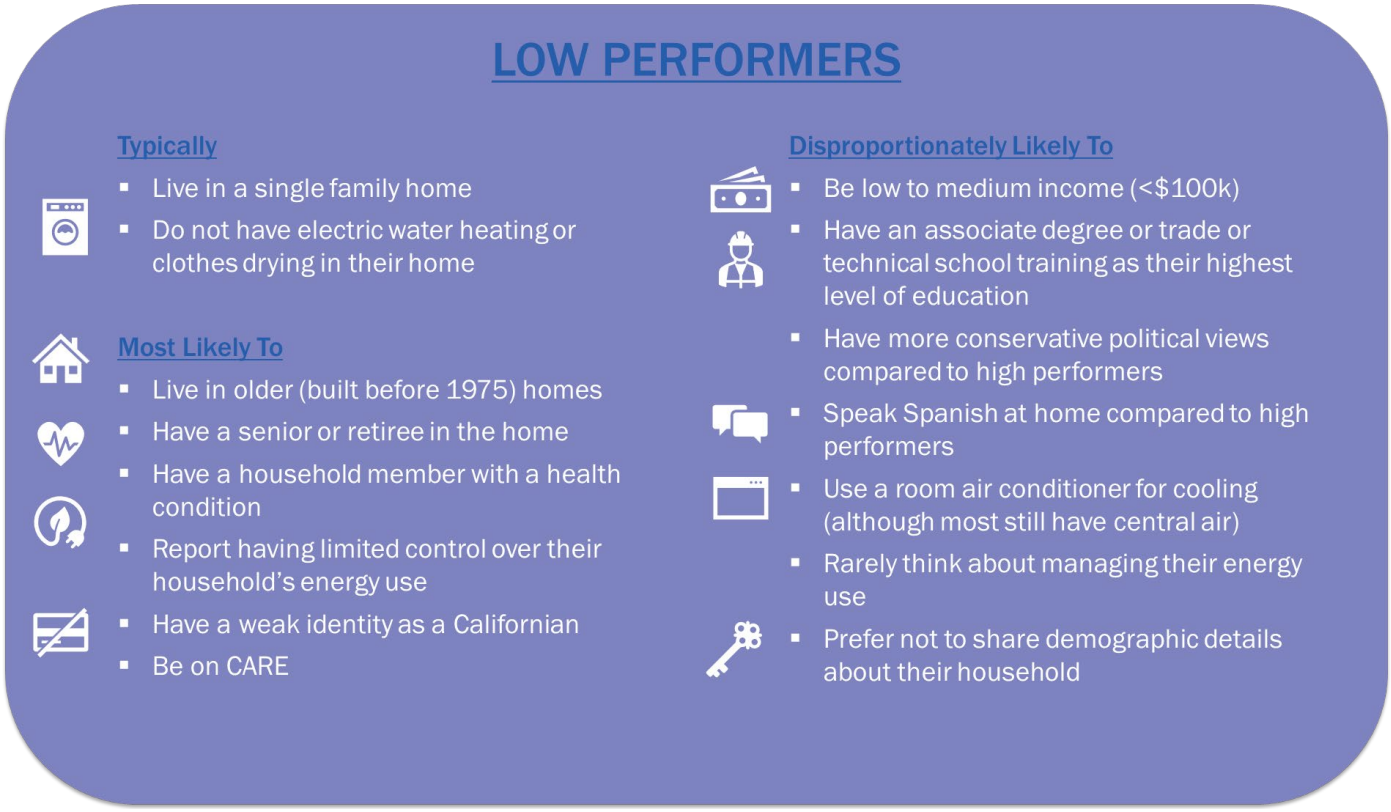


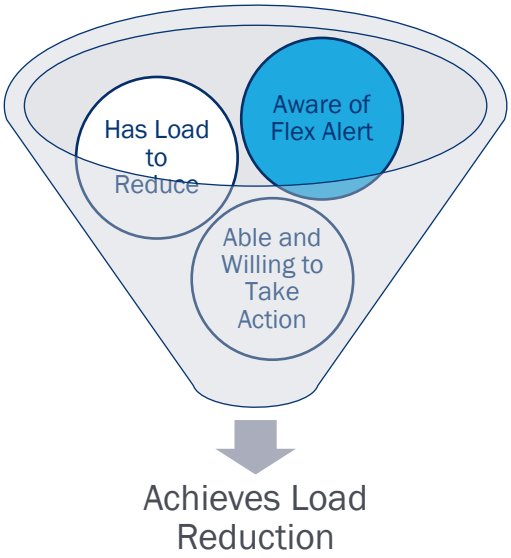
Figure 23. Key Characteristics of Customers in Low-Performance Group



4.3 AWARENESS AND UNDERSTANDING OF FLEX ALERTS

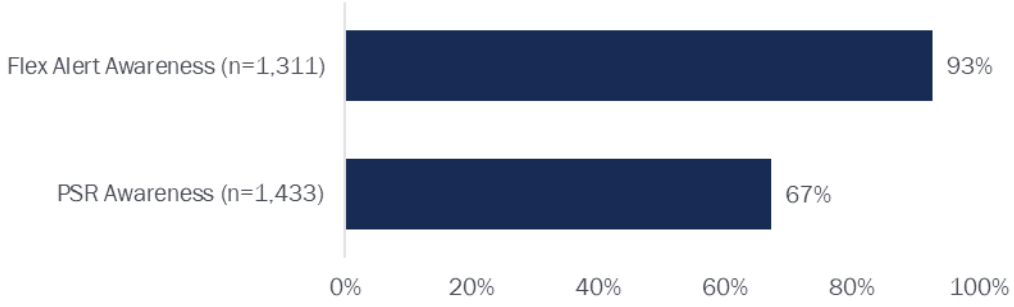
A critical component of customer engagement with Flex Alerts is awareness of them (Figure 24). In this section, we will discuss awareness and understanding of Flex Alerts overall and in relation to performance.

Figure 24. Flex Alert Customer Engagement Contributors – Aware of Flex Alert



Among survey respondents, awareness of Flex Alerts was high, with 93% of Flex Alert customers reporting they were aware of the campaign. Awareness was lower for PSR-enrolled customers, with 67% of those respondents reporting they were aware of the campaign when it was presented as PSR (Figure 25).[20] In both groups, awareness was similar among respondents regardless of their performance. High performers were not more likely to be aware of Flex Alerts or PSR than lower performers, suggesting that awareness is not a determinant of Flex Alert performance, at least among survey respondents.

Figure 25. Flex Alert and PSR (PSR) Awareness



Respondents also exhibited a relatively accurate understanding of the Flex Alert campaign, but there is some room for improvement. Across performance levels, 72% of respondents correctly identified 4:00 p.m. to 9:00 p.m. as the most important time for reducing electricity on days when Flex Alerts are called.[21] While there was no statistically significant

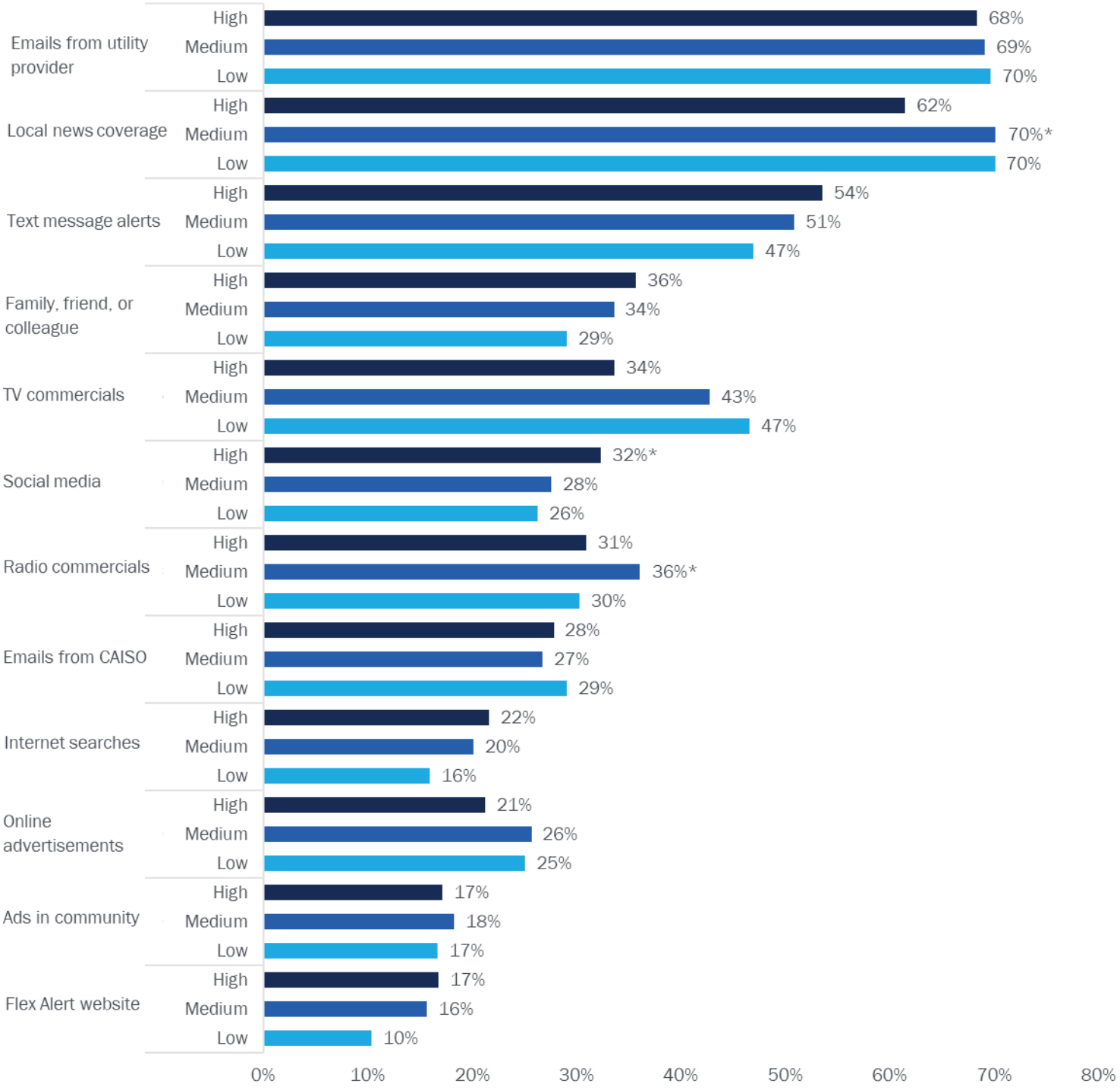
[20] While we cannot verify based on the available information, we hypothesize that a portion of the PSR-enrolled customers who are unaware of PSR are aware of the Flex Alert campaign and that this is why no difference in performance is observed based on awareness.

[21] For simplicity, we present the remainder of the results in this section in reference to "Flex Alerts." However, it is important to note that in the survey, customers were asked questions with reference to their assigned program. PSR-enrolled customers were asked about their participation and experience in PSR events while non-PSR-enrolled customers were asked about their participation and experience in Flex Alert events.

difference in customers' ability to identify the correct timeframe between performance levels, there is a trend in which high performers were slightly more likely to identify the correct timeframe (75%) than low performers (69%).

Given the nature of the campaign, customers receive information about Flex Alerts from a variety of sources, including both traditional and digital media streams. Across all respondents, the most commonly cited sources of campaign awareness were local news coverage (69%), e-mails from their electric or gas provider (69%), and text alerts (51%). There were some differences in sources of awareness by performance level, with high performers more likely to hear about events through social media and least likely to get their information from TV commercials or local news. Medium performers were more likely than the other groups to get information about Flex Alerts from local news coverage or radio commercials. These distinctions likely reflect underlying differences in how the members of each group prefer to get information. In other words, while certain information streams (e.g., social media) are more likely to reach high performers, reaching someone through that stream is unlikely to turn a low performer into a high performer. One exception concerns motivation and interest. Low performers were least likely to hear about Flex Alerts through proactive information-gathering exercises such as searching the internet or a website. Figure 26 summarizes the information sources by performance level.

Figure 26. Sources Where Respondents Heard About Flex Alerts by Performance Level (n=2,076)

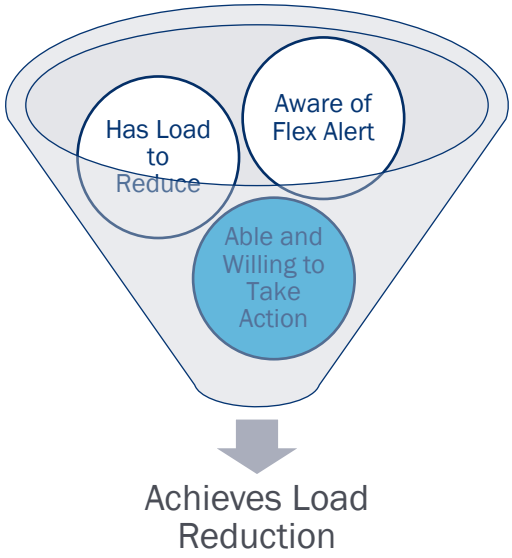


*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).
Note: High performance group (n=291), medium performance group (n=1,413), low performance group (n=251).

4.4 ACTIONS TAKEN, MOTIVATORS, AND BARRIERS

Awareness of Flex Alerts is not enough to achieve load reductions during them. In this section, we take a deep dive into customers' actions during Flex Alerts, what motivates or deters them from taking action, and how this relates to event performance (Figure 27).

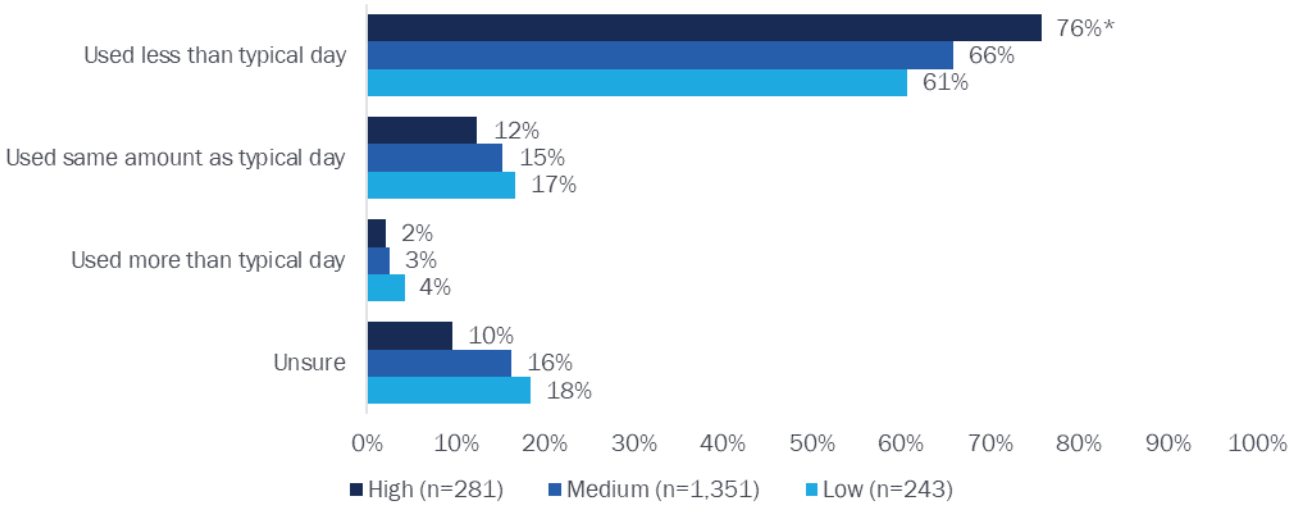
Figure 27. Flex Alert Customer Engagement Contributors – Able and Willing to Take Action



Among survey respondents aware of Flex Alerts, 90% reported reducing their energy usage during one or more Flex Alert events in 2022. The percentage of respondents who self-reported reducing their energy usage during events was similar among Flex Alert and PSR-enrolled customers, regardless of performance level. Self-reported participation in Flex Alerts was consistent, with most respondents saying they participated in all eleven (36%) or eight to ten (29%) event days in 2022. Low performers were most likely to report taking action for some but not all Flex Alerts.

In general, respondents found participating in Flex Alerts to be between a little to somewhat difficult (61%), with low performers less likely to say that it is not at all difficult (31% vs. 36% overall) and more likely to find it very difficult (5% vs. 3% overall). Most respondents said their household used less electricity on event days than on a typical day (67%). However, low performers were less likely to say this (61%), and high performers were more likely (76%), suggesting that customers are generally self-aware of their performance (Figure 28).

Figure 28. Self-Reported Household Usage During Flex Alert Events by Performance Level

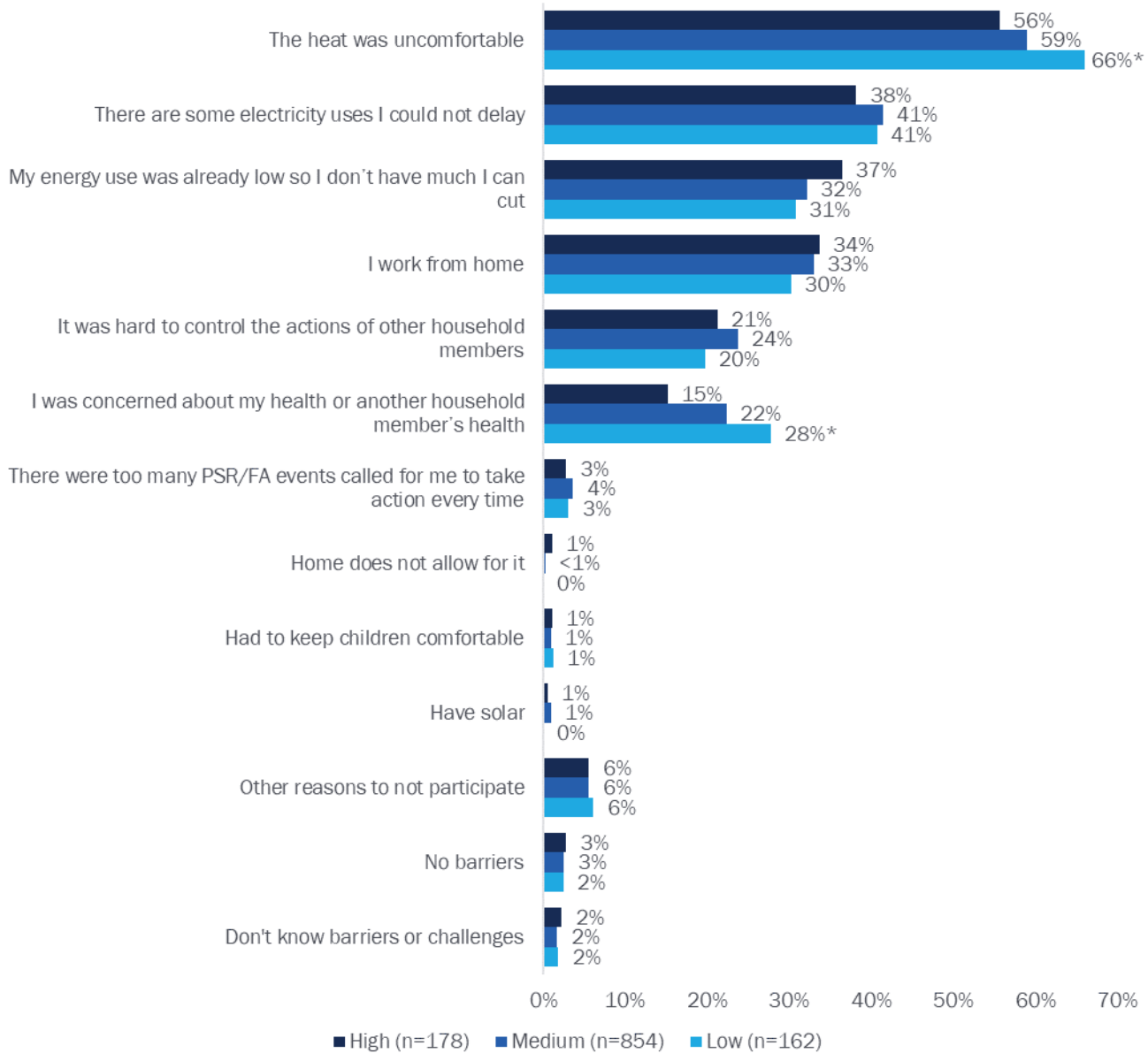


*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).

Similarly, when asked whether their household did everything it could to reduce energy use on a typical event day, most reported they did all they could (60%) or more than expected (12%) but over a quarter (28%) said they could have done more. High performers were less likely than other customers (23%) to say they could have done more.

Respondents were asked if someone is typically home between 4:00 p.m. and 9:00 p.m. The presence of someone in the home during a Flex Alert is likely to increase the range of actions that customers can take during a Flex Alert. However, it also may make it more challenging to take those actions. While most respondents (93%) said that someone was typically home during the timeframe when Flex Alerts typically occur, this was more common among low performers (96%) than among high performers (90%). Among customers who reported attempting to reduce their use during Flex Alerts and found it difficult to do so, the most common barriers were that the heat was uncomfortable (60%) and that some electricity uses could not be delayed (41%). Low performers were more likely than other groups to cite the discomfort of the heat and concern for a household member's health. In contrast, high performers were less likely to face barriers due to health concerns than the other groups (Figure 29).

Figure 29. Barriers to Reduce Usage During Flex Alert/PSR Events by Performance Level

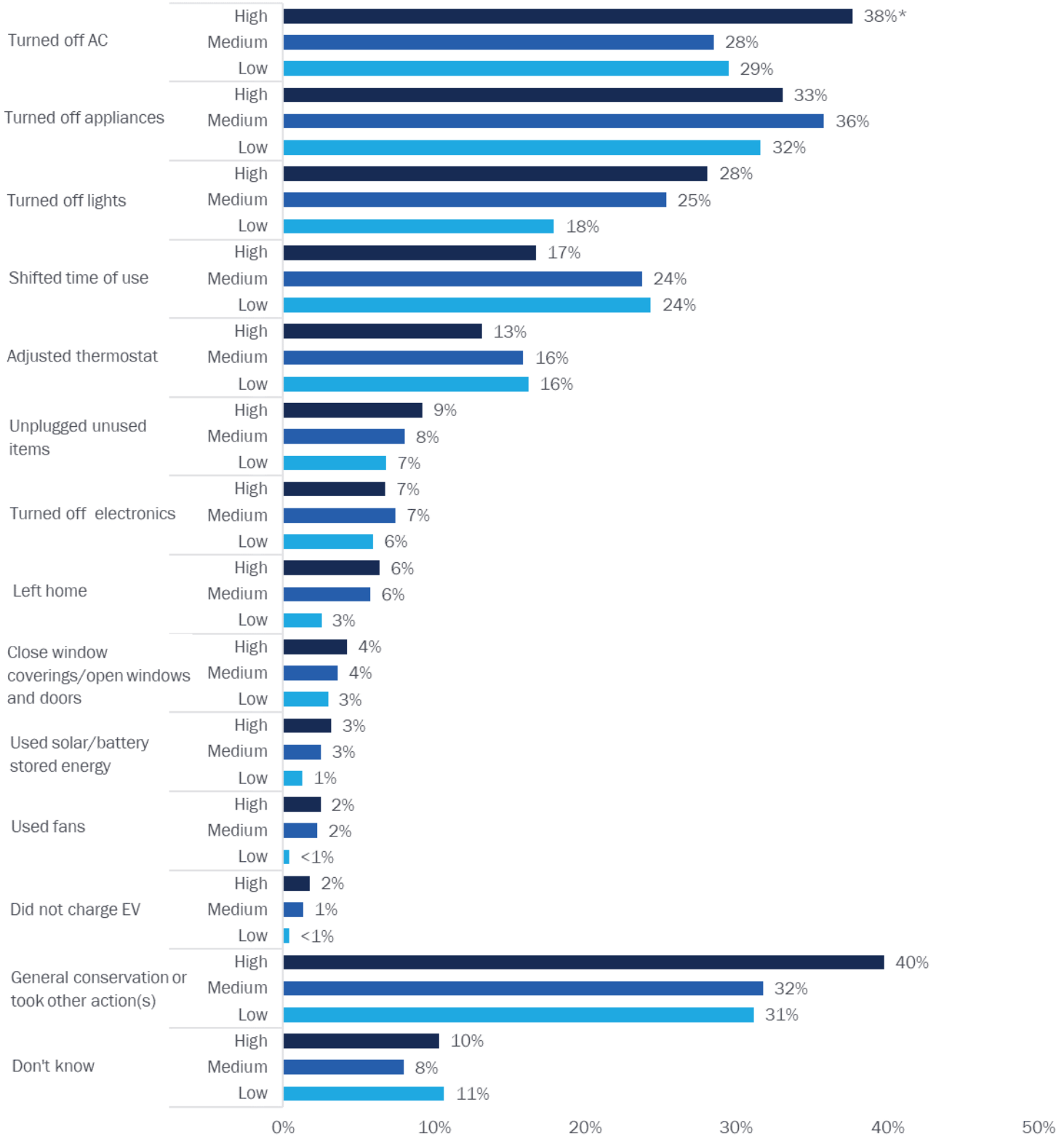


*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).

While it was rare for customers to say they did not attempt to reduce their electricity usage during any Flex Alerts (10% overall), among those who did report this, the most common reason was already having very low energy use (33%), having a solar/backup (13%) system, or feeling it was not their responsibility (11%).

Most respondents across performance levels reported taking multiple actions during Flex Alerts, with the most common number of actions being three (29%) or four (25%). Respondents were asked which actions they took on Flex Alert event days. The most common actions overall were turning off appliances (35%), turning off air conditioning (30%), other or unspecified energy conservation actions (29%), turning off the lights (25%), and shifting the time of use (23%). High performers were more likely to turn off their air conditioning than the other performance groups and less likely to shift their time of use, potentially either because their load has already been optimized under the time of use rate or because they prefer to shed rather than shift load. Low performers were less likely to turn off their lights, which is notable given that this is a low-effort option available to nearly everyone. Figure 30 summarizes the actions taken by customers in each performance grouping.

Figure 30. Actions Taken by Respondents During Flex Alert Event by Performance Level

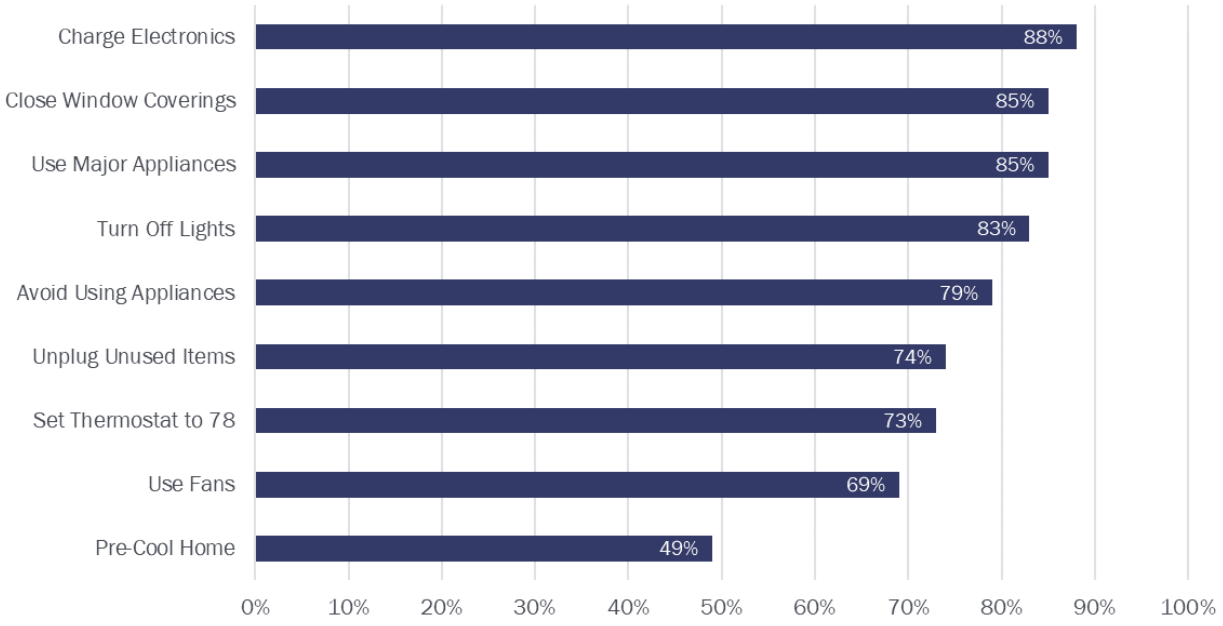


*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).
Note: Multiple responses allowed. High-performance group (n=281), medium-performance group (n=1,351), and low-performance group (n=234).

In addition to asking customers which actions they took during Flex Alerts, we assessed the timeframe during which they took these actions because the most effective timing varies depending on the action. Some actions (e.g., charging electronics, using major appliances) should be avoided during the event window, others (e.g., pre-cooling the home, closing window coverings) are most effective when done in preparation for the event, and finally, others (e.g., turning up the thermostat, avoiding major appliance use) should be completed during the event window.

We found that most customers who took a given action did so during an effective timeframe (Figure 31). Actions like turning off the lights, shifting the use of appliances, and charging devices outside the event window were easiest for customers to take during the correct time. Actions related to controlling the temperature of the home were more frequently taken at an incorrect time. Pre-cooling, an action most effective in preparation for an event, was the action customers least frequently completed during the correct timeframe. Low performers were least likely to pre-cool their homes during an effective timeframe (39% vs. 49% overall). In addition, high performers were more likely to unplug unused items during the event than at another time during the day (81% vs. 74% overall).

Figure 31. Percent of Customers Who Took an Action and Did So During an Effective Timeframe



Respondents were asked about their attitudes towards energy efficiency and climate change to assess how messaging that relies on these themes might motivate or hinder their performance. Overall, low performers were least likely to have a positive attitude towards energy efficiency and were disproportionately likely to either "strongly disagree" or "neither agree nor disagree" with these statements. In general, high performers had a more positive attitude towards energy efficiency than low and medium performers and were more likely to "strongly agree" that they were motivated to save energy than members of the other groups. Nevertheless, this type of messaging should generally resonate with most customers across performance levels (Table 7).

Table 7. Level of Agreement with Statements Used in Energy Efficiency Score by Performance Groups

Performance Groups	Level of Agreement with Statement				
	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
It is possible for individual citizens to help address climate change by reducing their energy use.					
High	42%	38%	9%	7%	5%
Medium	39%	37%	13%	6%	5%
Low	34%	38%	16%*	6%	6%
Overall Sample	**39%**	**37%**	**13%**	**6%**	**5%**
Environmental challenges like climate change are important issues.					
High	58%	27%	7%	2%	5%
Medium	55%	25%	11%	5%	4%
Low	50%	29%	11%	5%	5%
Overall Sample	**55%**	**26%**	**10%**	**4%**	**4%**
By saving energy, I will be helping others in my community.					
High	39%	38%	15%	4%	4%
Medium	36%	37%	19%	5%	3%
Low	31%	37%	24%*	5%	4%
Overall Sample	**36%**	**38%**	**19%**	**5%**	**3%**
I am motivated to save energy.					
High	42%*	44%	10%	3%	2%
Medium	35%	47%	14%	2%	2%
Low	34%	44%	16%	3%	3%*
Overall Sample	**36%**	**46%**	**14%**	**2%**	**2%**
I do not feel responsible for conserving energy because my personal contribution is small.					
High	4%	9%	20%	42%	25%
Medium	5%	10%	24%	39%	23%
Low	6%	8%	25%	41%	19%
Overall Sample	**5%**	**9%**	**23%**	**40%**	**22%**

*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).

Note: Overall n will not match with performance level totals as it includes 24 customers for which a performance assignment could not be made. High-performance group (n=387), medium-performance group (n=1,890), low-performance group (n=316), and overall sample (n=2,744). The final statement ("I do not feel responsible for conserving energy because my personal contribution is small.") was asked in reverse. Thus, the scale was flipped when calculating the EE Attitudes Score (i.e., the proportion that selected "Strongly Disagree" was used to calculate positive EE attitude).

Because the Flex Alert campaign relies on messaging about assisting other Californians, we asked questions to assess the importance of being a Californian to the respondents' identity. Low performers were least likely to identify with Californians as a group and were disproportionately likely to state that being a Californian is "not at all" important to them. Medium performers were more likely than the other groups to say that being a Californian is "extremely important" to them. Nevertheless, in general, this type of messaging should resonate with most customers across performance levels (Table 8 and Table 9).

Table 8. Level of Importance of Being a Californian by Performance Group

Performance Group	Importance of Being a Californian				
	Extremely Important	Moderately Important	Somewhat Important	Slightly Important	Not At All
High (n=387)	31%	26%	17%	8%	19%
Medium (n=1,890)	34%*	22%	16%	8%	20%
Low (n=316)	29%	22%	17%	9%	24%*
Overall Sample (n=2,744)	**33%**	**23%**	**16%**	**8%**	**20%**

*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).
Note: Overall n will not match with performance level totals as it includes 24 customers for whom a performance assignment could not be made.

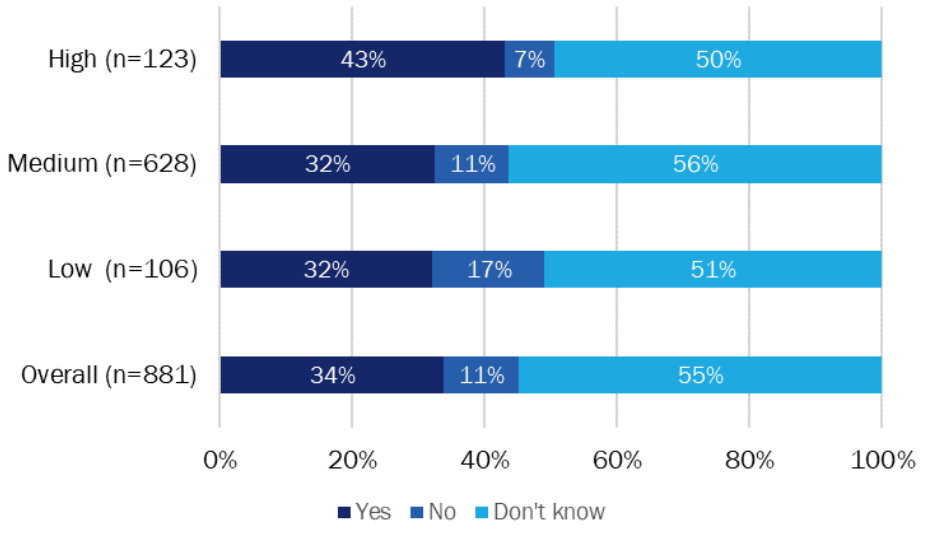
Table 9. Extent Respondents' Feel Tied to Californians as a Group

Performance Group	Feel Tied to Californians as a Group				
	A Great Deal	Quite a Bit	Somewhat	A little	Not At All
High (n=387)	28%	23%	25%	11%	13%
Medium (n=1,890)	28%	24%	24%	11%	13%
Low (n=316)	22%	24%	22%	16%*	16%*
Overall Sample (n=2,744)	**27%**	**24%**	**23%**	**12%**	**13%**

*The percentage for the indicated performance group is statistically higher than the overall sample average (p<.10).
Note: Overall n will not match with performance level totals as it includes 24 customers for whom a performance assignment could not be made.

Customers enrolled in PSR receive bill credits for their load reductions during Flex Alerts. Among these customers, over half (55%) stated that they did not know whether they had received a bill credit, with about a third (34%) stating they did. Low performers were more likely to say they received no credit (17%), and high performers were more likely to recall receiving a credit (43%). However, even among high performers, 50% were unsure whether they received a bill credit (Figure 32).

Figure 32. Recall of Power Saver Awards Bill Credit



Note: Overall n will not match with performance level totals as it includes 24 customers for whom a performance assignment could not be made.

4.5 LOAD REDUCTION POTENTIAL VS. PERFORMANCE

Our analysis suggests that California households have high awareness of the Flex Alert ME&O campaign and are generally taking some form of action to reduce their load during events. However, the highest load reductions tend to come from smaller homes with lower baseline energy usage. One strategy to increase the overall impact of the campaign would be to experiment with messaging designed to reach customers who have a lot of load available to reduce but are currently not achieving high load reductions during Flex Alerts.

To this end, the evaluation team analyzed how performance potential, as assessed through the clustering analysis, corresponds with actual performance. Table 10 shows the results of this analysis. For customers with low to low-moderate load reduction potential and low performance (5%), the campaign may choose not to take any particular action given the low expected return in terms of overall increase in load reduction. Half of the customers (51%) are already performing well or exceedingly well, given their potential load for reduction, and we recommend strategies to retain and encourage these customers' participation in Flex Alerts. For customers with high-moderate to high load reduction potential who are not achieving high performance (45%), the campaign may consider experimenting with messaging designed to reach customers in this group.

Table 10. Load Reduction Potential and Performance

Potential	Performance			Total
	Low	Medium	High	
Low	2%	17%	4%	**23%**
Low-Moderate	3%	19%	4%	**26%**
High-Moderate	2%	11%	2%	**14%**
High	5%	27%	5%	**36%**
Total	**12%**	**73%**	**15%**	**100%**

Strategy	None	Retain	Grow

The evaluation team analyzed key barriers among customers in the "grow" group. These barriers and potential strategies to address them are summarized in the Conclusions and Recommendations section.

5. CONCLUSIONS AND RECOMMENDATIONS

Table 11 summarizes key campaign challenges that Opinion Dynamics identified as part of this study and recommended strategies that can be tested to address these challenges. This table is referenced in the conclusions and recommendations that follow.

Table 11. Flex Alert Challenges and Campaign Strategies

Focus Area	Description of Challenge	Strategies to Test
1	**The heat is uncomfortable**	▪ **For customers with air conditioning:** Educate customers on pre-cooling as a two-step action and highlight that they can take one or both steps (e.g., pre-cooling, increasing the temperature during events) based on what works with their schedule. ▪ Educate customers on techniques for keeping their home cool while reducing reliance on air conditioning during the event (e.g., closing shades during the hottest part of the day, using fans, limiting activity). ▪ Encourage customers to leave the home when it is safe and viable. ▪ Offer energy-reducing actions that customers can take to contribute without affecting the temperature of the home.
2	**It is difficult to control the actions or use of other household members**	▪ Highlight how families and roommates can participate in Flex Alerts together. ▪ Conduct outreach with a variety of age groups (e.g., through schools, youth, or senior centers). ▪ Consider leveraging social media platforms popular with younger generations (e.g., Tik Tok).
3	**Health concerns in the household**	▪ Continue to prioritize safety. ▪ Highlight energy-reducing actions that do not affect the temperature of the home and encourage customers to take these actions if it is safe to do so.
4	**Has solar**	▪ Help customers understand how their solar generation period corresponds with the typical Flex Alert event period. ▪ Help NEM customers without a battery understand how they can contribute to the event by sending more excess solar generation back to the grid than on a typical day. ▪ Encourage customers to participate in the second half of the event once solar generation wanes. Consider framing NEM customers as "reinforcements" who can step in when other customers are becoming hot and tired. ▪ Consider also testing non-traditional messaging (5).
5	**Does not resonate with traditional campaign messaging (i.e., California identity, climate change, energy efficiency)**	▪ Consider messaging that focuses on the benefits of participation to the individual, the household, one's family and friends, or the local community ▪ **For PSR participants:** Emphasize how they can reduce their energy bills by participating in events. Consider providing feedback on event performance to help customers understand the impact of their actions early in the season.
6	**Perceived or actual limited opportunities to reduce or shift load given systems or already low usage**	▪ Highlight the ease of making small and temporary reductions to energy use available to all households, such as unplugging appliances and turning off lights. ▪ Encourage small but consistent actions to increase confidence and form habits. ▪ Encourage customers to take multiple actions on event days and provide examples of combinations of actions.
7	**Customer is already reducing their load during events but could do more**	▪ Suggest higher impact actions, such as turning up or shutting off the air conditioning during events, alongside educating customers on supportive actions, such as pre-cooling the home. ▪ Encourage customers to take multiple actions on event days and provide examples of combinations of actions.

Below, we provide additional commentary on the study conclusions and the strategies suggested in the table above.

- Conclusion: Awareness and understanding of Flex Alerts is high and is not a significant driver of event performance. While there are differences between higher and lower performers in terms of where they get information about Flex Alerts (e.g., social media, TV commercials, local news coverage), these differences likely reflect variation in information consumption preferences and are unlikely to drive performance. However, there are opportunities to improve customers' understanding of the appropriate timeframe for taking action, - both in general and for specific action types.
  - **Recommendation:** Continue to emphasize the typical event window (4:00 p.m.–9:00 p.m.) across all Flex Alert messaging, employing a wide variety of traditional and digital media channels to reach the most customers.
  - **Recommendation:** Help customers understand event-day behaviors that should occur outside event hours including pre-cooling the home before the event to increase comfort and shifting actions such as the use of major appliances and charging of electronic devices before or after event hours.
- **Conclusion:** Most survey respondents reported participating in Flex Alerts on the majority of event days, and this is supported by the performance data, suggesting that customers have the interest and ability to reduce their load in support of Flex Alerts. High performers more consistently reduce their electric load than do low and medium performers, demonstrating that consistent actions lead to higher performance.
  - **Recommendation:** Consider using A/B experiments to test messaging that focuses on taking actions consistently and building Flex Alert routines or habits. For example, provide sample routines that highlight habits such as pre-cooling the home before the event, enjoying a low-cook dinner and household game night during the event, and running the dishwasher after the event is complete. The campaign can also consider messaging and tips specific to a given type of event day, such as a weeknight event, holiday event, or event on a weekend evening. Weeknight event tips can focus on behaviors associated with typical weekday routines (e.g., cooking dinner, completing chores). In contrast, holiday and weekend messaging might include tips associated with staying cool outside the home (e.g., having a cookout, going to a pool or movie theater).
- **Conclusion:** Awareness of PSR bill credits is low. Over half of respondents did not recall whether they received a bill credit. Although high-performing customers were more likely to recall receiving a bill credit than other customers, among high performers half were still unsure whether or not they received a credit, suggesting that bill credits were not an effective tool for motivating most PSR-enrolled customers to reduce their energy usage during Flex Alerts in summer 2022.
  - **Recommendation:** Consider conducting outreach to increase awareness of PSR enrollment, the program structure, and the benefits of participation to motivate participation in Flex Alerts among this group.
- **Conclusion:** There is a lot of variation in the load customers have available to reduce during Flex Alerts. However, our analysis suggests that event performance is more strongly driven by motivation and interest in participation than by available load. Although some customers reported that their household's already-low energy use is a barrier to event participation, we find that, on average, low performers tend to be the highest energy users, even though they reduce their load the least during Flex Alerts.
  - **Recommendation:** Consider strategies to appeal to high-opportunity customers—those who currently achieve low to medium performance but have moderate to high load reduction potential. Consider strategies for customers who find the heat uncomfortable (1), have difficulty controlling the actions of other household members (2), face health concerns in the household (3), have solar (4), or do not resonate with traditional campaign messaging (5) (Table 11).
- **Conclusion:** Engaging low performers is critical given that their households use about 11% more energy during non-event day RA window hours than high performers. Due to their higher average energy consumption these customers have the potential to make meaningful contributions to Flex Alert campaign performance. While the typical low performer reduces their energy consumption for some events, their load reductions tend to be small.

- **Recommendation:** Focus on building an understanding of the importance and relevance of Flex Alerts using messaging that is engaging to those customers who find the heat uncomfortable (1), face health concerns in the household (3), do not resonate with traditional campaign messaging (5), or have perceived or actual limited ability to shift load (6) (Table 11). Help customers build interest and confidence in participating by taking small, achievable actions.
- **Recommendation:** Using these strategies, the IOUs may consider conducting targeted outreach with PSR-enrolled customers to improve their performance with a focus on older customers, those with health conditions, with natural gas service, or on a CARE rate.

- **Conclusion:** Medium performers are already consistently exhibiting their willingness and ability to reduce their load during Flex Alert events. Given their relatively high energy consumption, many medium performers could contribute more, and their increased contributions would be meaningful to the campaign given that most customers are in the medium performance group.
  - **Recommendation:** Promote self-enrollment in PSR, combined with incremental additional efforts compared to those taken during previous events, to incentivize and motivate customers to improve their performance. Consider strategies for customers with children in the home (2) or for increasing contributions (7) (Table 11).
- **Conclusion:** High performers tend to be very motivated, have many electric end uses despite living in smaller homes with lower consumption overall, and face few barriers to participation. Encouraging high performers to continue taking consistent and effective actions is critical to the campaign's continued success.
  - **Recommendation:** Continue marketing through channels that reach high performers, such as social media, and continue to emphasize the importance of doing one's part in the Flex Alert events for the state of California and to support energy efficiency and the climate. Suggest a wide range of end uses for load shedding and shifting, including strongly discouraging EV charging during events, running electric appliances before or after the event, and reducing cooling load.
  - **Recommendation:** Using these strategies, the IOUs may consider conducting targeted outreach with PSR-enrolled customers to maintain their performance with a focus on younger customers, those living in multifamily dwellings, customers on EV rates, and customers engaged with social media messaging from their utility, CCA, or other organizations that provide Flex Alert and PSR messaging throughout the state.

APPENDIX A. POST-EVENT SEASON SURVEY INSTRUMENT

Access the survey instrument here.

APPENDIX B. CUSTOMER LOAD SHAPE CLUSTERING METHODS

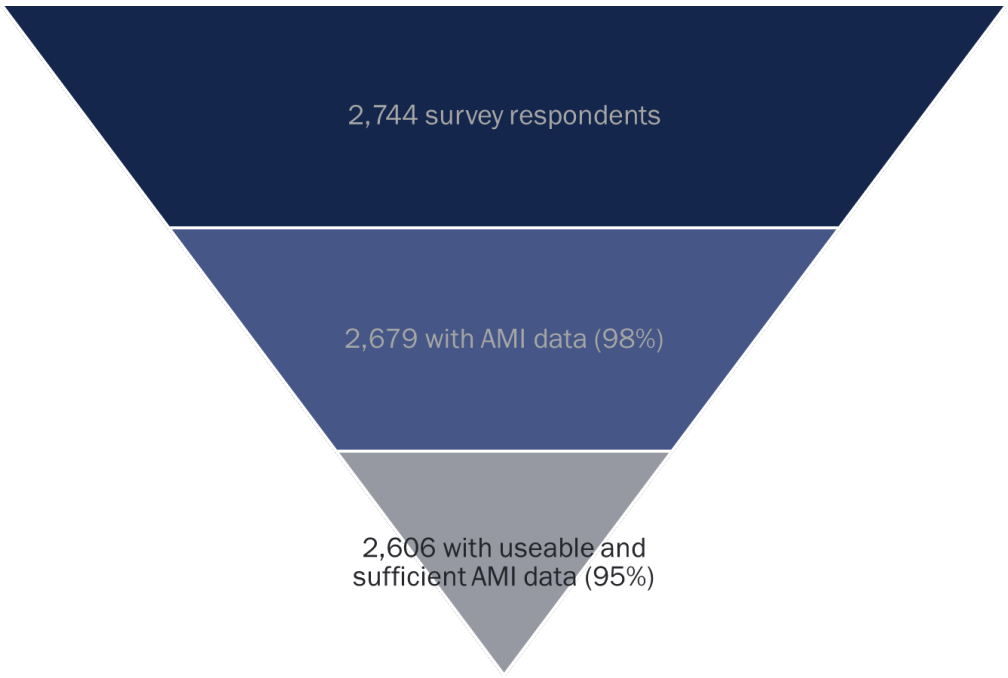
DATA PREPARATION

Beginning with the AMI datasets provided by the IOUs for each survey respondent, we limited the data to the summer 2022 period of May 1, 2022, through October 31, 2022. We reviewed and prepared the data to restrict the dataset to those customers and records well suited for the clustering analysis. We took the following steps to prepare the data:

- **No AMI data:** Survey respondents without AMI data were excluded from the analysis.
- **Event days:** Event days were excluded from the clustering analysis.
- **Duplicates:** Removed exact duplicate records and identified and accounted for instances of multiple readings for the same account, premise, and interval.
- **Checked kWh values:** Removed records where the kWh was missing, zero, or negative.
- **Insufficient AMI data:** Removed accounts with AMI data for less than 75% of the days in the summer 2022 period.
- **Clustering features:** Removed accounts that did not have a full 24 hours of weekday clustering features.

Figure 33 summarizes the results of the data cleaning process for the clustering analysis. We were able to include 95% of the survey respondents in this analysis.

Figure 33. Data Cleaning Results - Clustering Analysis

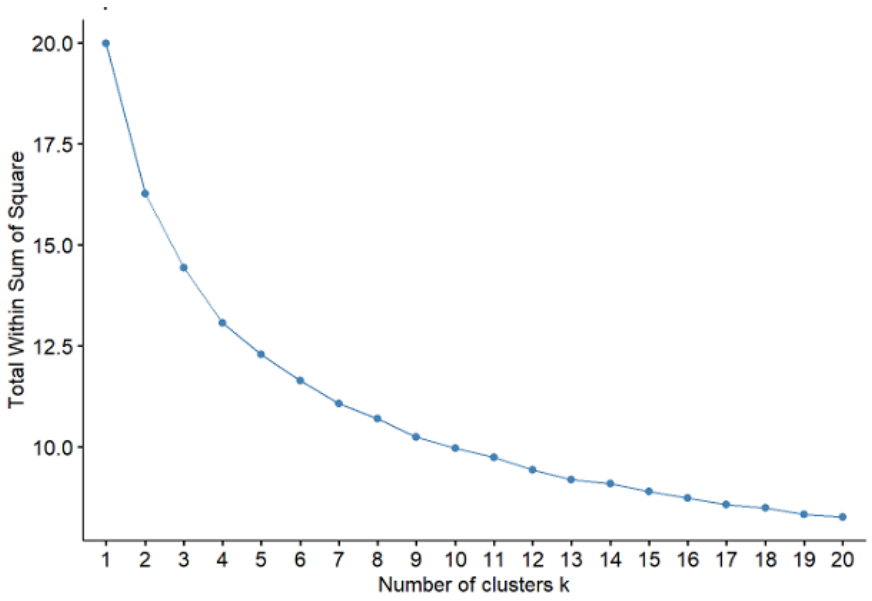


CLUSTERING METHODOLOGY

Prior to performing the clustering analysis, we pre-processed the data using a method proposed by Lawrence Berkely National Laboratory (LBNL).[22] We subtracted the daily minimum hourly usage (kW) from each hourly usage value for each customer. The process, known as "de-minning," results in an estimate of active behavior electricity consumption in a residential setting and represents the discretionary load that can be shifted, for example, in the context of a Flex Alert. Next, we normalized the discretionary load so that each hour's load value represented the proportion of the day's total discretionary usage within that hour. By clustering on relative as opposed to absolute usage values, we can better isolate customers with a higher proportion of load during the RA window.

We used a k-means clustering algorithm to group customers based on their discretionary load consumption patterns on summer weekdays and corresponding ability to reduce load during the RA window.[23] As part of the k-means algorithm implementation, the sole parameter the evaluation team needed to specify was the number of clusters the algorithm would use in partitioning the participating customers. The industry standard approach is the "Elbow Method." To apply this method, we computed multiple iterations of the k-means clustering using different values of K and calculated the within-cluster sum of squares (WCSS) present in the final clusters for each K. We plotted the results to form a curve showing the relationship between the number of clusters and this total deviation. The team identified an "elbow," or a range of values (4 to 8) where the curve appears to bend. This decrease in slope represents the specific number of clusters with which each additional cluster returns marginally diminishing information. This process helped us avoid introducing too many clusters so we wouldn't overfit the data and produce hyper-specific clusters while maintaining as many uniquely distinct clusters as possible. Figure 34 shows that the optimal number of clusters for this effort was between four and eight.

Figure 34. Elbow Method Assessment of Optimal Number of Clusters



[22] Jin, Ling, Anna Spurlock, Sam Borgeson, Daniel Fredman, Liesel Hans, Siddarth Patel, and Annika Todd. "Load shape clustering using residential smart meter data: a technical memorandum." *Lawrence Berkeley National Laboratory* (2016).

[23] We elected to complete the clustering analysis on only weekdays due to the high correlation and similarity between weekday and weekend load shapes, on average. Such correlation precludes us from including weekend and weekday features in the same clustering analysis without using dimensionality reduction techniques such as Principal Components Analysis (PCA). In addition, due to the level of similarity that we observed between a typical household's weekday and weekend load shapes, we also do not anticipate that creating a separate set of clusters on weekend data would produce meaningfully different results.

We supplemented the Elbow Method with a statistical methodology developed by academic researchers to determine the relevant number of clusters in a data set.[24] We leveraged the open-source NbClust package in R to conduct this analysis. We relied on 23 statistical indices to evaluate the validity of the clusters generated using the k-means algorithm. 19 out of 23 indices indicated that the valid number of clusters existed within four to eight clusters, as described in Figure 35.

Figure 35. Statistical Indices to Evaluate Optimal Number of Clusters

Index	KL	CH	Hartigan	CCC	Scott	Marriot	TrCovW
Number of Clusters	11	2	4	2	3	11	3
Value of Index	3	463	82	55	1429	0	0
Index	**TraceW**	**Friedman**	**Rubin**	**Cindex**	**DB**	**Silhouette**	**Duda**
Number of Clusters	4	3	4	15	15	2	2
Value of Index	1	1063297	0	0	2	0	1
Index	**PseudoT2**	**Beale**	**Ratkowsky**	**Ball**	**PtBiserial**	**Frey**	**McClain**
Number of Clusters	2	2	3	3	8	1	2
Value of Index	-351	-4	0	3	0	NA	1
Index	**Dunn**	**Hubert**	**Sdindex**	**Dindex**	**SDbw**		
Number of Clusters	8	0	4	0	5		
Value of Index	0	0	50	0	1		

In addition to these tests, we conducted a visual analysis of the resulting clusters across the range of potential K values from four to eight, as suggested by the Elbow Method and statistical tests. Given the implication for load shifting potential, one of our secondary objectives was to cluster customers who exhibited overnight charging behavior. A K-value of eight produced a distinct cluster with high usage for these customers, ultimately leading us to select eight clusters to capture this important variation.

A meaningful proportion (22%) of customers included in the clustering analysis are NEM, as defined based on the IOU-provided NEM flag. For NEM customers, the amount of energy delivered to the customer from the grid in a given hour is highly dependent on the amount of solar generation available. As a result, NEM customers exhibit highly unique and often variable load shapes. Because of this, we chose to automatically place NEM customers into their own cluster and exclude them from the k-means clustering algorithm. Ultimately, this combination of statistical analysis, visual inspection, and logical deduction led us to select the final nine clusters used throughout this analysis. Table 12 shows the final distribution of respondents across the nine clusters.

Table 12. Cluster Distribution

Cluster	Customer Count	Customer Percentage
1	219	8%
2	325	12%
3	68	3%
4	279	11%
5	395	15%

[24] Charrad, Malika, Nadia Ghazzali, Véronique Boiteau, and Azam Niknafs. "NbClust: an R package for determining the relevant number of clusters in a data set." *Journal of statistical software* 61 (2014): 1-36.

Cluster	Customer Count	Customer Percentage
6	93	4%
7	373	14%
8	278	11%
NEM	576	22%
Total	**2,606**	**100%**

Note: Counts presented in this table are slightly higher than when survey data were presented by cluster, as cluster assignments for some customers (n=13) could not be connected back to the survey data.

CLUSTER LOAD SHAPES

Figure 36 illustrates how the average weekday load profile compares between all clusters identified in the analysis.

Figure 36. Average Weekday Load Profile for All Clusters

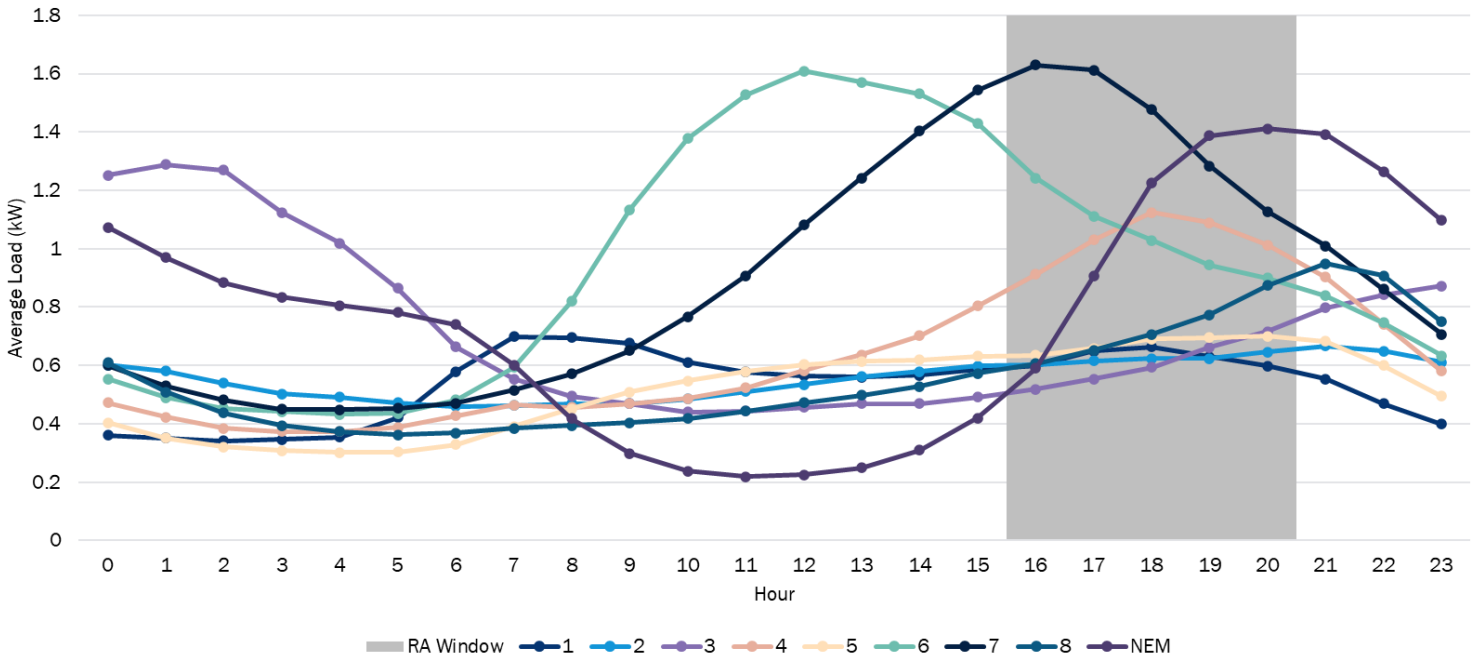
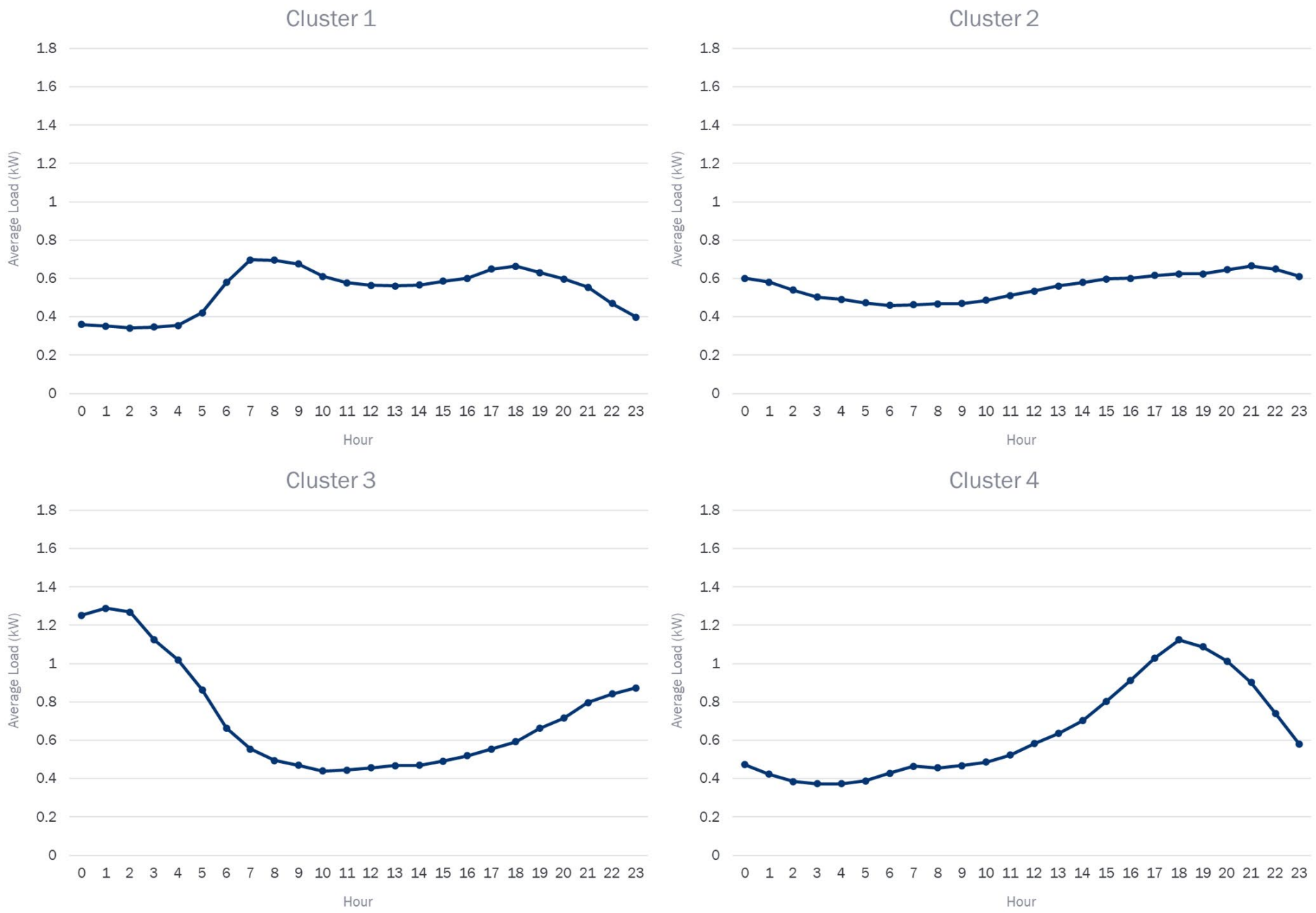
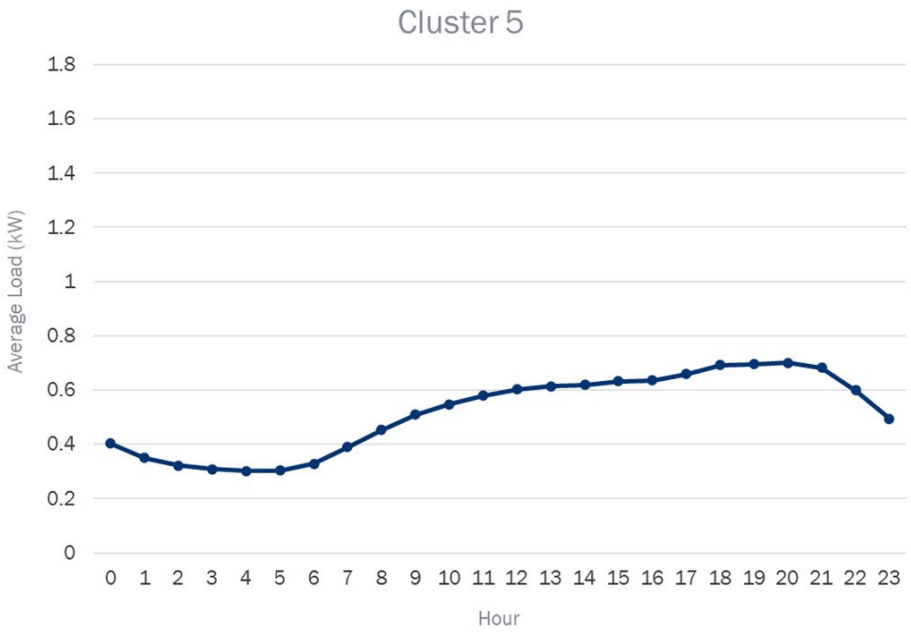
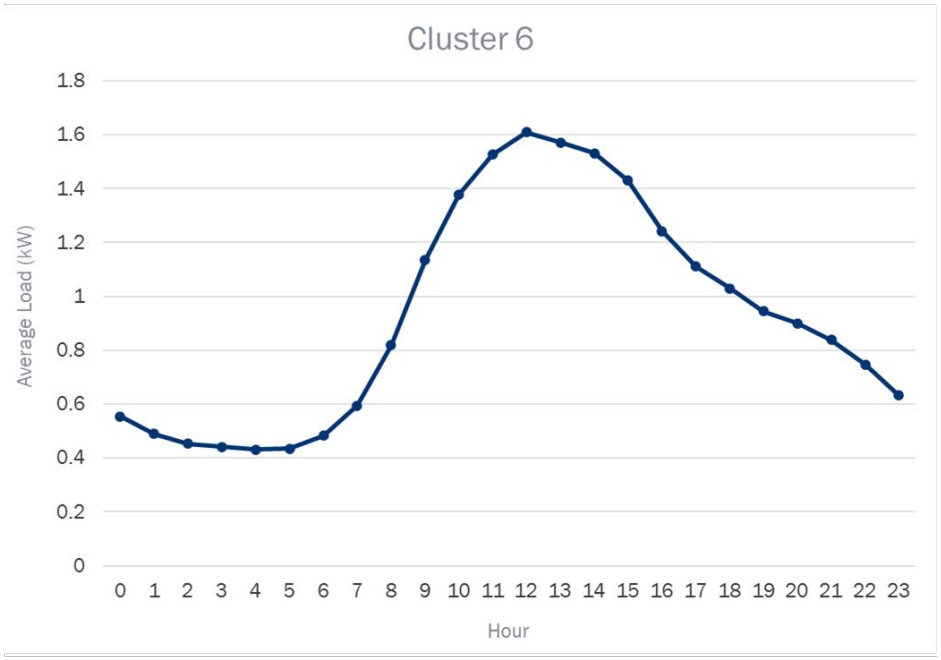


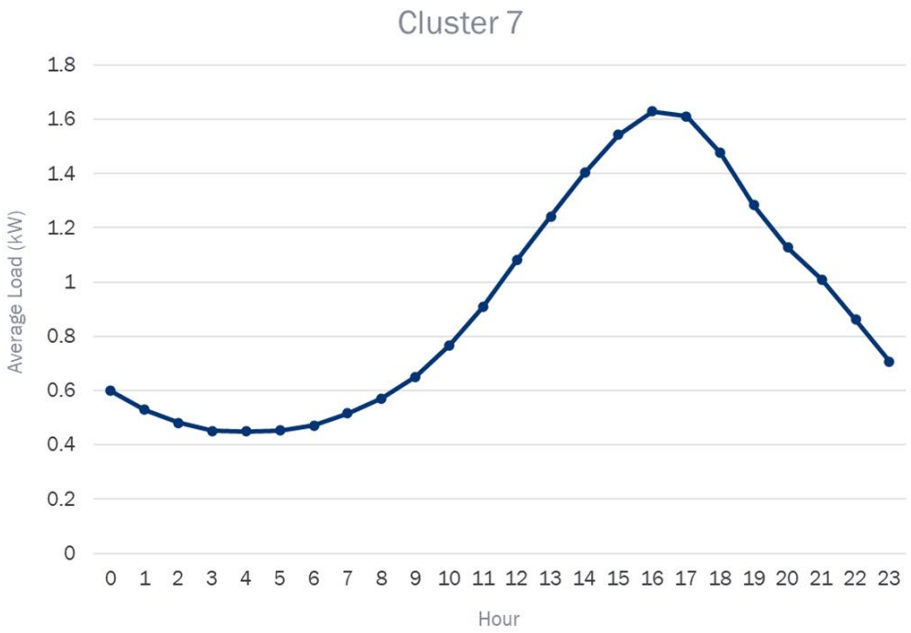
Figure 37 depicts the load profile separately for each cluster.

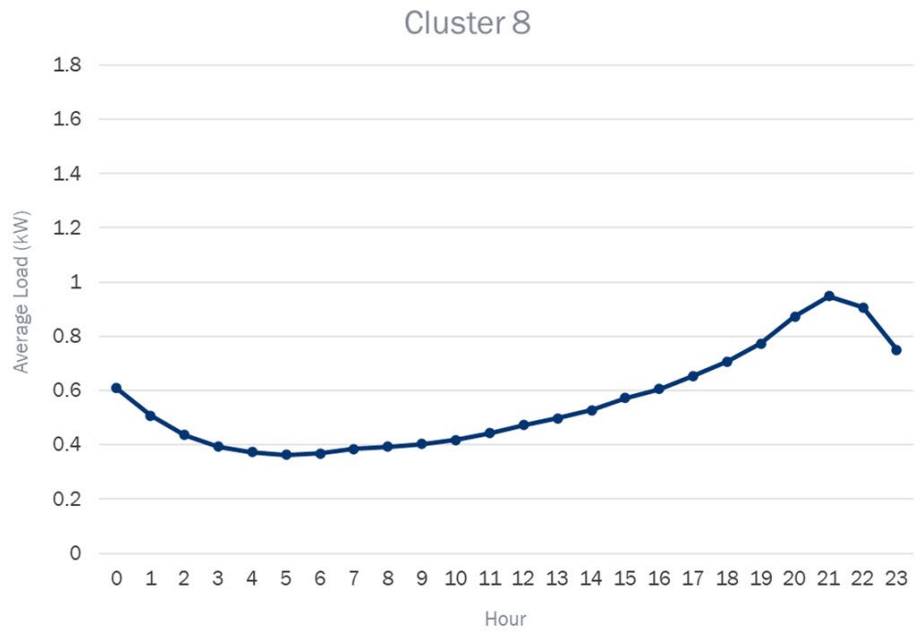
Figure 37. Average Weekday Load Profile by Cluster

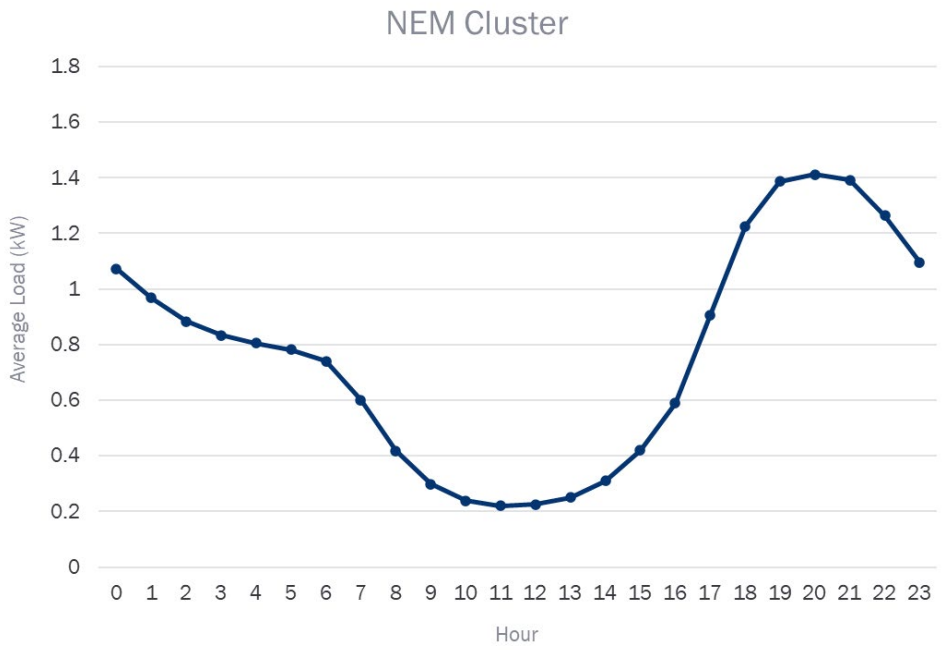



Cluster 5
Average Load (kW)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour


Cluster 6
Average Load (kW)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour


Cluster 7
Average Load (kW)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour


Cluster 8
Average Load (kW)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour


NEM Cluster
Average Load (kW)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour

DIFFERENTIATING FACTORS BETWEEN CLUSTERS

Table 13 through Table 40 summarize key attitudinal, demographic, and housing characteristics by cluster.

For each table in this section, the number of customers by cluster are as follows: 1 (n=219), 2 (n=323), 3 (n=66), 4 (n=277), 5 (n=393), 6 (n=93), 7 (n=372), 8 (n=277), NEM (n=573), and overall (n=2,744).[25]

Table 13. California Identity Score by Cluster

Clusters	California Identity Score		
	High	Medium	Low
1	61%	15%	24%
2	55%	18%	27%
3	58%	17%	26%
4	55%	16%	29%
5	63%*	13%	24%
6	47%	17%	35%
7	56%	17%	27%
8	59%	16%	25%
NEM	50%	16%	34%*
Overall Sample	**56%**	**16%**	**28%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 14. Energy Efficiency Attitude Score by Cluster

Clusters	Energy Efficiency Attitude Score		
	Positive	Neutral	Negative
1	79%	16%	5%
2	77%	19%	4%
3	80%	17%	3%
4	76%	18%	6%
5	86%*	11%	4%
6	68%	23%	10%*
7	76%	17%	6%
8	79%	16%	5%
NEM	75%	17%	8%*
Overall Sample	**78%**	**16%**	**6%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

[25] The overall n includes 151 customers who completed the survey but did not receive a cluster assignment due to data limitations.

Table 15. Control Over Energy Use by Cluster

Clusters	Control Over Energy Use			
	A Great Deal	Quite a Bit	Some	Not Very Much or None
1	21%	43%	26%	10%
2	23%	39%	29%	9%
3	20%	39%	33%	8%
4	19%	40%	32%	9%
5	22%	38%	33%	7%
6	25%	40%	30%	5%
7	17%	41%	30%	12%*
8	22%	33%	32%	13%*
NEM	21%	43%*	30%	6%
Overall Sample	**21%**	**40%**	**30%**	**9%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 16. Home Ownership by Cluster

Clusters	Home Ownership	
	Own	Rent
1	69%	31%
2	46%	54%*
3	52%	48%*
4	58%	42%*
5	55%	45%*
6	69%	31%
7	62%	38%
8	55%	45%*
NEM	95%*	5%
Overall Sample	**65%**	**35%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 17. Amount of Things Customer Could Change in Home to Increase Energy Efficiency by Cluster

Clusters	How Many Things Could Change to Make Their Home More Energy Efficient			
	A Lot	Some	A Few	Home is Already as Efficient as Possible
1	19%	41%	28%	12%
2	25%*	38%	28%	8%
3	23%	39%	23%	15%
4	23%*	37%	29%	12%
5	21%	37%	27%	15%
6	15%	41%	30%	14%
7	21%	40%	26%	13%
8	21%	43%*	24%	12%
NEM	10%	33%	35%*	23%*
Overall Sample	**19%**	**38%**	**29%**	**15%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 18. Dwelling Type by Cluster

Clusters	Dwelling Type				
	Single-family Detached	Single-family Attached or Multifamily (2-4 units)	Multifamily (5+ units)	Mobile or Manufacture Home, Boat, RV, Camper, Other	Prefer Not to Say
1	51%	26%*	20%	3%	<1%
2	44%	25%*	28%*	1%	2%
3	32%	24%	33%*	3%	8%*
4	56%	21%	21%*	1%	2%
5	47%	22%*	26%*	3%	2%
6	74%*	8%	15%	1%	2%
7	58%	17%	16%	6%*	3%
8	45%	25%*	22%*	5%*	3%
NEM	88%*	7%	2%	2%	2%
Overall Sample	**58%**	**19%**	**18%**	**3%**	**2%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 19. Home Build Year by Cluster

Clusters	Home Build Year				
	Before 1950	1950–1974	1975–1999	2000 or later	Unsure
1	11%	29%	37%	13%	10%
2	10%	25%	30%	17%	17%*
3	18%*	15%	27%	18%	21%*
4	13%	25%	34%	18%	11%
5	13%*	28%	30%	17%	11%
6	6%	32%	34%	19%	8%
7	7%	29%	35%	13%	15%*
8	13%	27%	25%	19%	16%*
NEM	9%	27%	35%*	27%*	1%
Overall Sample	**11%**	**27%**	**32%**	**19%**	**11%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 20. Home Square Footage by Cluster

Clusters	Home Square Footage						
	Less than 750	751–1,000	1,001–1,500	1,501–2,000	2,001–3,000	More than 3,000	Unsure
1	12%	16%*	33%*	18%	12%	4%	5%
2	17%*	15%*	31%*	12%	9%	3%	12%
3	14%	18%*	17%	17%	15%	11%	9%
4	12%	13%	28%	16%	14%	3%	14%*
5	13%*	16%*	25%	16%	15%	3%	12%
6	10%	5%	19%	19%	22%	14%*	11%
7	10%	12%	30%*	17%	13%	2%	16%*
8	13%*	12%	26%	15%	16%	2%	15%*
NEM	1%	4%	18%	26%*	33%*	14%*	3%
Overall Sample	**10%**	**12%**	**26%**	**18%**	**18%**	**6%**	**10%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 21. Primary Cooling Source by Cluster

Clusters	Cooling Source				
	Central Air Conditioning	Room Air Conditioning	Fans Only	Other	None
1	41%	11%	37%*	2%	9%*
2	45%	25%*	22%	3%	6%
3	44%	24%*	23%	2%	8%
4	56%	13%	24%*	2%	5%
5	43%	22%*	23%*	3%	9%*
6	60%	16%	18%	2%	3%
7	77%*	14%	7%	1%	1%
8	43%	21%*	27%*	1%	8%*
NEM	81%*	7%	8%	2%	2%
Overall Sample	**58%**	**16%**	**19%**	**2%**	**5%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 22. Thermostat Type by Cluster

Clusters	Thermostat Type			
	Wi-Fi Connected Smart Thermostat	Programmable or Remote Style Thermostat (Not Wi-Fi-Connected)	Manual or Dial Thermostat	Don't Have Any Thermostats
1	10%	50%	29%*	15%
2	12%	40%	25%*	24%*
3	12%	36%	29%*	26%*
4	15%	13%	17%	19%*
5	12%	49%	23%*	18%
6	22%	52%	16%	12%
7	17%	60%*	15%	10%
8	16%	44%	17%	25%*
NEM	37%*	54%*	8%	4%
Overall Sample	**19%**	**50%**	**18%**	**15%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).
Note: Multiple responses allowed. The response option "Don't have any thermostats" was exclusive.

Table 23. Water Heater Fuel by Cluster

Clusters	Water Heater Fuel			
	Electric	Gas (Natural Gas or Propane)	Other	Unsure
1	21%*	61%	0%	18%
2	16%	61%	0%	23%*
3	18%	68%	0%	14%
4	17%	65%	0%	18%
5	19%*	59%	<1%	23%*
6	6%	80%*	0%	14%
7	12%	68%	<1%	19%
8	17%	62%	1%*	20%*
NEM	13%	83%*	<1%	4%
Overall Sample	**16%**	**68%**	**<1%**	**17%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 24. Whether Customer Has an Electric Clothes Dryer in Home by Cluster

Clusters	Have an Electric Clothes Dryer		
	Yes	No	Unsure
1	42%*	54%	4%
2	36%	57%	7%
3	29%	70%*	2%
4	35%	60%	5%
5	39%	54%	7%*
6	32%	65%	3%
7	34%	61%	5%
8	34%	58%	9%*
NEM	35%	62%*	2%
Overall Sample	**36%**	**59%**	**5%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 25. Appliances in Home by Cluster

Clusters	Appliances in Home				
	Second or Spare Refrigerator	Stand-alone Freezer	Dishwasher	Rooftop Solar Panels	Battery Storage Device
1	21%	16%	65%	2%	1%
2	22%	20%	54%	1%	2%
3	24%	15%	61%	3%	3%
4	30%	12%	58%	1%	<1%
5	20%	15%	57%	2%	1%
6	40%*	15%	60%	5%	0%
7	28%	21%	53%	<1%	1%
8	25%	12%	54%	3%	2%
NEM	50%*	32%*	80%*	97%*	9%*
Overall Sample	**30%**	**20%**	**62%**	**22%**	**3%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 26. Whether Customer Drives EV by Cluster

Clusters	Drives EV		
	Yes	No	Unsure
1	5%	95%	2%
2	11%	95%	2%
3	26%*	89%	5%
4	5%	94%	4%
5	3%	96%*	2%
6	2%	98%	1%
7	2%	94%	5%*
8	9%	93%	4%
NEM	21%*	93%	1%
Overall Sample	**10%**	**94%**	**3%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 27. IOU Provider by Cluster

Clusters	IOU Provider		
	PG&E	SCE	SDG&E
1	45%*	12%	43%
2	32%	28%*	40%
3	27%	23%	50%
4	43%*	27%	30%
5	36%	24%	40%
6	33%	25%	42%
7	32%	40%*	28%
8	32%	30%*	37%
NEM	34%	12%	54%*
Overall Sample	**35%**	**26%**	**40%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 28. Customer Age by Cluster

Clusters	Age			
	18–34	35–54	55–74	75+
1	7%	25%	48%*	20%*
2	17%*	37%	38%	9%
3	18%	39%	39%	3%
4	12%	43%*	38%	7%
5	13%	32%	40%	15%
6	5%	33%	47%	14%
7	13%	33%	41%	12%
8	21%*	35%	38%	7%
NEM	5%	31%	47%*	16%*
Overall Sample	**12%**	**34%**	**41%**	**12%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 29. Customer Level of Education by Cluster

Clusters	Level of Education						
	Less than High School Degree	High School Degree	Technical or Trade School	Associate Degree or Some College	Bachelor's Degree	Professional Degree (e.g., JD, MBA, MD, PhD)	Don't Know
1	2%	9%	4%	20%	36%*	28%	1%
2	5%	13%	6%	23%*	30%	22%	1%
3	3%	12%	3%	18%	21%	39%*	3%
4	4%	13%	4%	21%	28%	28%	2%
5	4%	12%	5%	19%	30%	29%	2%
6	2%	12%	4%	20%	24%	35%	2%
7	6%*	18%*	9%*	21%	26%	17%	3%*
8	6%*	17%*	7%	13%	30%	26%	2%
NEM	<1%	6%	5%	15%	36%*	37%*	1%
Overall Sample	**3%**	**12%**	**6%**	**19%**	**31%**	**28%**	**2%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 30. Working From Home Schedule by Cluster

Clusters	Working From Home Schedule				
	Full-Time	Hybrid (Work from Home Part-Time)	Never	Other Schedule	Prefer Not to Say
1	38%*	23%	45%	2%	5%
2	30%	22%	54%	3%	4%
3	28%	32%	51%	0%	8%
4	17%	25%	61%*	4%*	6%
5	34%	26%	43%	3%	6%
6	33%	21%	47%	3%	4%
7	30%	17%	54%	2%	9%*
8	22%	25%	58%*	2%	7%
NEM	37%*	30%*	46%	3%	3%
Overall Sample	**31%**	**24%**	**51%**	**3%**	**5%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 31. Political Party Affiliation by Cluster

Clusters	Political Party		
	Republican	Democrat	No Preference
1	17%	42%*	41%
2	13%	37%	50%
3	9%	36%	55%
4	18%	34%	49%
5	11%	40%*	49%
6	20%	30%	49%
7	17%	28%	55%*
8	13%	34%	53%*
NEM	20%*	37%	43%
Overall Sample	**16%**	**36%**	**48%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 32. Customer Race by Cluster

Clusters	Race					
	White	Asian	Black or African American	Hispanic or Latino	Other	Don't Know/ Prefer Not to Say
1	66%*	14%	3%	3%	7%	11%
2	52%	16%	6%*	6%*	6%	20%
3	53%	15%	6%	2%	6%	21%
4	58%	13%	3%	5%*	5%	21%
5	54%	17%*	4%	3%	9%*	20%
6	63%	15%	2%	3%	4%	18%
7	60%	8%	4%	4%	7%	21%
8	52%	19%*	4%	4%	6%	21%
NEM	69%*	10%	4%	2%	6%	14%
Overall Sample	**60%**	**14%**	**4%**	**4%**	**6%**	**18%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 33. Primary Language Spoke in Home by Cluster

Clusters	Primary Language Spoken in Home		
	English	Spanish	Other
1	86%	4%	10%
2	80%	9%	11%*
3	89%	8%	3%
4	80%	14%*	6%
5	83%	10%	7%
6	85%	8%	8%
7	83%	13%*	5%
8	74%	15%*	11%*
NEM	93%*	3%	4%
Overall Sample	**84%**	**9%**	**7%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 34. Whether Household Member(s) Have Health Condition by Cluster

Clusters	Whether Household Member(s) Have Health Conditions		
	Yes	No	Don't Know/ Prefer Not to Say
1	11%	84%*	5%
2	14%	79%	7%
3	15%	80%	5%
4	16%	79%	6%
5	17%	77%	6%
6	12%	80%	9%
7	27%*	64%	8%
8	15%	79%	6%
NEM	19%	74%	7%
Overall Sample	**17%**	**76%**	**6%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 35. 2022 Annual Household Income by Cluster

Clusters	2022 Household Annual Income						
	Less than $30,000	$30,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999	$100,000 to $199,999	$200,000 or more	Prefer Not to Say
1	11%	9%	11%	11%*	25%	9%	25%
2	20%*	14%*	13%	6%	17%	9%	22%
3	11%	5%	15%	8%	21%	17%	24%
4	9%	15%*	14%	8%	22%	10%	22%
5	16%	10%	13%	7%	18%	10%	27%
6	12%	10%	9%	9%	16%	16%	29%
7	20%*	15%*	12%	7%	16%	5%	24%
8	18%*	10%	13%	6%	19%	11%	22%
NEM	4%	5%	8%	8%	27%*	19%*	29%*
Overall Sample	**13%**	**10%**	**11%**	**7%**	**21%**	**12%**	**25%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 36. Whether or Not Children Live in Home by Cluster

Clusters	Do Children Live in the Home?	
	Yes	No
1	23%	77%*
2	25%	75%*
3	27%	73%
4	40%*	60%
5	27%	73%
6	23%	77%
7	35%*	65%
8	34%	66%
NEM	30%	70%
Overall Sample	**30%**	**70%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 37. Whether Someone is Typically Home During Flex Alert Events

Clusters	Whether or Not Someone is Typically Home During Flex Alert Event (4–9 p.m.)	
	Yes	No
1	96%	4%
2	89%	11%*
3	86%	14%*
4	95%	5%
5	93%	7%
6	96%	4%
7	95%	5%
8	92%	8%
NEM	96%*	4%
Overall Sample	**93%**	**7%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 38. Customer Climate Zone by Cluster

Clusters	Climate Zone		
	Coastal	Inland	Mountains
1	57%*	23%	20%
2	47%*	34%	19%
3	56%*	24%	20%
4	40%	40%	20%
5	54%*	31%	15%
6	38%	39%	24%*
7	17%	63%*	20%
8	50%*	32%	18%
NEM	38%	51%*	12%
Overall Sample	**42%**	**41%**	**17%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 39. Whether Customer is On CARE by Cluster

Clusters	CARE Customer	
	Yes	No
1	29%	71%*
2	42%*	58%
3	27%	73%
4	40%*	60%
5	39%*	61%
6	27%	73%
7	54%*	46%
8	42%*	58%
NEM	13%	87%*
Overall Sample	**34%**	**66%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

Table 40. Whether Customer Self-Enrolled in PSR by Cluster

Clusters	Self-Enrolled in PSR	
	Yes	No
1	7%	93%
2	2%	98%
3	9%	91%
4	1%	99%*
5	4%	96%
6	0%	100%
7	2%	98%*
8	5%	95%
NEM	9%*	91%
Overall Sample	**4%**	**96%**

*The percentage for the indicated cluster is statistically higher than the overall sample average (p<.10).

APPENDIX C. CUSTOMER PERFORMANCE ASSESSMENT METHODS

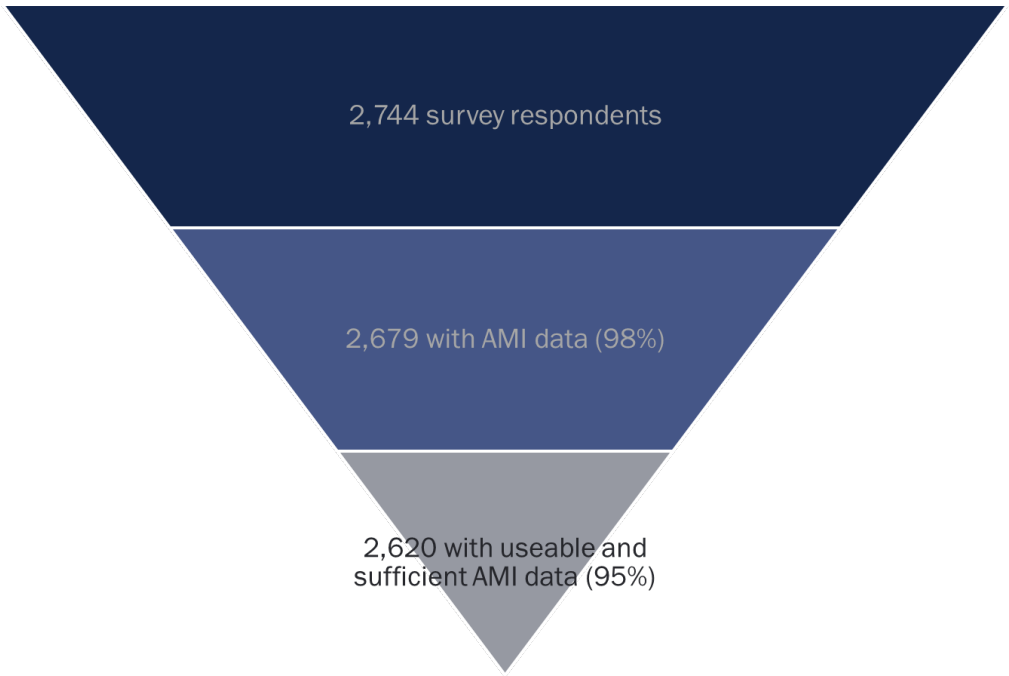
DATA PREPARATION

Beginning with the AMI datasets provided by the IOUs for each survey respondent, we limited the data to the summer 2022 period of May 1, 2022, through October 31, 2022. We reviewed and prepared the data to restrict it to those customers and records well suited for the performance analysis. We took the following steps to prepare the data:

- **No AMI data:** Survey respondents without AMI data were excluded from the analysis.
- **Duplicates:** Removed exact duplicate records and identified and accounted for instances of multiple readings for the same account, premise, and interval.
- **Checked kWh values:** Removed records where the kWh delivered was missing, zero, or negative (excluding net usage values for customers flagged as NEM).
- **Insufficient AMI data:** Removed accounts with missing data on event or baseline days. Removed accounts with AMI data for less than 75% of the days in the analysis period.
- **Net usage:** We conducted additional review and preparation of data on excess solar generation returned to the grid for net energy metered (NEM) customers and calculated their net energy usage (delivered to customers from the grid – excess generation sent to the grid). These data were only used for the exploratory NEM analysis presented below.

Figure 38 summarizes the results of the data cleaning process for the clustering analysis. We were able to include 95% of the survey respondents in this analysis.

Figure 38. Data Cleaning Results - Performance Analysis



IOU-SPECIFIC BASELINE METHODOLOGIES

From each IOU, we requested documentation of the methodology used to calculate performance in Flex Alert events for participants in the PSR program. We then applied these methodologies to calculate event performance for both Flex Alert and PSR customers in our sample. For NEM customers, load impacts were calculated using "delivered" energy values instead of net usage. Table 41 summarizes the baseline methods for each IOU.

Table 41. Baseline Methods

IOU	Weekday Event	Weekend/Holiday Event
PG&E	5-in-10 with same-day adjustment	Weighted average 3-in-5 with same-day adjustment
SCE	5-in-10 with same-day adjustment	Weighted average 3-in-5 with same-day adjustment
SDG&E	3-in-5 without adjustment	1-in-3 without adjustment

A 5-in-10 or 3-in-5 baseline refers to the selection of baseline days before an event. A 5-in-10 baseline, for example, is calculated by averaging the five highest total usage days out of the 10 similar days prior to the event, excluding other event days. Similar days are either weekends/holidays or weekdays, depending on whether the event day is a weekday or weekend/holiday. SCE and PG&E use a weighted average for weekends, where more recent days are weighted more heavily in the baseline.

Both PG&E and SCE use the same same-day adjustment: a ratio of ratios. First, they calculate a ratio of the average load two to four hours before the event to the average load two to four hours after the event for (a) the event day and (b) the average load of the base days. Then, they take the ratio of a to b. The final ratio is limited, so it cannot be less than 0.6 or greater than 1.4. Since the PSR events end at 9:00 p.m., the approach calls for stopping the post-event average at midnight (so the post-event average only includes the time two to three hours after the event, or 11:00 p.m. to midnight). The same-day adjustment is then multiplied by the average baseline to get the final baseline, which is used to calculate performance.

PERFORMANCE AGGREGATION

Our analysis resulted in customer-level, hourly load (kW) impacts, which were converted to percent load impacts by dividing these by the baseline load. If the performance during the event hour represented an increase in load over the baseline (i.e., impacts less than zero), the results were floored at zero (i.e., impact of 0%). To estimate each customer's average performance throughout the event season, we first took the average of their zero floored percent load impacts across all hours in the event. Next, we calculated each customer's average event performance for the season by taking an average of the percent load reduction for each event.

Based on their average percentage load reductions across all events in the season, each customer was classified as a low, medium, or high performer. Performance groupings were defined based on standard deviations from the mean percent load reduction, where the medium performance group is anyone who performed within one standard deviation above or below the mean percent performance value for the season.

DETAILED RESULT

Figure 39,

Figure 40, and Figure 41 depict the event day vs. baseline load shapes. We show these overall and for only those customers who saved in the event. In general, the evaluation team feels there are some limitations to the baseline methodology when deployed for the estimation of load impacts, specifically as it relates to the performance and

accuracy of the baseline. Given that the objective of this study was not to estimate load impacts for either the Flex Alert or PSR campaign but rather to understand drivers of *relative* load reduction achieved between customers, we are comfortable leveraging the methodology despite these limitations.

Figure 39. High-Performance Group: Average Event Day vs. Baseline Load Shape

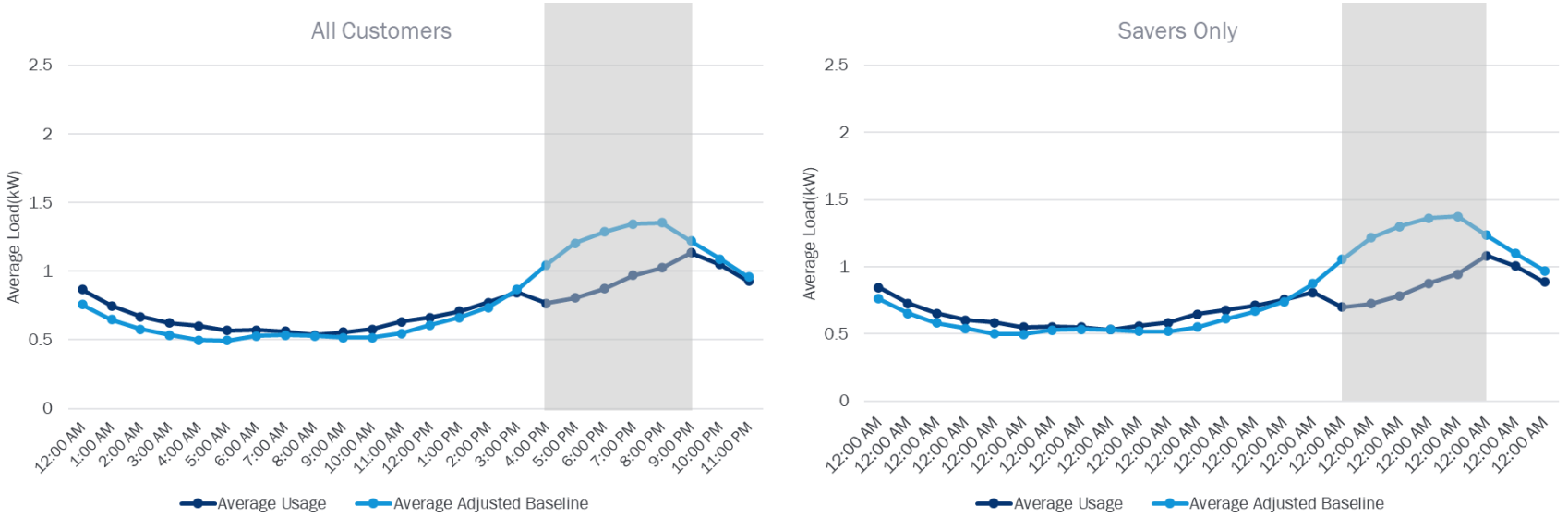


Figure 40. Medium-Performance Group: Average Event Day vs. Baseline Load Shape

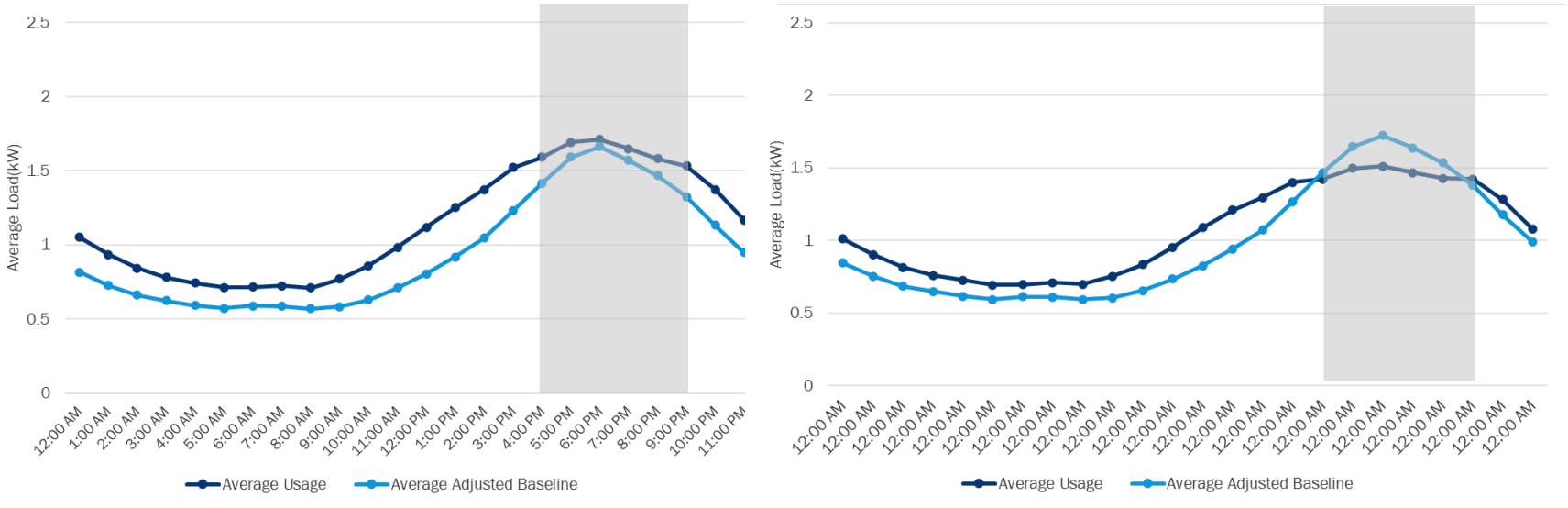


Figure 41. Low-Performance Group: Average Event Day vs. Baseline Load Shape

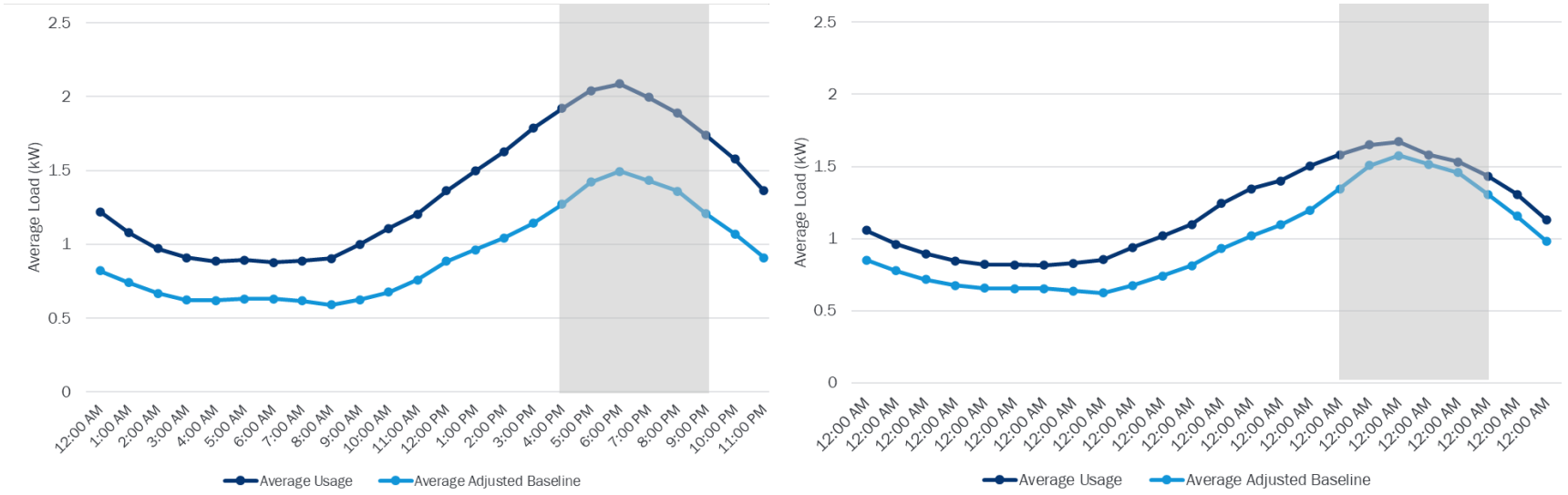


Table 42 provides performance results by event and performance level.

Table 42. Average Per-Household Performance by Event and Performance Level

Event	Low Performers		Medium Performers		High Performers		Average	
	kW	% Baseline	kW	% Baseline	kW	% Baseline	kW	% Baseline
8/17/2022	0.25	13.11	0.45	25.34	0.54	39.66	0.41	26.04
8/31/2022	0.06	4.03	0.31	19.52	0.58	45.61	0.31	23.05
9/1/2022	0.06	3.72	0.27	17.23	0.61	45.60	0.31	22.19
9/2/2022	0.06	3.75	0.32	18.59	0.69	48.25	0.36	23.53
9/3/2022	0.04	2.58	0.29	16.86	0.59	44.20	0.31	21.22
9/4/2022	0.04	2.83	0.27	15.09	0.59	42.91	0.30	20.28
9/5/2022	0.04	2.44	0.23	12.66	0.52	36.15	0.27	17.08
9/6/2022	0.03	1.83	0.25	14.27	0.61	43.42	0.30	19.84
9/7/2022	0.03	1.71	0.26	14.06	0.60	42.61	0.30	19.46
9/8/2022	0.05	2.40	0.29	14.83	0.58	40.11	0.30	19.11
9/9/2022	0.26	11.05	0.56	26.00	0.70	45.67	0.51	27.57
Average	0.08	4.50	0.32	17.68	0.60	43.11	0.33	21.76

Table 43 provides performance results by event and IOU. IOU results are not directly comparable due to methodological differences between the IOUs.

Table 43. Average Per-Household Performance by Event and IOU

Event	PG&E		SCE		SDG&E		Average	
	kW	% Baseline	kW	% Baseline	kW	% Baseline	kW	% Baseline
8/17/2022	0.47	26.81	0.51	23.99	0.38	26.48	0.45	25.76
8/31/2022	0.41	29.58	0.32	15.69	0.24	19.39	0.32	21.55
9/1/2022	0.35	23.79	0.32	16.31	0.22	18.40	0.30	19.50
9/2/2022	0.44	27.07	0.40	17.87	0.22	18.10	0.35	21.01
9/3/2022	0.36	23.38	0.35	16.91	0.24	16.81	0.31	19.03
9/4/2022	0.29	19.36	0.35	16.80	0.25	16.72	0.30	17.63
9/5/2022	0.24	15.67	0.29	13.96	0.23	14.66	0.25	14.76
9/6/2022	0.31	18.00	0.32	14.85	0.22	17.40	0.29	16.75
9/7/2022	0.36	19.39	0.35	16.27	0.18	14.72	0.30	16.79
9/8/2022	0.30	17.50	0.39	16.61	0.24	16.85	0.31	16.99
9/9/2022	0.41	23.08	0.85	31.06	0.48	28.00	0.58	27.38
Average	0.36	22.15	0.40	18.21	0.26	18.87	0.34	19.74

ADDITIONAL FINDINGS FOR NEM SITES

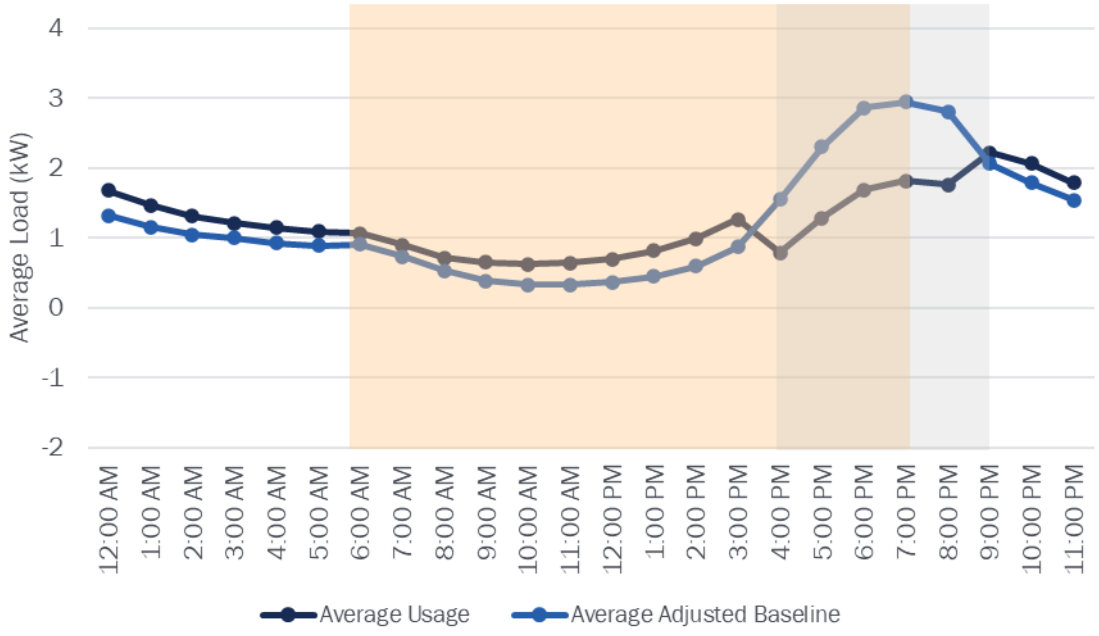
For all customers in our analysis, we conducted a performance assessment using delivered energy values instead of net usage (net usage is delivered energy from the IOU – customer excess generation returned to the grid). This

approach aligns with the methodologies documented and shared by the IOUs and was used for the performance assessments presented throughout this report. We also calculated load impacts from net usage energy values for NEM customers. We conducted this analysis because a meaningful proportion (22%) of customers are NEM, and using net energy values to calculate load impacts might more accurately represent the load reductions achieved by NEM customers and resulting grid impacts. For example, one could hypothesize that if a NEM customer always has enough solar generation on a typical summer weekday to cover their household's energy needs, their delivered energy value would be zero even before any actions are taken to reduce energy usage. However, when net usage is used in the calculation, we might see that their actions resulted in the ability to send additional energy back to the grid (e.g., net usage decreasing from -0.2 kW to -0.6 kW, representing a load reduction of 0.4 kW).

Through our analysis, we found that the SCE, PG&E and SDG&E baseline methodologies have limitations when applied to net usage values. First, the algorithm for the determination of similar days to be used in the baseline prioritizes recent days and days that are similar in terms of use (aligning weekdays with weekdays and weekend/holidays with weekend/holidays), rather than days with similar solar generation. This could lead to a biased baseline when calculating performance from net consumption values, as a series of cloudy days in the baseline and a sunny event day would underestimate the solar generation on the event day or vice versa. Likewise, for some IOUs we apply a same-day adjustment factor derived in part from the hours before the event which cover peak sunlight hours when delivered kWh may approach or reach zero and net values may become negative. This effect leads the adjustment calculated with net kWh values to be higher on average than the adjustment calculated with delivered kWh values. Taken together, these findings suggest that additional exploration is warranted into how accurate current baseline approaches are when applied to net usage values.

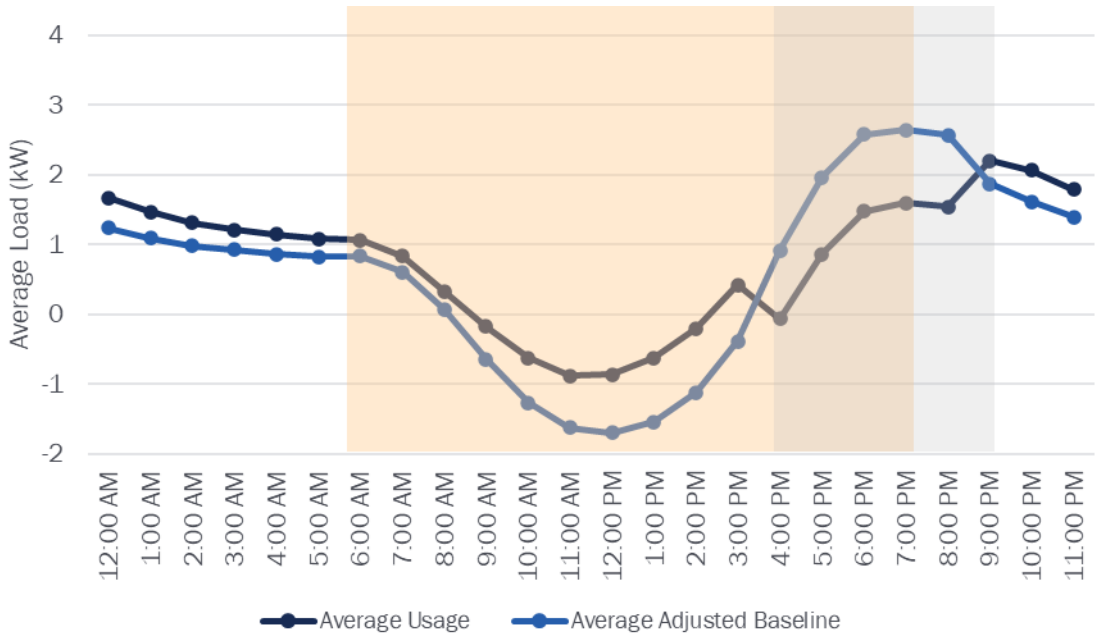
In our analysis, results calculated with the net kWh baseline were more varied across customers and had unrealistic performance as a percentage of baseline load, with percent savings as high as 190%.[26] The different results derived from using delivered versus net usage values can be observed in Figure 42 and Figure 43, respectively.

Figure 42. NEM Customer Event Day Loadshape - Delivered Consumption



[26] The highest percent load reduction observed when savings were calculated with delivered kWh values was 91%.

Figure 43. NEM Customer Average Event Day Loadshape - Net Consumption



Nevertheless, we found that, on average, the kW load impact calculated using net usage versus delivered energy is not meaningfully different for NEM sites. This trend is observed across event days (Table 44). On average, the difference in load impacts between the approaches was 0.02 kW. The approach using delivered energy values produced higher load impacts more often than the approach using net energy values (64% of days).

Table 44. Average Per-Household Performance for NEM Sites by Event and Energy Consumption Types

Event	Delivered Energy		Net Consumption	
	kW	%	kW	%
8/17/2022	0.58	30.9	0.54	79.1
8/31/2022	0.36	22.1	0.54	84.0
9/1/2022	0.35	20.1	0.41	47.9
9/2/2022	0.37	18.9	0.42	40.9
9/3/2022	0.35	17.2	0.41	70.8
9/4/2022	0.34	16.1	0.33	55.0
9/5/2022	0.34	14.4	0.28	35.3
9/6/2022	0.38	18.2	0.33	122.8
9/7/2022	0.39	17.8	0.28	115.3
9/8/2022	0.42	18.1	0.34	70.1
9/9/2022	0.78	29.2	0.57	191.9
Average	0.42	20.26	0.41	83.00

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