

Clean Power Alliance **POWER RESPONSE PROGRAM**



Authors:

Vasudha Lathey
Joe Bourg
Marc Gaulier
Eniko Torneby

Alexander Storton
Forrest Csulak
Devon Schmidt
Naor Deleanu

Power Response Program (2019-2021)

FINAL REPORT

Prepared and Submitted by Olivine Inc.
November 2021



Table of Contents

Executive Summary	3
1.0 Introduction	5
2.0 Program Planning	9
2.1 Program Goals and Objectives	9
2.2 CPA Load Profile Analysis	10
2.3 DER Screening and Technology Selection	10
2.4 Cost Effectiveness Analysis	12
3.0 Program Design	12
3.1 Program Enrollment Process	14
3.2 Energy Savings Events and Trigger Strategy	15
3.3 Battery Rebate Program Offer	16
3.4 Program Marketing	17
4.0 Program Technology	19
4.1. Olivine Community Customer App	20
4.2. Olivine DER Platform	22
4.3. Customer Engagement Platform	23
4.4. Enrollment and Performance Reporting	24
5.0 Program Implementation Results	26
5.1 Program Implementation Summary	26
5.2 Program Enrollment Results	28
5.3 Event Performance Results	30
5.4 Customer Experience Survey Results	34
6.0 Resource Aggregation and Market Participation	35
6.1 Market Integration Overview	35
6.2 Market Operations	35
6.3 Resource Performance	36
6.4 Future Opportunities	37
7.0 Lessons Learned and Recommendations	38
Appendix A: Acronyms/Terms List	42
Appendix B: Map of sub-LAPs within CPA Service Area	43
Appendix C: Program Cost Effectiveness Scenarios and Results	44

List of Figures and Tables

Figure 1: How Clean Power Alliance Works	5
Figure 2: Olivine DER™ Platform Solution for CPA Power Response Program	6
Figure 3: Power Response Program Timeline	8
Figure 4: DER Screening Process	11
Figure 5: Program Enrollments Over Time with Marketing Activity	18
Figure 6: DAC vs non-DAC Responses to “Where did you hear about the program?”	19
Figure 7: Olivine Technology Suite Diagram	20
Figure 8: Olivine Community App for CPA Screenshot Examples	22
Figure 9: Customer Engagement Platform Screenshot Example	23
Figure 10: Enrollment Dashboard Showing Enrollment Density in CPA Service ZIP Codes	25
Figure 11: Map of Power Response Customers by Customer Class and Disadvantaged Status	28
Figure 12: Residential Customer Event Performance Over Time with Event Participation Method	31
Figure 13: Residential Customer Ratings for Overall Program Experience	34
Figure 14: Baseline Calculation Methodology Comparison - SCEC Aggregation August 20, 2020 Event	36
Table 1: DER Measure Screening Criteria and Weightings	11
Table 2: Economic Value Streams Analyzed by the DER-VM	12
Table 3: Power Response Program Design Summary	14
Table 4: Energy Savings Events Triggers	15
Table 5: Summary of Battery Rebate Program Details	16
Table 6: Primary Marketing Channels Used to Reach Customer Segments	18
Table 7: Customer Enrollments by Status	29
Table 8: Customer Enrollments by Technology	30
Table 9: Residential Customer Cost Effectiveness by Technology	33
Table 10: Residential Customer Impact by Technology	33
Table 11: Average Market Bid and Award Pricing	37
Table 12: Market Resource Participation and Performance Summary	37
Table 13: Summary of program cost effectiveness scenarios	44
Table 14: Program cost effectiveness scenarios by pillar	45

Executive Summary

This final report documents the planning, launch, implementation, and operations activities of the Clean Power Alliance's (CPA) Power Response Program, as well as highlights the program impacts and performance results of the Distributed Energy Resources (DER) aggregations managed by the program. The Power Response Program is an innovative Demand Response (DR) pilot program which was designed, launched, and administered in partnership with Olivine Inc. (Olivine) from 2019 to 2021. The Power Response Program was modeled after the Olivine Community™ model which manages diverse aggregations of DER technologies across all customer segments. The program offerings were collaboratively developed to meet policy, regulatory, procurement, and equity goals and objectives of CPA. The program pilot was designed around three technology pillars that were selected based on a rigorous screening and analyses. The resulting technology pillars were:

1. **Smart Thermostats** for residential and small business customers
2. **Battery Energy Storage Systems** for residential and small business, medium business and large commercial & industrial (C&I) customers
3. **Electric Vehicle (EV) Chargers** for medium business and large C&I customers

The Power Response Program was designed to maximize grid service value to a Community Choice Aggregator (CCA) and its enrolled customers via participation in Energy Savings Events that occurred weekdays between 4-9 pm. In response to event notifications, participants reduced their energy consumption during Energy Savings Events, which coincided with system-wide peak demand periods and high wholesale energy costs. The Power Response Program was powered by the Olivine Technology Suite, which performed a broad range of functions including customer communication, enrollment management, California Independent System Operator (CAISO) market resource registration, market participation, device control, DR event management, event performance measurement, and program metrics dashboarding and reporting. The program provided customers with attractive program enrollment and participation incentives without any penalties for under-performance during program events. In addition, underserved customers¹ were paid higher program incentives to achieve CPA's community equity goals of increased program participation among this customer segment.

As of July 31, 2021, the program had 621 customers and devices enrolled with 13% of enrollments coming from the underserved customer segment. The majority of devices (97%) enrolled in the Power Response Program were smart thermostats (600). The remaining enrolled devices included 3 EV charging stations and 18 battery energy storage systems. The program dispatched 41 events between July 2020-2021. The participation of customers in Energy Savings Events has resulted in 11,631 kWh of avoided wholesale energy purchases in peak periods which amounts to an estimated \$4,432 of avoided wholesale energy costs, \$6,401 of potential value in avoided Resource Adequacy (RA) purchases (which are not currently monetizable), and a total of 9,235 kg of carbon emission offsets for CPA. The CPA customers

¹ Underserved customers are defined as customer either residing in a Disadvantaged Community (DAC) or a customer on a California Alternate Rates for Energy (CARE) or Family Electric Rate Assistance (FERA) rate tariff.

have earned a total of \$122,215 in enrollment and participation incentives and event participation has resulted in an estimated \$2,848 of bill reductions. The program reached 19% of the enrollment target for residential energy storage, and 67% of the enrollment target for the residential smart thermostat program. While the pilot phase of the program was not designed to be cost effective, by increasing enrollments by 25% each year, reducing incentive levels by 25-50% and developing more vendor integrations, the program can be expected to become cost effective within 8 years. In May 2021, the Power Response Program became one of the first CCA administered programs to bid into the CAISO market. Supported by Olivine's comprehensive market bidding strategy designed to maximize value streams, CPA has positioned itself as a leader of DER integration among California CCAs.

The Power Response Program has received a positive response from customers and has helped CPA build brand recognition throughout its customer base. The results of a customer experience survey showed that over 85% of program participants have learned more about CPA and 83% of participants reported having a positive experience with the program. The survey also revealed that Power Response has led customers to learn more about Demand Response activities and new strategies to reduce energy consumption during peak hours. Additionally, the survey showed that customers would like to see more DER programs in the future that expand to include other DER technologies.

The design, launch, implementation, and operation of the Power Response Program has positioned CPA as a leader among California's CCA community and has resulted in important lessons learned. Among the six CCAs in California that have established DER programs, the Power Response program pilot was unique in its design and ability to engage all customer segments utilizing several DER technologies. Despite facing unique implementation challenges to engage C&I customers during COVID restrictions, the program did well with residential customers, helped CPA build customer relationships and brand awareness and engaged multiple technology vendors to support the program in the future. The Power Response program DER aggregation scaled adequately in spite of COVID challenges, and it is the first wholesale market integrated CCA program in the state of California. In addition, the program's "per event" load reduction performance was on par with more mature residential DR programs and is poised to continue to grow with the largest CCA customer base in the state. On average, residential participants in the program were able to provide 0.45 kW of load reduction in all events, compared with 0.22kW in PG&E's SmartRate program and 0.7 kW in SCE's Summer Discount Program. This high level of performance can be attributed to both direct control of smart thermostat devices as well as customer engagement in the app, which provided customers insight into their energy use and performance.

The path forward for the program will continue to leverage its unique design that allows participation from diverse customer segments and DER technologies, focus on equitable customer access, expanding services and offers for customers and continue providing valuable grid services to the CAISO markets. Based on the lessons learned and recommendations documented in this report, the program is well positioned for on-going success and increased scaling of the DER aggregation.

1.0 Introduction

This final report summarizes the design, launch and implementation of CPA's Power Response Program. CPA partnered with Olivine on this innovative and unique DER pilot program, one of the first such programs for a CCA, to provide end-to-end program design, implementation, and operations from 2019 to 2021.

CPA is a Load Serving Entity (LSE) and operates as a CCA providing high renewable content and competitively priced energy to its customers. Formed as a Joint Powers Authority, CPA has thirty-two member jurisdictions comprising thirty cities and the unincorporated areas of Los Angeles and Ventura Counties. CPA began serving its first customers in early 2018 by purchasing clean power that is delivered to customers by Southern California Edison (SCE). CPA is now the largest CCA in the State of California, and the nation's leading provider of 100% renewable energy, servicing over one million customer accounts and spanning a broad service area characterized by diverse geography, climate, and customer demographics. Since the early stages of its formation, CPA has placed a high level of importance on providing clean energy resources in its supply portfolio, complemented by the development and management of DERs in its service area (See Figure 1). The Power Response Program launched in 2019 and is CPA's first DER management program for its residential and C&I customers.

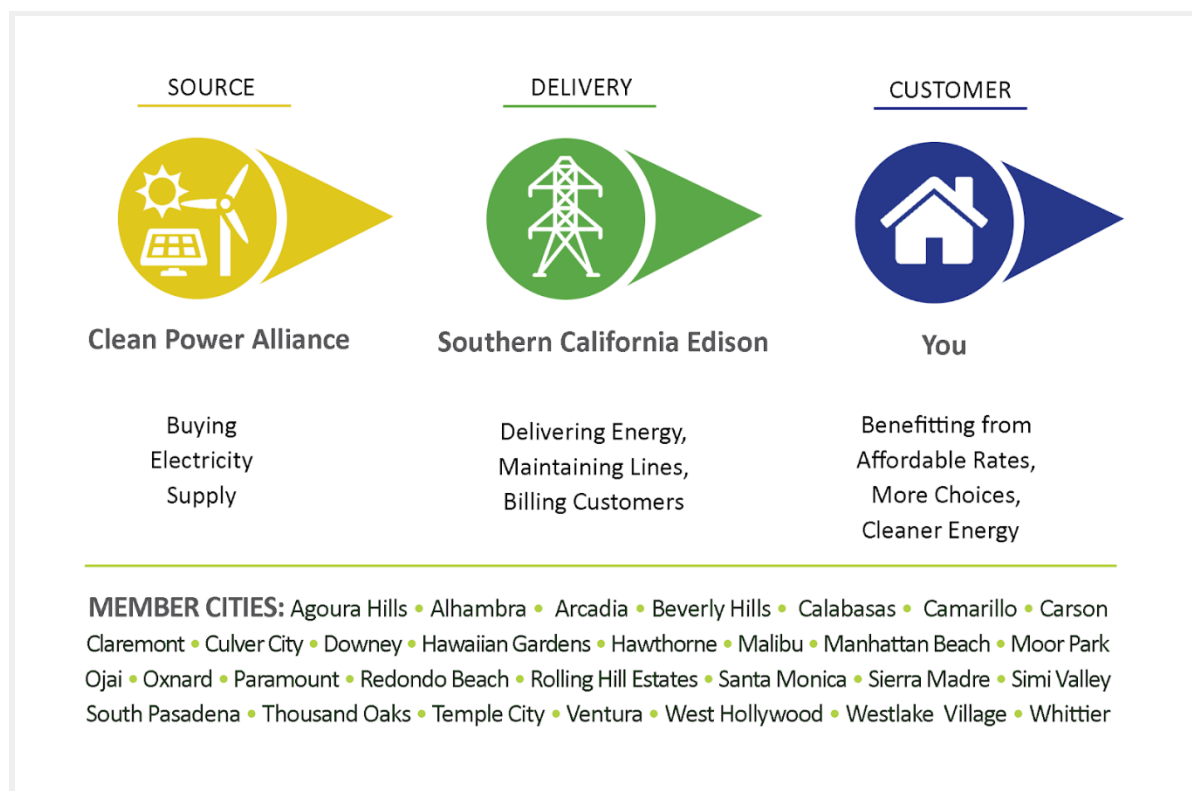


Figure 1: How Clean Power Alliance Works

Olivine is a DR and DER management industry pioneer committed to maximizing the value of behind-the-meter flexible loads and DERs through the provision of grid services. The Power Response Program utilizes the award-winning Olivine DER™ Platform and the Olivine Technology Suite to provide grid services while capturing value streams from wholesale procurement offsets, RA, and wholesale energy market revenues. The Olivine Technology Suite provides seamless and cost-effective resource integration, bid optimization and support, and value-added operational services in support of the Power Response Program's goals and objectives. Figure 2 below provides an overview of the Olivine DER™ Platform's end-to-end solution for managing behind the meter customer assets for the Power Response Program.

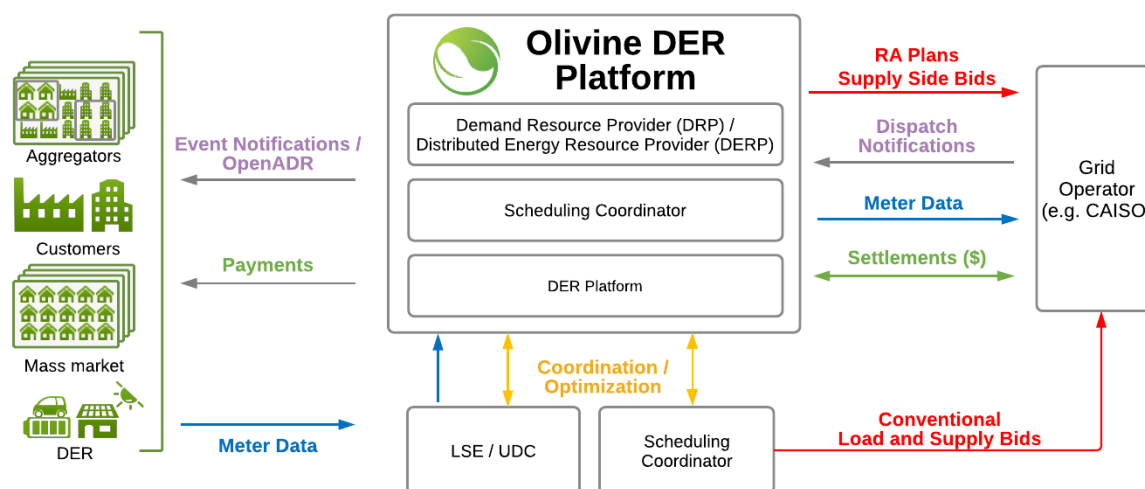


Figure 2: Olivine DER™ Platform Solution for CPA Power Response Program

In 2019 CPA engaged Olivine to gain real-world knowledge of how DER program deployments can be used to reduce system and customer demand, offset wholesale energy procurements, monetize DER deployments and establish a CPA brand presence in its service territory. The Olivine Community™ model was leveraged to design the CPA Power Response Program and Olivine worked collaboratively with the CPA team to customize the program design, market the program, enroll customers, manage the registration and operations of DER assets, oversee resource aggregations and events, develop market bidding strategies and event trigger parameters, process incentives and rebates, and provide technical assistance and support to CPA customers.

The Olivine Community™ model facilitated the deployment and aggregation of diverse DER assets across multiple customer classes that were collectively managed to meet the Power Response Program goals and objectives - making the program unique and innovative in the marketplace. Historically, DER program offerings by utilities have often focused on deployment of single-technology programs, which did not take full advantage of combining the benefits and operational characteristics of multiple and diverse technologies across a wide geographic range, customer classes and demographics. The increased flexibility and value proposition of the Olivine Community™ model optimizes DER aggregations to provide grid services when and where they are needed, maximizing benefits to both the customer and CPA.

The Olivine Community™ model also provides an equitable platform for everyone to participate in the clean energy ecosystem, including increased incentive values to encourage participation from low-income and DAC customers. Customers that can afford enabling technology may participate in programs by onboarding their DER technologies to the Olivine platform for remote management, while customers that lack the funds for such devices can still engage through the behavioral pathway through which customers take manual actions to reduce their load and participate in the program.

The Power Response Program is a multi-technology program for residential, small and medium-sized businesses, and C&I customers. The program has the following DER offerings (or ‘Technology Pillars’- as referred to in this report):

1. **Smart Thermostats** for residential and small business customers
2. **Battery Energy Storage Systems** for residential and small business, medium business and large C&I customers
3. **EV Chargers** for medium business and large C&I customers

The program was designed to aggregate these DERs by sub-Load Aggregation Point (sub-LAP) as defined by the CAISO² and optimize them to provide targeted grid services, strategic system peak load reduction, strategic load building, greenhouse gas (GHG) reductions, wholesale energy procurement offsets, RA, and local air quality and health benefits based on market, regulatory, and environmental conditions. The program dispatched and aggregated these individual DERs during Energy Savings Events, which requested customers to decrease load during select hours of the peak demand period for the grid (4-9 pm).

This report covers the CPA Power Response Program’s planning, design, and operations – culminating in the integration of program resources into the CAISO wholesale market. Figure 3 below details the key activities completed under the four phases of the program. Each of these components is addressed separately in this report.

² See Appendix B for a map of the sub-LAPS within the CPA service area



* Includes month of July

Figure 3: Power Response Program Timeline

2.0 Program Planning

The program planning phase (Q1-Q4 2019) included a series of sequential activities to develop the program design and prepare for program launch. The team kicked off the planning for the program by working in close collaboration with the CPA team to define the overall program goals and objectives. The team then conducted a detailed analysis of CPA's system load curves and customer class load profiles to identify opportunities for flattening the load curve and reducing wholesale procurement costs through the implementation and management of DERs. This information was used to develop a comprehensive list of DER measures for consideration in the program. Finally, the team conducted a comprehensive screening analysis to identify those DER measures that would most effectively achieve the program goals and objectives and to obtain the maximum strategic and economic benefits for CPA and its customers.

2.1 Program Goals and Objectives

The Power Response Program was designed to meet policy, regulatory, and procurement objectives for CPA that guided the design of the program. Specifically, this influenced the selection of technology pillars, identification of use cases, and the target mix of customer classes and demographics.

- *Policy:* The program aimed to support CPA policy objectives to improve air quality and public health, support and manage electrification, target underserved customers for program participation, support cost-effective renewable integration, and address local needs and resilience.
- *Regulatory:* The program was designed to support CPA in meeting several regulatory requirements such as the AB 2514 Storage Mandate, goals outlined in CPA's Integrated Resource Plan, CPUC RA requirements and the SB 350 Renewable Portfolio Standard.
- *Procurement:* The program targeted the attainment of cost-savings and optimization of value streams through reducing CPA's wholesale energy purchases, generating wholesale market participation revenues, capturing RA, and reducing customer bills. In addition to reducing energy consumption during peak wholesale price hours, the program was designed to leverage DER technologies that can increase energy usage during low-cost solar overgeneration hours through pre-cooling and load shifting via charging of battery energy storage systems and EVs, while reducing emissions from fossil fuel fired power plants.
- *Customer Benefits:* The program also focused on providing customer benefits such as program incentives and utility bill savings, and customer engagement and education focused on the energy and environmental benefits of program participation.
- *Community Benefits:* Beyond individual customers, the program was designed to provide value at the community level by reducing GHG emissions, improving air quality, and increasing grid resiliency.

The following sections describe the qualitative and quantitative analyses completed to identify the target customer segments and technologies that would align best with the above-stated program goals and objectives.

2.2 CPA Load Profile Analysis

The target customer segments for the program were identified by analyzing load curves for each customer segment and rate classification. The visualization of customer load data helped to identify the individual customer segments that contribute the most to the CPA system peak loads during times of high wholesale market prices, and correspondingly, best support the goals and objectives of the program. The load profile analyses also served to identify an initial list of DER technologies³ that could help flatten the system load profile and could support one or more one of the following load modification strategies:

1. Strategic load building during solar over-generation hours
2. Load shifting from peak hours to pre- and post- peak hours
3. Load curtailment / demand response on during peak load and high-cost hours

These initial DER measures were further analyzed in a DER Screening process which served to identify the final DER technologies for deployment through the Power Response Program.

2.3 DER Screening and Technology Selection

The DER screening process involved developing criteria for scoring and ranking all identified DER measures according to their potential to provide the desired benefits for CPA and its customers. From the CPA perspective, the selected screening criteria included examining the potential of each DER measure to meet CPAs strategic goals, wholesale market benefits, greenhouse gas emissions reduction, and accessibility to DAC and other underserved customers. communities from CPA's perspective. From the customer perspective, the screening criteria included the potential for bill savings and other economic benefits, ease of installation, and other benefits. All the initially identified DER technologies were evaluated and scored according to their relative ability to meet each of the specified criteria. [Figure 4](#) below outlines the process of narrowing down the initial list of technologies to the short list that would be further analyzed for inclusion in this program.

³ The initial list of DER technologies included Solar PV (rooftop and community), solar plus storage, A/C cycling, smart home packages, electric vehicles, smart thermostats, resistance water heaters, heat pump water heaters, behavioral demand response, smart appliances, pool pumps, flywheel, thermal storage, CHP, building management systems, and automated demand response.

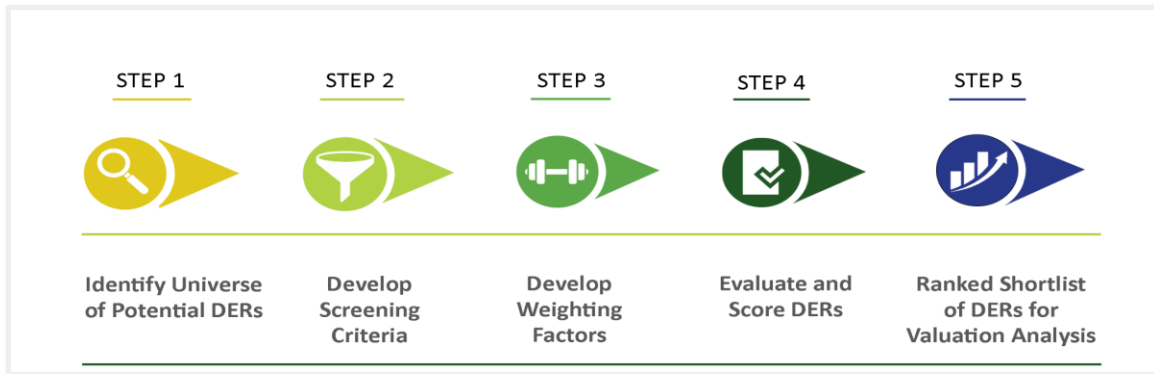


Figure 4: DER Screening Process

Table 1 below details the comprehensive list of criteria and their weighting factors in developing the relative scores for each DER measure from both the CPA and customer perspectives.

CPA Perspective			Customer Perspective		
Category	Criteria	Weight	Category	Criteria	Weight
CPA Goals	Air Quality and Public Health	9	Value Stream	Energy Savings	10
	Electrification	6		Demand Charge Management	10
	Target DACs	7		Energy Savings	10
	Cost-Effective Renewable Integration	10		Wholesale Market Revenue / Participation Incentive	10
	Local Needs and Resilience	8		TOU Arbitrage	10
CPA Benefits	CCA Storage Mandate	10		Reduction in O&M	10
	Reduced Wholesale Energy Procurement	10		Other Incentives	10
	Resource Adequacy	10	Ease of Implementation	Interconnection	10
Wholesale Market Participation	Day-Ahead Market	7.5		Permitting	10
	Real-Time Market	5		Availability	10
	Ancillary Services	2.5	Other Benefits	Comfort	5
Other Criteria	Technology Readiness	5		Backup Power	5
	Economic Development	2.5			
	Regulatory Support	2.5			
	LCFS Credit Generation	2			
	Scalability	3			
Total		100	Total		100

Table 1: DER Measure Screening Criteria and Weightings

Once the screening analysis of the initial DERs was complete, the DERs were ranked by score from highest to lowest from the CPA and customer perspectives separately. Next the top 10 DERs from each perspective were compared, and DERs that were in the top 10 for both perspectives were selected for additional cost-effectiveness analysis.

2.4 Cost Effectiveness Analysis

The final step in the program analysis and technology pillar selection was to model the cost-effectiveness of the DER use cases for each applicable customer segment resulting from the DER screening process. The cost effectiveness for each measure was modeled using the Olivine DER Valuation Model (DER-VM) from both the CPA and customer participant perspectives. The DER-VM matches anticipated load changes due to DER technology impacts to wholesale prices and customer rates to determine the financial impact of these DER technologies to CPA and the program participants. The model calculated the value streams for CPA and its customers shown below in [Table 2](#).

Perspective	Benefits	Costs
CPA	<ul style="list-style-type: none"> • Reduced Net Wholesale Energy Procurement Cost • Wholesale Market Revenues • RA Value 	<ul style="list-style-type: none"> • Lost Net Retail Energy Revenues • Customer Incentive Payments
Customer	<ul style="list-style-type: none"> • Reduced Net Energy Costs • Reduced Demand Charges (C&I only) • Program Incentives 	<ul style="list-style-type: none"> • Equipment Cost

Table 2: Economic Value Streams Analyzed by the DER-VM

The results of the valuation analysis documented which measures would provide the highest degree of cost effectiveness for CPA and its customers. Based on the final cost-effectiveness rankings of the short-listed DER measures, the following three DER technology measures were selected to be included in the program offering and categorized as ‘technology pillars’:

1. Smart Thermostats
2. Battery Energy Storage Systems
3. EV Chargers

3.0 Program Design

After selecting the three technology pillars, the team finalized the other program design elements with the main goals of maximizing the reach of the program among all CPA customers, meeting CPA’s equity goals, and removing some of the known barriers for demand response programs such as complex enrollment processes and underperformance penalties. The Power Response Program was finalized for launch using the Olivine Community™ model

which facilitated the deployment and aggregation of DER assets across multiple customer classes and helped CPA move away from a traditional siloed approach of program implementation. The community model also provides everyone an equitable access to programs and provides customers to participate in programs through technologies that can be remotely controlled or through a behavioral response by customers to control their devices.

The three program pillars were offered for enrollment across the following diverse customer classes:

1. **Smart Thermostats** for residential and small business customers
2. **Battery Energy Storage Systems** for residential and small business, medium business and large C&I customers
3. **EV Chargers** for medium business and large C&I customers

To attract as many people to the program as possible, the program provided customers with an enrollment incentive along with a participation incentive and no penalties for underperformance (See Table 3). To meet CPA's community equity goals, higher incentive levels were provided for underserved customers that resided in a DAC or if they were on utility assistance (CARE) or (FERA) discounts on their energy bill. Residential and small business customers were paid their incentive using an electric card which was redeemable for a VISA card or retail gift cards. Commercial and industrial customers were paid using credits on their utility bills. The program team also established some enrollments targets for each pillar that included targets for equity or underserved customers. Table 3 summarizes the key details of the program design.

Program Design Element	Details
Technology Pillars and Customer Segment	<ul style="list-style-type: none"> ● Pillar I: Residential and Small Business Smart Thermostat ● Pillar II: Residential, Small Business and C&I Battery Energy Storage ● Pillar III: C&I EV Charging
Incentives	<ul style="list-style-type: none"> ● Residential/SB participants (Paid via e-card): <ul style="list-style-type: none"> ○ Enrollment Incentive: \$100 (\$125 for underserved customers) ○ Participation Incentive: \$100/yr (\$125/yr for underserved customers) ● C&I participants (Paid via bill credits) <ul style="list-style-type: none"> ○ Enrollment Incentive: \$250 (\$300 for customers located in a DAC census tract) ○ Participation Incentive: \$100/kW-yr (\$125/kW-yr for customers located in a DAC census tract) ● A \$10 referral bonus for underserved customers when they helped facilitate other enrollments

Program Design Element	Details
Participation Targets	<ul style="list-style-type: none"> • Res/SB Pillar I: 900 enrollments (125 underserved) • Res/SB Pillar II: 100 enrollments (15 underserved) • C&I Pillar II: 90 enrollments (30 underserved) • C&I Pillar III: 45 enrollments (15 underserved) • Total: 1135 enrollments (195 underserved)

Table 3: Power Response Program Design Summary

3.1 Program Enrollment Process

The enrollment process for the Power Response Program was designed to make customer onboarding as smooth as possible. Residential and small business customers enrolled using a simple process via the multilingual Olivine Community web or mobile app. These customers used the app to create their account, get verified as active CCA (CPA) customers, accept program terms and conditions (T&Cs) and the participation agreement (PA), and provide Olivine authorization to access their electric meter data. All of these were required enrollment steps for customers to enroll in a CCA-run DR program in California. The Olivine app consolidated all these steps into one seamless process for customers. After confirming that these customers had completed these steps in the Olivine app and were not enrolled in any conflicting DR programs, the team enrolled them in the program and registered them in the CAISO markets. Program marketing efforts primarily guided customers to the Olivine app, and the ease of the app experience facilitated their conversion to full enrollments. Of the people that downloaded the app, 73% went on to complete enrollment. About 10% of those that did not complete enrollment did so only because they had a program conflict. In a survey sent out to customers, many customers said that the app flow was “easy.”

The program team engaged several DER technology vendors to facilitate direct control of DER technologies for their customers and established a partnership with ecobee smart thermostats. This vendor partnership also enabled ecobee customers to initiate program enrollment directly through the ecobee mobile app. The ecobee devices enrolled in the program were remotely controlled by Olivine during events. All other customers were asked to behaviorally control their DER technology during events. The program continues to actively engage other DER technology vendors as partners so that more customers could be offered the direct control participation route in the future.

C&I and municipal customers were enrolled through a more personalized approach, which offered them technical tools and free consulting to evaluate program participation benefits and were onboarded by completing an electronic program enrollment package. The team worked closely with C&I customers and provided technical assistance to determine their program participation benefits and what resource capacity (kW)⁴ they could commit into the program. The

⁴ The resource capacity commitment was the power capacity, in kilowatts (kW), the customer agreed to reduce during program events.

team analyzed these customers' historic load to determine if their buildings met the program minimum load requirements and accordingly recommended an appropriate resource capacity commitment for enrollment in the program. These customers were then enrolled in the program after they reviewed and accepted their capacity commitment and agreed to the Customer Information Service Request (CISR) agreement, program T&Cs, and PA.

3.2 Energy Savings Events and Trigger Strategy

Program participants were asked to reduce their energy consumption during Energy Savings Events during 4-9 PM to evaluate the potential for the program to earn revenues in the CAISO wholesale markets in accordance with CPUC rules. Participants received an event notification a day prior to the event via app, email, and/or SMS and had the flexibility to decline event requests if they met the minimum participation criteria set forth in the terms and conditions. The program's event trigger strategy was carefully designed to ensure the program delivered maximum benefits for CPA while balancing customer comfort and ability to perform. The program limited its Energy Savings Events to a maximum of 35 events per year for up to 4-hour duration per event. Program participants never received more than five event notifications per month, and most events were triggered based on a minimum CAISO wholesale market price which adjusted periodically. In addition to wholesale prices, the program could choose to trigger events based on other triggers such as CAISO emergencies, extreme weather or air quality events, or for event testing. The program's initial established event triggers are outlined in Table 4 below.

Trigger Category	Criteria
Wholesale Day-Ahead Hourly Energy Price	<ul style="list-style-type: none"> • Summer: \$75/MWh • Winter: \$65/MWh
Extreme Weather Conditions	Temperature forecast exceeding 100°F the following day
Air Quality	Air Quality Index forecast exceeding 150 the following day
CAISO Grid Emergency	Emergency Alert or Warning Notice issued for the following day

Table 4: Energy Savings Events Triggers

These triggers were set to ensure a manageable number of events for participants. The following restrictions were set to limit customer participation fatigue and simplify participation:

- Energy Savings Events may be triggered on any weekday between the hours of 4 p.m. to 9 p.m., Monday through Friday, excluding holidays
- Events can be scheduled on a Day-Ahead basis on any weekday except holidays. Event notifications for Day-Ahead Events on a Monday will be sent on the preceding Sunday
- The maximum number of Events is 35 per calendar year
- Events are a minimum of 1 hour and maximum of 4 hours
- The maximum number of events per day is one
- There are a maximum of 5 events per month

3.3 Battery Rebate Program Offer

The program also offered additional funding to customers for purchasing and installing new batteries through a Battery Rebate program offer. This rebate offer provided customers with up-front capital as well as ongoing incentives in return for continued participation in the program. Table 5 below summarizes the details of the Battery Rebate Program.

Criteria	Detail	
Incentive Level	<ul style="list-style-type: none">Storage with ITC: \$125/kWhStorage without ITC: \$175/kWh	
Battery Size	<ul style="list-style-type: none">Minimum: 40kWhMaximum: 550kWh	
Capacity Commitment	Battery Rebate recipients would be required to enroll at least 50% of battery capacity into Power Response Program	
Application Timeline	Round 1: <ul style="list-style-type: none">Released: 5/15/2020Deadline: 6/15/2020	Round 2: <ul style="list-style-type: none">Released: 10/28/2020Deadline: 1/17/2021

Table 5: Summary of Battery Rebate Program Details

The program also offered customers additional technical assistance to understand the benefits of program participation and remove some barriers for participation. Some of these technical assistance tools included a Battery Sizing Tool, program capacity commitment analysis and assistance, a multilingual customer support department, training for community-based organizations (CBOs) for engaging underserved customers, and personalized meetings with key clients to help understand and enroll in the program.

The program design also included a Customer Satisfaction Survey deployment to solicit customer feedback on the program design and participation experience (See Section 5.4 Customer Experience Survey Results). Overall, the results of the survey provided CPA positive feedback and revealed that customers were happy with the design features, enrollment process, incentives received, and their experience in participating in Energy Savings Events. Several customers wrote in responses thanking the program for giving them the opportunity to have a positive impact on the environment while also being incentivized to do so.

The most appreciated features of the program design were having access to a mobile app to receive event notifications (65%), flexibility of accepting or declining event requests (73%), receiving electronic cards as incentives (79%) and getting an opportunity to make a positive environmental impact.

– Customer Experience Survey Results

“It’s a pretty easy program to use, and I particularly like seeing my usage/stats. This helps me to know what kind of impact I’m making on energy usage and conservation.”

3.4 Program Marketing

The Power Response Program was an opportunity for CPA to create brand awareness for itself, build a stronger presence, and develop customer relationships within its territories. The program marketing strategy was designed to achieve these goals, educate customers, and help remove barriers to enrollment. The marketing plan was also focused on advancing enrollments and the reach of the program within the underserved customers in CPA's territory. The roles and responsibilities of the key entities involved in the program marketing included the following:

- *CPA Team:* The CPA team led the marketing efforts for the program and employed a multi-channel approach. Residential customers were targeted through emails, social media, direct mail, radio and a program website, whereas commercial customers were engaged through in-person direct outreach efforts by their CPA customer representatives through email and/or meetings.
- *Community Based Organizations:* The program partnered with five CBOs - Temple City Chamber of Commerce, Filipino American Chamber of Commerce, Merito Foundation, Climate First: Replacing Oil and Gas (CFROG) and Breathe LA - for outreach and marketing to its low-income and underserved populations. The CBO partners marketed the Power Response Program through a variety of channels including events and in-person community outreach as permitted by COVID guidelines.
- *Olivine:* The Olivine team supported CPA's marketing efforts in multiple ways. The Olivine team helped create multilingual marketing collateral, hosted and managed the multilingual customer support center, and helped all customers through the program enrollment journey. Olivine provided Power Response Program technical training for the CBOs and provided them ongoing support as needed. The Olivine team analyzed load profiles of CPA customers to identify high-priority C&I customers for targeted program marketing. The Olivine team also developed and delivered webinars for C&I customers and worked closely with the CPA team to provide technical assistance to these customers. Olivine also led the engagement of DER technology vendors for the program who were envisioned to help co-market the program as well.
- *Technology Vendors:* The program engaged several DER technology vendors. Some of these vendors (e.g. ecobee) became program partners and marketed the program to CPA customers and enabled their customers to initiate program enrollment via their devices directly. Other technology vendors and equipment installers engaged with the program team in meetings and webinars and provided customers in CPA ZIP codes information about the program and encouraged them to enroll.

Table 6 below is a summary of the various stakeholders and the marketing channels that were employed.

Customer Segment	Primary Marketing Channels	Stakeholders
Residential and Small Business Customers	Website, Email, Direct Mail, Social Media	CPA Olivine ecobee
Medium Business and C&I Customers	Email, In-person outreach and meetings, Free technical assistance, Webinars	CPA Olivine
Underserved and Low-income	Online events and Emails	CBO Partners

Table 6: Primary Marketing Channels Used to Reach Customer Segments

As illustrated in Figure 5, the number of program enrollments increased significantly after specific marketing interventions- namely the residential enrollments following the smart thermostat mailer in May and smart thermostat email in August. The ecobee partnership also helped drive a steady flow of new enrollments starting in late July.

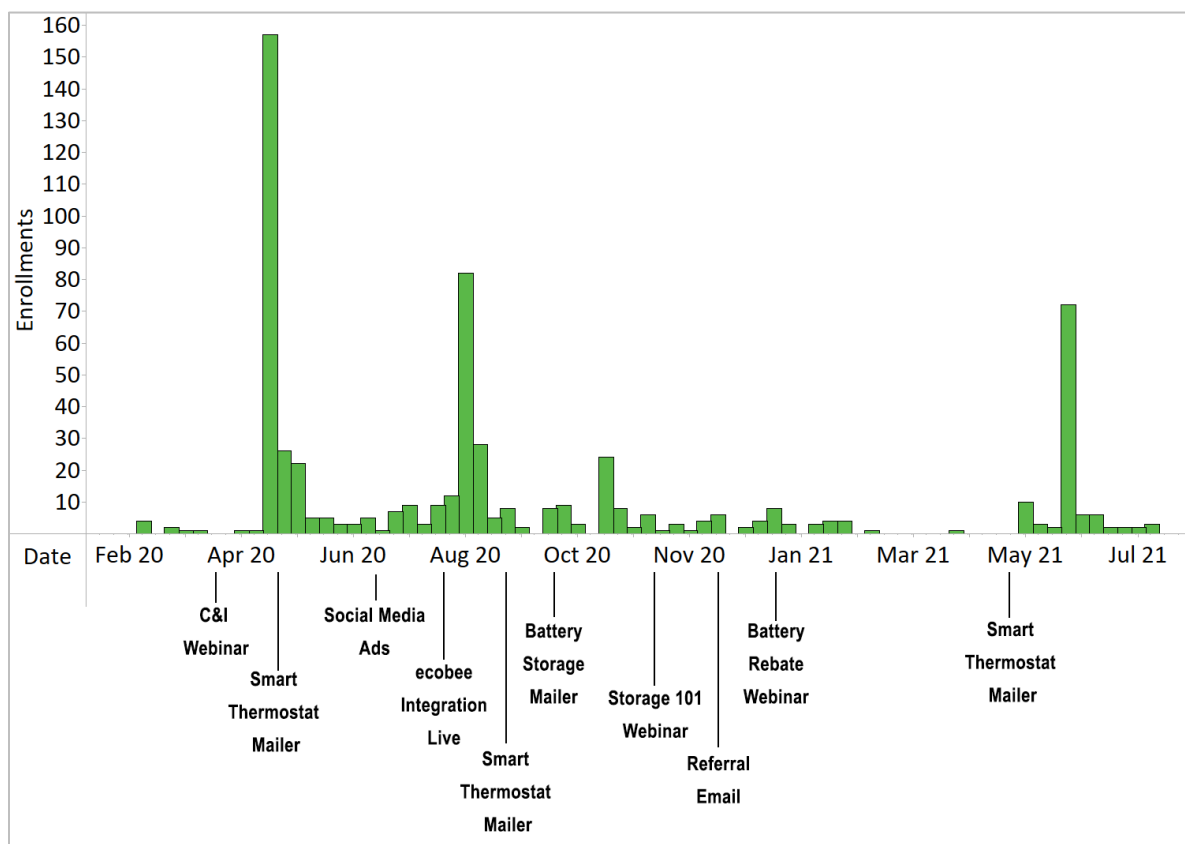


Figure 5: Program Enrollments Over Time with Marketing Activity

The efficacy of the program’s marketing efforts was also examined through the Customer Experience Survey which asked customers how they heard about the program. Based on the survey responses, most customers heard about the program via an email from the CPA team. This is shown in Figure 6 below.

Other methods that helped advance program enrollments were flyers, direct mailers, and the ecobee partnership. Few mentioned learning about the program through referrals from friends and family or social media. This could be an area of improvement for future program marketing efforts.

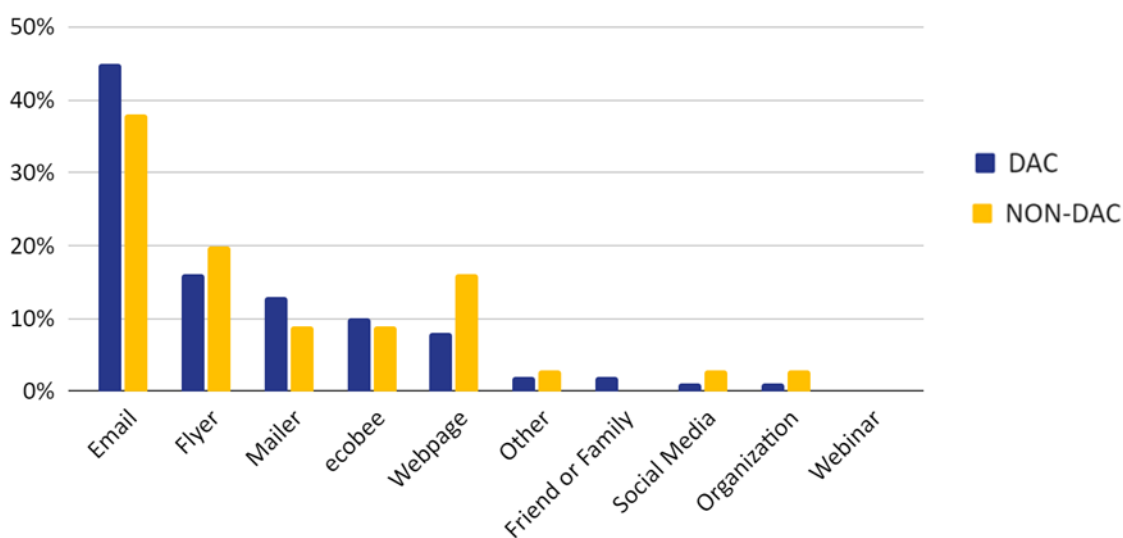


Figure 6: DAC vs non-DAC Responses to “Where did you hear about the program?”

The following section describes the technology deployed for the implementation and management of the Power Response Program.

4.0 Program Technology

The Power Response Program was powered by the Olivine Technology Suite which provided key interfaces between participating customers, CAISO wholesale markets, and CPA. The Technology Suite enabled customer enrollment, engagement and communication, DER device control and management, CAISO registration, market participation, performance measurement and program metrics reporting. The suite includes an award-winning DER Platform, Olivine Community App, Customer Engagement Platform and state of the art program implementation tracking and reporting tools. Figure 7 below provides a summary of the capabilities of the Olivine Technology Suite as implemented for CPA, and the following sections detail the role of each of the technology component in the program.

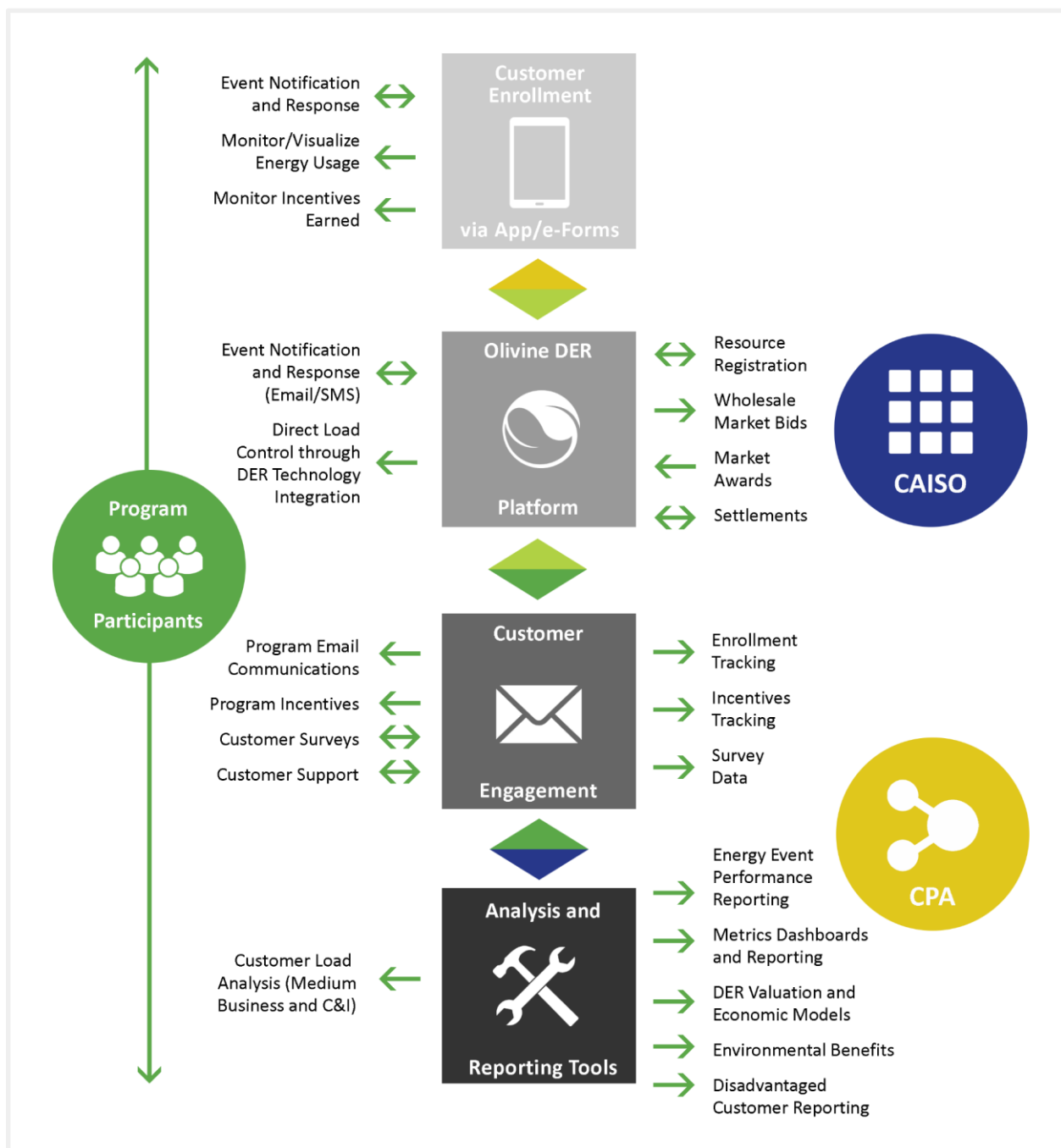


Figure 7: Olivine Technology Suite Diagram

4.1. Olivine Community Customer App

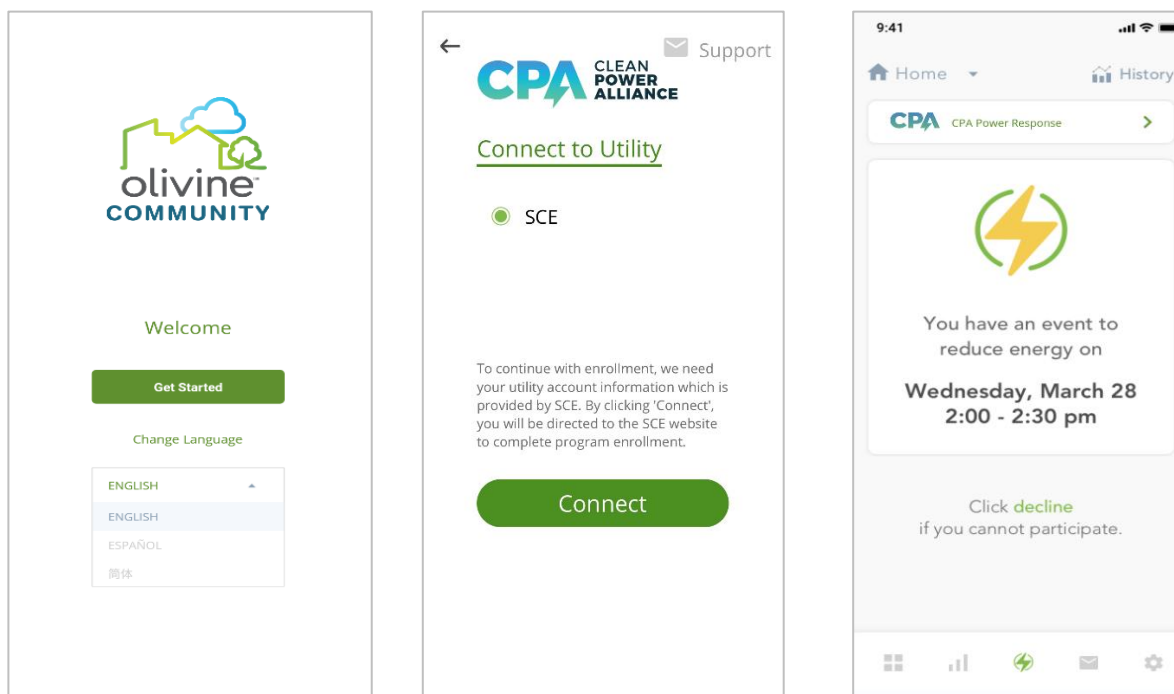
As previously mentioned, the multilingual Olivine Community app (web and mobile) was the primary way for enrolling and engaging with residential and small business customers in the Power Response Program. The Olivine Community App was natively built for iOS and Android,

and all app functionality was supported in modern Web browsers. The Web app was included specifically for hard-to-reach populations, residents of DACs and low-income customers who may not have access to smartphones or data plans to support mobile customer enrollment.

The survey responses showed that the usage of the mobile and web version for program enrollments was almost evenly split among customers. However, enrollments via the web app were 14% higher among the underserved customers. Most respondents found the program app easy or very easy to use.

– Customer Experience Survey Results

The app was offered in English, Spanish, and Chinese language options and provided a seamless way for residential and small business customers to enroll in the program (See Section 3.1 Program Enrollment Process). The Olivine Community app also allowed customers to monitor home energy usage and event performance, receive and respond to event notifications, view performance and incentives earned, and provide referrals into the program. Both the mobile and web versions of the app were used by customers in the program, with 52 percent enrolling through the mobile version and 48 percent using the web app to enroll and engage with the program. Figure 8 shows several screenshots of the Olivine Community app user experience.



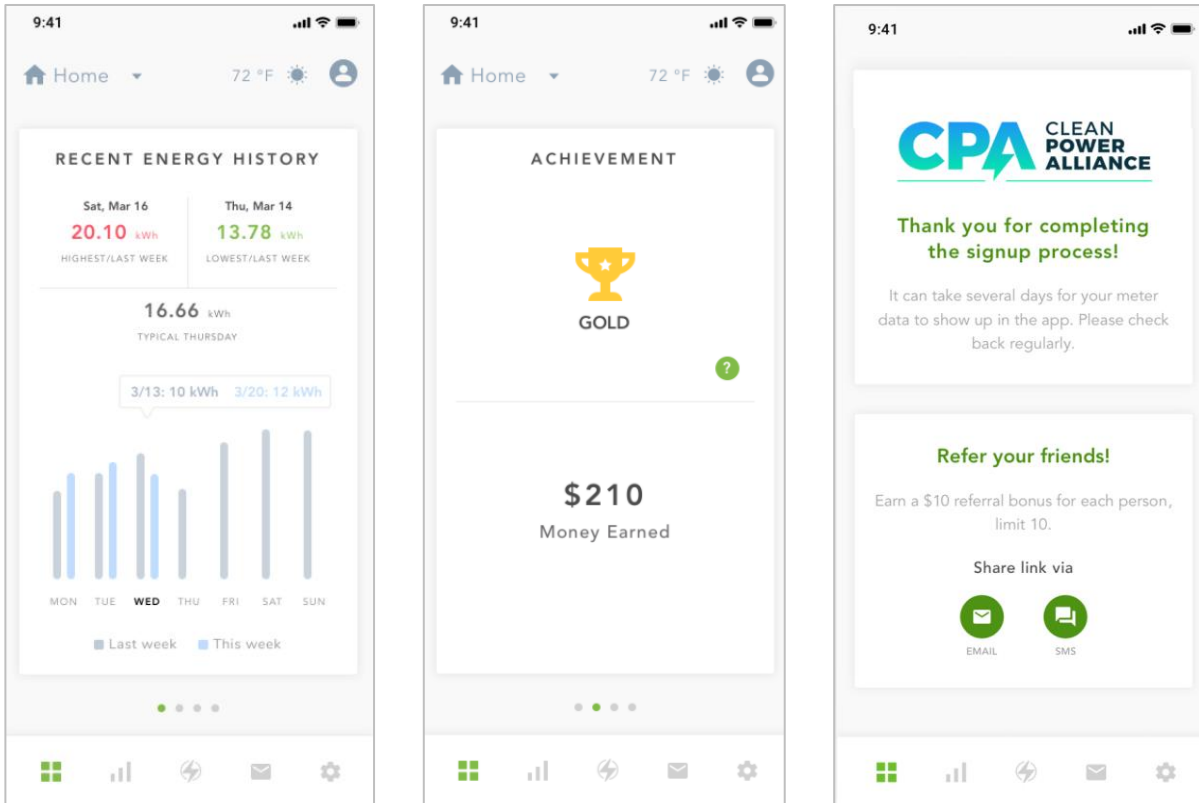


Figure 8: Olivine Community App for CPA Screenshot Examples

The Customer Experience survey administered during the program showed that customers really enjoyed engaging with the app, only the English language option in the app was used, and customers engaged with the app primarily for tracking events and their energy use in the dashboards.

“It is great that you have an informative app that actually works. All in one place to get everything related to the program. Keep up the good work.”

“I’ve used other programs before...but they don’t follow through. CPA Power Response is much better and has a BEAUTIFUL USEFUL APP.”

– Customer feedback

4.2. Olivine DER Platform

The award-winning Olivine DER Platform - a comprehensive DER Management System (DERMS) enabled the management of DER resources within the program and was the interface with the CAISO wholesale markets. The Olivine DER Platform not only facilitated the submission of market inputs and receipt of dispatch notifications from the wholesale market operator but

also enabled the aggregation and management of various DER technologies during events. The platform provided business rules for program options, calculated event performance baselines and load reduction metrics, and managed related services such as meter data management and telemetry. The platform included device integration with technology vendors for automated dispatch of DER technologies (e.g. ecobee smart thermostats), and managed events and notifications to participants through integrations with the Olivine community app, SMS and email. Figure 9 shows an example of a screen in the Olivine DER Platform used to monitor event performance.

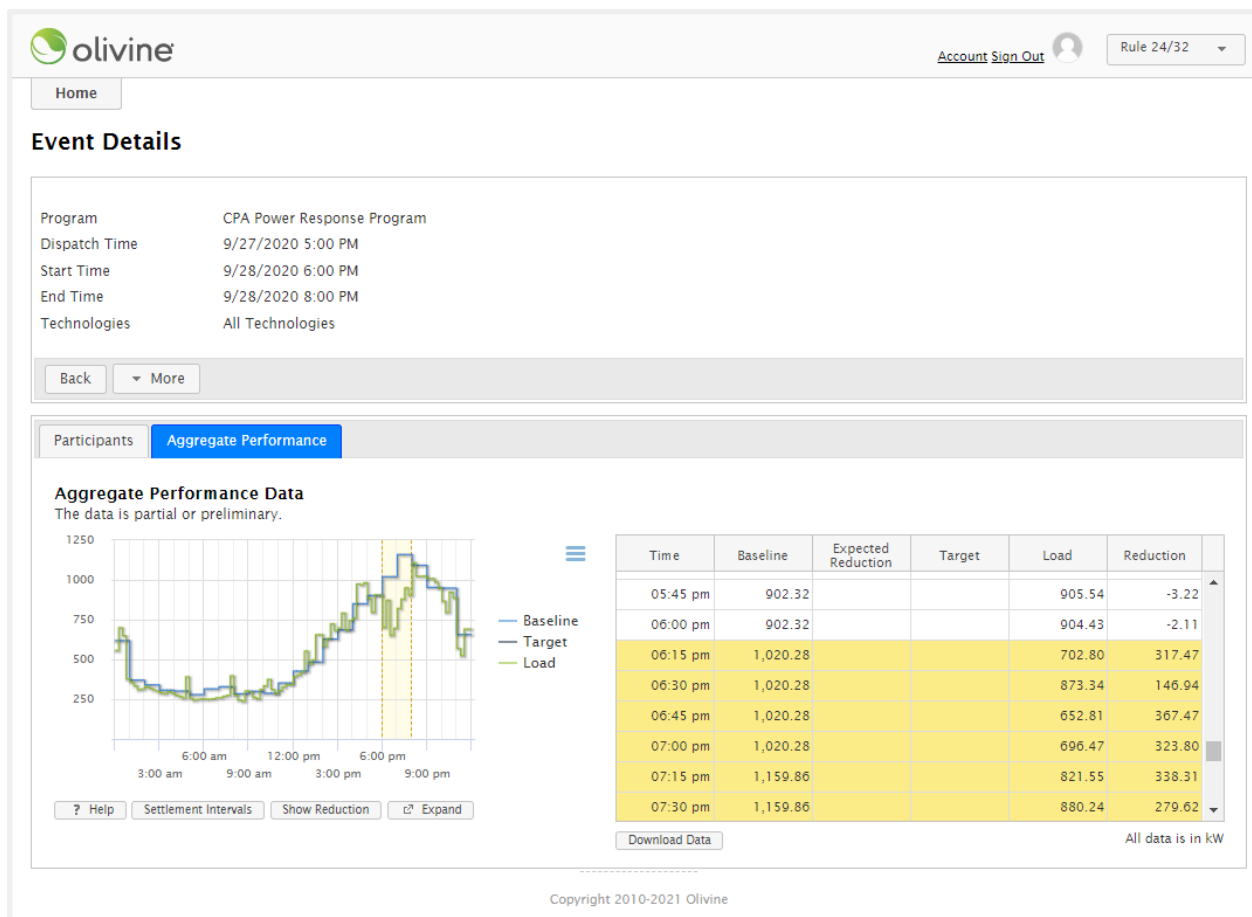


Figure 9: Customer Engagement Platform Screenshot Example

4.3. Customer Engagement Platform

The program's customer engagement processes were anchored around a Customer Relationship Management (CRM) system which tracked customer program enrollments, sent program email communications to customers, managed customer support interactions with a ticketing system and provided surveys to customers for program reporting. CPA was provided access to this system for enrollment tracking and other basic reporting. The customer

engagement platform was also used to manage the process of disbursing incentives to customers.

86% of program participants were ‘extremely satisfied’ or ‘satisfied’ by the program’s customer support center
– Customer Experience Survey Results

4.4. Enrollment and Performance Reporting

The Olivine Technology Suite was also leveraged to track and manage the implementation of the program using comprehensive dashboards which provided timely updates on customer enrollments, event performance and other key performance indicators (KPIs) for the program. These dashboards were designed specifically for the Power Response Program and were regularly updated to analyze customer enrollment trends and understand the efficacy of outreach and marketing efforts. Event performance dashboards were used to provide insights into the capacity for customers to perform, inform the wholesale market bidding strategy, and track the customer outreach and customer engagement in the program. Program dashboards included data, graphs, maps, and other visuals to track the following:

1. *Program Enrollments*: These dashboards tracked and analyzed customer and DER device enrollments, customer details such as customer type, underserved status, location (ZIP code, city, sub-LAP etc.) and how customers heard about the program. These statistics, trends and maps were instrumental in tracking the trends customer enrollment progress and in the future can be used for conducting targeted marketing and outreach campaigns in locations of low program enrollments.

An example of one of these mapping dashboards is provided below in Figure 10. This figure shows the density of enrollments across the various ZIP codes in CPA service territory, helping to visualize which regions were responding to outreach efforts and where these efforts would need to be focused or adjusted in the future.

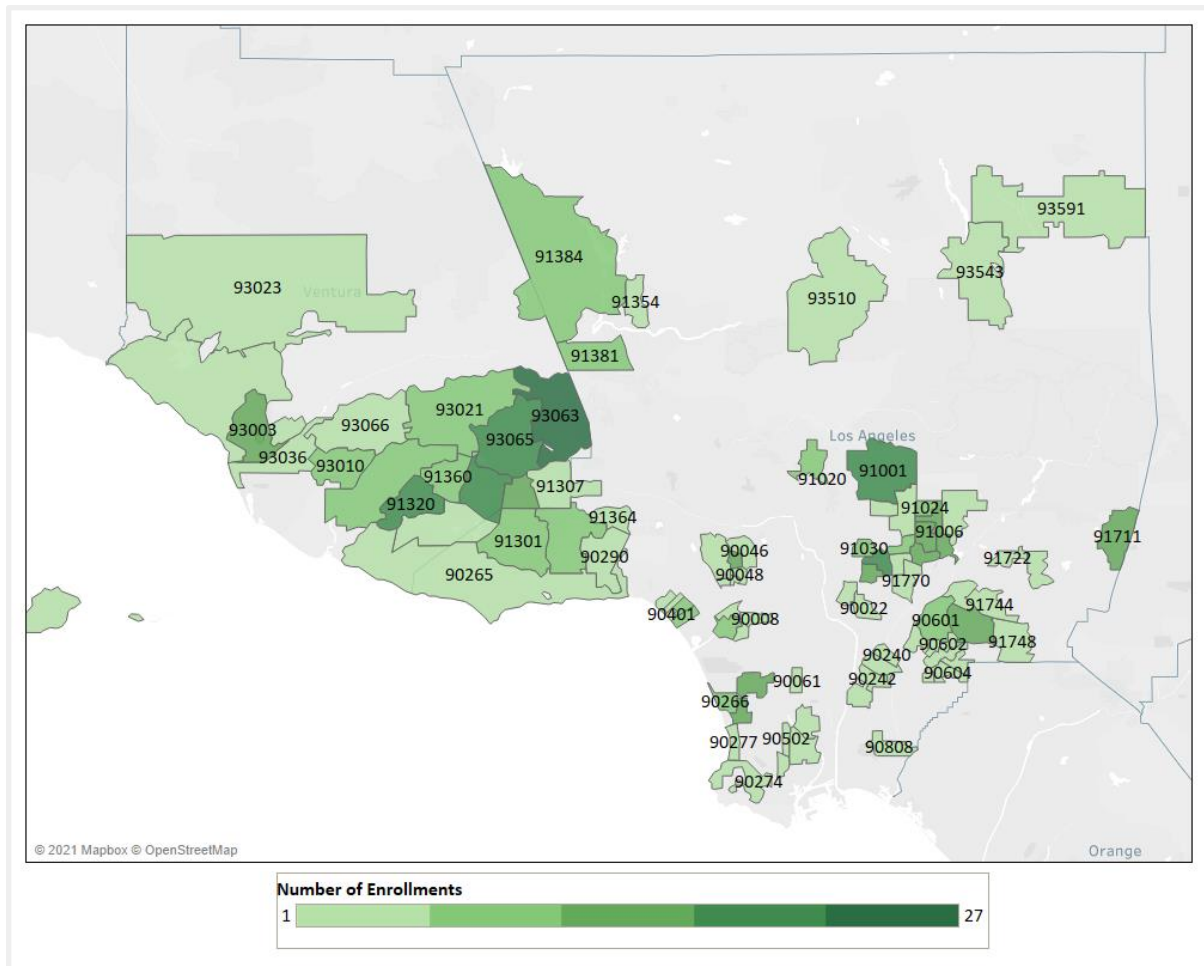


Figure 10: Enrollment Dashboard Showing Enrollment Density in CPA Service ZIP Codes

2. **Energy Savings Events Performance:** These dashboards reported and analyzed demand response event performance by detailing the energy and demand impacts of all events scheduled through the program. Event performance was segmented and analyzed based on key customer type, DER device, sub-Lap, and whether the customer's device could be automatically controlled. These dashboards helped the program team understand that on average smart thermostats delivered between 0.2 and 1.3kW of load reduction capacity per device, with hotter days resulting in higher performance (see Section 5.2 for more detail on event performance). Devices automatically controlled resulted in higher load drop than those devices participating through a behavioral response in the program.
3. **Other Program KPIs:** Results of the in-app survey, which provided self-reported information on demographic data, including household size, income level, ethnicity, and marketing channel efficacy. This data was used to inform in-program adjustments to the marketing and outreach efforts to maximize customer enrollments, for instance by informing the decision to focus on email and mail outreach rather than mass marketing through radio spots.

Together, the Olivine Technology Suite not only helped make the program enrollment easy and efficient for the customers- it also provided the CPA team unique insights into the status of the ongoing implementation of the program discussed in Section 5.0 Program Implementation

5.0 Program Implementation Results

5.1 Program Implementation Summary

This section summarizes the program implementation results for the Power Response Program till July 31, 2021. The Power Response Program was launched in Q1 of 2020 with the release of the program website, the multilingual Olivine Community App, C&I enrollment tools, and a multilingual customer support center. The team focused Q2 2020 on marketing and outreach which involved sending mailers to customers, training CBOs⁵ to conduct outreach in DACs, and hosting a webinar for C&I customers. These efforts resulted in over 200 enrollments.

Marketing and outreach continued in Q3 of 2020 with the launch of social media and email marketing campaigns. Olivine also integrated with ecobee to enable direct control of smart thermostats, making event participation easier. ecobee marketed the program to their existing customer base in CPA's territory. With these additional marketing efforts, the program surpassed 300 total enrollments. Olivine began processing enrollment and participation incentives and calling Energy Savings Events in Q3. A total of 11 events were called, several in response to grid emergencies in August 2020 brought on by unprecedented wildfires.

The focus of Q4, 2020 was on scaling the program, streamlining operations, and getting participant feedback. The team launched the second round of the Battery Rebate Program and a program Hub. They also launched the Referral Program, allowing residential customers to receive incentives for referring other customers to the program. They hosted two battery storage webinars to educate C&I customers about the value

The outbreak of COVID at the beginning of Q2 2020 triggered a significant change in the planned implementation of the pilot program.

Despite the outbreak of this global pandemic, the team was able to adjust the implementation of the program and continue to enroll customers and engage safely with the community. The COVID lockdown largely impacted the program team's ability to engage and enroll C&I customers as those buildings were largely unoccupied and non-functional during 2020 and the decision makers were dispersed in various locations.

Future stages of the program implementation should focus efforts on C&I customer outreach, marketing, and engagement.

⁵ There were five CBO partners for this program which included Breathe LA, Climate First: Replacing Oil and Gas (CFROG), Filipino American Chamber of Commerce, South Bay LA, Merito Foundation and Temple City Chamber of Commerce.

batteries can provide to their businesses and the funding opportunities available. The program surpassed 450 enrollments and reached a total of 26 Energy Savings Events.

In Q1, 2021, the project team ramped up direct outreach to C&I customers in an effort to increase program enrollments within that customer segment. The program enrollments across all customer segments surpassed 500. The team also developed a wholesale market bidding strategy, the first step to commencing wholesale market operations and increasing program value streams.

By the end of Q2 2021, the program had grown to 587 enrollments, and a total of 36 events had been called. In May 2021, the program reached a significant milestone with the first market-integrated event dispatched for customers located in the SCEC sub-LAP. The program continued to add enrollments and register two additional market resources in Q3 2021 for the SCEW and SCNW sub-LAPs. By July 31, 2021, program enrollments reached 621 and the team continued to refine techniques for forecasting the performance of market-integrated resources to ensure accurate bid quantities into the CAISO.

The team was successful in engaging and building relationships with C&I customers and expanding their brand awareness as part of the program outreach efforts. However, in spite the outreach efforts, the program's C&I enrollment efforts faced some challenges as COVID restrictions discouraged potential C&I customers from joining the program for various reasons. Most C&I buildings were not operational due to COVID restrictions and C&I customers couldn't guarantee to have enough load to meet the program's terms and conditions. Other commercial customers were actively downsizing their real estate portfolios, permanently shutting down offices and pivoting to remote or hybrid work environments. Some commercial customers were also financially impacted by the pandemic and could not afford to install any new enabling technology. The project team had limited data on existing installations of EV chargers or energy storage across CPA service territory making targeted outreach difficult for the team. Many existing C&I customers were also unable to participate in Power Response due to already being enrolled in conflicting DR programs such as the SCE Charge Ready program, or lack of support from their energy storage service provider for the needed control of batteries for DR event participation. The technology vendor agreements for the program were also challenging to formalize during the COVID period as most technology partners were not willing to support a one-year pilot program and were hesitant to market an offer to their customers with the uncertainty around the continuation of program. Olivine did manage to attract a technology partner with a large portfolio of energy storage sites to participate in the program and enroll its existing customers in the program, however the C&I incentive budget was eliminated by the time that deal was finalized. These complex situations resulted in the CPA team being able to engage over a dozen technology partners and many C&I customers (47 EV charging sites and 25 battery storage sites), but only three sites could be successfully enrolled in the program. As the program enters a new phase with a multi-year implementation period, the increased certainty around the program duration and clear pathways for technology onboarding will help the program attract more technology vendors, and more enrollees, in the future.

The following sections provide more detail about the program's impact in terms of customer and device enrollments numbers, event performance, financial and environmental impacts, and valuable feedback from customers about their experience of participating in this unique program.

5.2 Program Enrollment Results

Overall, the program was successful at reaching customers throughout CPA's service territory as seen below in Figure 11.

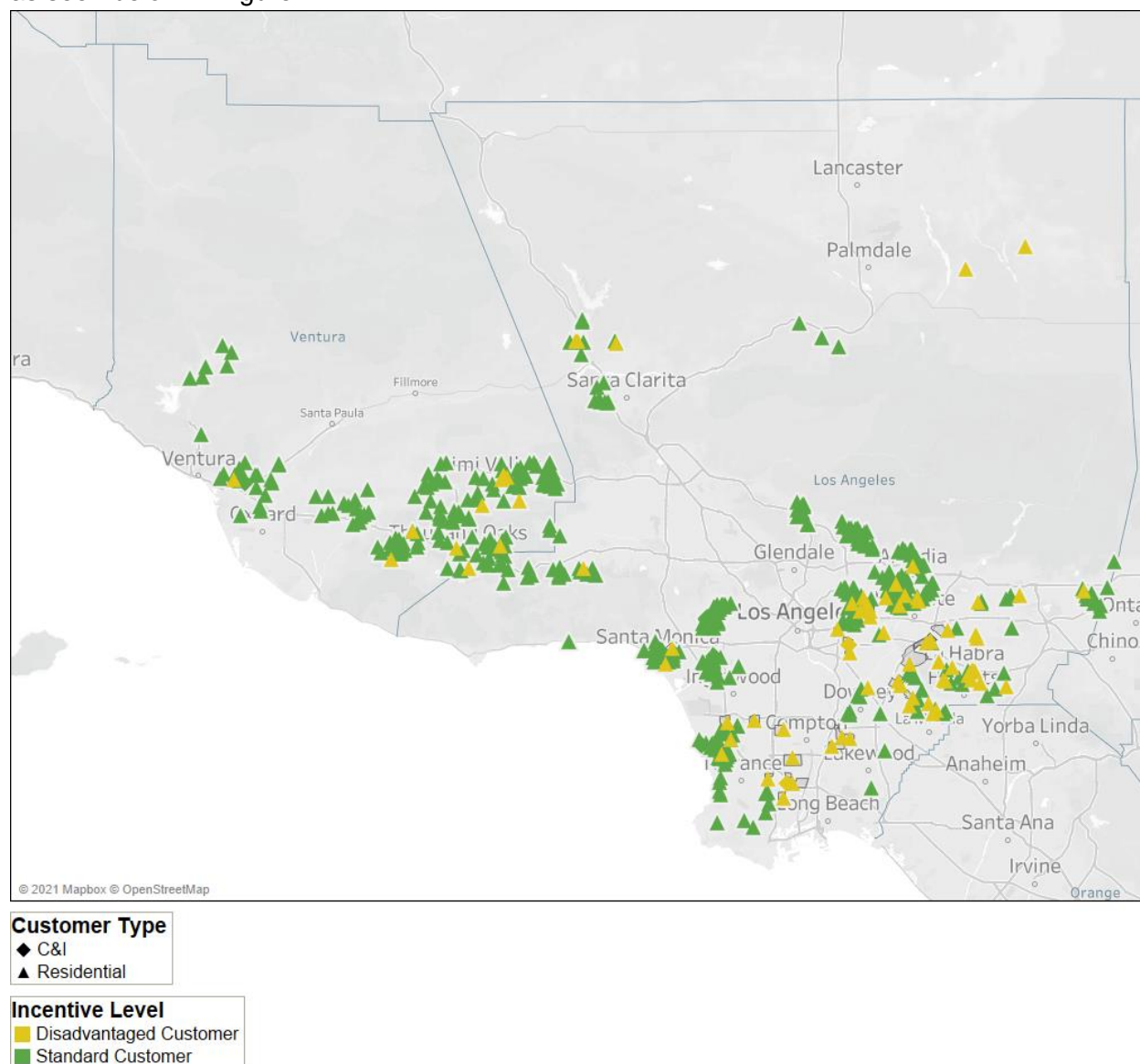


Figure 11: Map of Power Response Customers by Customer Class and Disadvantaged Status

As of July 31, 2021, 745 CPA customers had initiated enrollments into the Power Response Program. Of the customers that signed up for the program, 83% completed the enrollment, while 11% were unable to enroll in the program due to 3rd Party Program conflicts (7%) and

Utility Program conflicts (4%). Another 6% ultimately disenrolled from the program and by July 31, 2021, the program had 621 actively enrolled customers. Most of the enrollments were residential customers across all customer segments.

The program was also successful in enrolling 83 underserved customers (13% of enrollments) from DACs and low-income customers on subsidized utility rates (e.g., CARE, FERA). 20% Of CPA's customer accounts lie in DAC census tracts, 25% are receiving a CARE rate discount, and 0.5% are receiving a FERA rate discount⁶. While the rate of underserved customer enrollments is slightly below the average rate of underserved customers in the CPA territory, the level of DAC enrollments has still been a major accomplishment of the program.

The App enrollment data which tracks how did customers hear about the program shows us that underserved customers listed email marketing, flyers, and CBO referrals as the common sources of outreach and recruitment sources. This customer segment also benefits and needs more in person communication and outreach channels, and additional multi-modal outreach to underserved areas without COVID restrictions should help improve underserved enrollments in the program. Table 7 below shows a summary of enrollments in the program till July 31, 2021.

	Residential Enrollments	C&I Enrollments
Total Enrollments	618	3
Total Underserved Enrollments	83 (13 %)	0 (0%)
DAC Residents	32 (5%)	0 (0%)
DAC Low-Income Residents	7 (1%)	0
Low-Income	51 (8%)	0

Table 7: Customer Enrollments by Status

A total of 621 DER devices were enrolled in the program from all three pillars but most of the devices were smart thermostats, as shown below in Table 8.

⁶ Note that there is significant overlap between customers located in DACs and those receiving rate discounts.

Pillar	Customer Segment	Technology	Total Customer Enrollments	Total Device Enrollments
1	Residential	Smart Thermostat	600	600 ⁷
2	Residential	Battery Storage	18	18
2	C&I	Battery Storage	0	0
3	C&I	EV Chargers	3	3
Total			621	621

Table 8: Customer Enrollments by Technology

The program did not receive any enrollments through the battery rebate offer even though it was offered in two rounds: summer of 2020 and fall/winter of 2020/2021. Five applications were received in the first round, and only one application was received in round two. In an effort to increase interest in the program, Olivine and CPA held a series of joint webinars to explain the application process and help answer customer questions around energy storage with a round-table session. In response to the webinar series, many prospective site hosts reached out with interest in participating, however very few customers that were far enough along in their battery storage project design process to be able to submit a complete application. Similar programs like SGIP rely on project developer/installer networks to help prospective customers fill in and submit applications; future versions of the direct install program would benefit from including more detailed technical assistance to potential applicants. The City of Santa Monica was awarded an incentive for a 72kW/102.6kWh battery, but their battery project was put on hold indefinitely, and the incentive wasn't paid out.

5.3 Event Performance Results

The Power Response Program began scheduling Energy Savings Events in July 2020. Since then, a total of 41 events have been called for residential and C&I customers by July 31, 2021. Even though there were very few non-residential customers, there was a noticeable difference in how different customer segments responded to events. Residential customers actively participated in events with consistent load reduction performance, while C&I customers' performance was more inconsistent. Most customers participated in events by providing a behavioral response which often involved a manual DER device adjustment. Customers with ecobee thermostats participated with their devices being remotely adjusted during an event.

The acceptance rate for all events averaged around 50% with about half of the customers submitting a response to an event request through the app or by email and actively indicating

⁷ A single device is considered to be a battery, smart thermostat, EV charging station, or behavioral household

their intention to participate in events. The event participation rate was comparable for both DAC and non-DAC customers and remained consistent as the program grew over time.

The average event performance per participant ranged from 0 to 1.3 kW for all events in the program. Since most of the devices enrolled in the program were smart thermostats, the load reduction delivered was higher in the summer months (approximately June through October) than the winter months. Figure 12 shows the event performance for residential customers over time and its variation based on the method of event participation. The results show that customers with DER devices (smart thermostats) that could be automatically controlled demonstrated far greater load reduction than customers with manually controlled devices. This indicates that event performance can be expected to increase significantly as the program integrates with more technology vendors and customers enroll more devices that can be controlled remotely during an event. The results also demonstrate a sharp decline in event performance November for the program due to a significant temperature reduction. Events were paused between January and April due to program limitations and low winter performance.



Figure 12: Residential Customer Event Performance Over Time with Event Participation Method

Overall, the program demonstrated encouraging energy, environmental and financial impacts for CPA and its customers. As illustrated in Table 9: Residential Customer Cost Effectiveness by Technology below, event participation by residential customers saved CPA wholesale energy

costs and resulted in net bill reductions for participating customers via a decrease in peak energy usage. While these savings are not yet large enough to cover the program's costs, they are expected to grow significantly over the next 10 years. Using its DER Valuation Model, Olivine conducted a 10-year financial analysis for the program under a variety of scenarios (See Appendix C).

The various scenarios were developed by modeling the impact on program cost effectiveness by varying customer participation rates, incentive levels, and the performance level of resources in the aggregation. The recommended scenario selected by CPA management included the following assumptions for the program going forward:

- 25% annual participant growth rate
- 50% reduction in Res participation incentive, 25% reduction in Res enrollment incentive
- 25% reduction in C&I participation incentive, 100% reduction in C&I enrollment incentive
- At least 25% of smart thermostat devices directly controlled (i.e., more smart thermostat integrations)

This analysis showed that by reducing incentive levels to more closely align with mature programs and increasing vendor integrations for direct control, the program can be expected to be cash flow positive in 8 years and would result in a cost-benefit ratio of 1.44. These projected cost effectiveness numbers are in line with the Program Administrator Cost effectiveness calculations for comparable utility DR programs, such as PG&E's SmartAC program⁸.

Pillar	Customer Segment	Technology	Avoided Wholesale Energy Purchases in Peak Period (kWh)	Avoided Wholesale Costs (\$)	Potential Avoided RA Costs (\$)	Net Bill Reductions for Customers (\$) [▽]	Customer Cost Effectiveness [*]
1	Residential	Smart Thermostat Automatic	3,835	\$1,033	\$1,803	\$750	41
1	Residential	Smart Thermostat Behavioral	7,455	\$3,296	\$4,453	\$1,855	43

⁸ PG&E Advice Letter, 4/30/2021: https://www.pge.com/tariffs/assets/pdf/adviceletter/ELEC_6180-E.pdf

[▽] Net bill reduction was found by multiplying the energy reduction for each customer by their energy rate during the event period and subtracting the cost of the energy recovered. For smart thermostat participants, it was assumed that 50% of the energy consumed during the event would be recovered in the hour before and the hour after the event period. For battery participants, it was assumed that 100% of the energy consumed during the event would be recovered during the next off-peak TOU period.

^{*} Customer cost effectiveness calculation does not include equipment cost, as participants enter the program with devices they already own.

2	Residential	Battery Storage	341	\$103	\$145	\$243	18
-	Total	-	11,631	\$4,432	\$6,401	\$2,848	-

Table 9: Residential Customer Cost Effectiveness by Technology

Along with providing positive cash flows for CPA, the program is expected to effectively reduce greenhouse gas emissions. Table 10 illustrates how the program is already cutting emissions during peak periods and these GHG emission reductions are expected to grow significantly as more customers are enrolled in the program and event participation increases. The program is also expected to start generating revenue for CPA through wholesale energy market participation. This is detailed in Section 6.0 Resource Aggregation and Market Participation

Pillar	Customer	Technology	Line Loss Impacts (kWh)	Event Average Renewable Power (%)	Load Recovery Renewable Power (%)	Net CO2 Emissions Reductions (lbs)	Net NOx Emissions Reductions (lbs)
1	Residential	Smart Thermostat Automatic	153	14	26 [~]	2,728	0.55
1	Residential	Smart Thermostat Behavioral	298	14	17*	6,221	1.5
2	Residential	Battery Storage	14	14	36 [~]	286	0.3
	Total		465	-	-	9,235	2.35

Table 10: Residential Customer Impact by Technology

* Precooling through direct load control shifts consumption to earlier hours, which have a higher renewable percentage. Manual load shift results in less pronounced of a pre-cooling effect and is balanced with a post-event snapback increase in load during lower renewable hours. Increasing the level of direct load control in the future will not only have the impact of increasing load reduction, but also shifting consumption to higher renewable hours.

[~] Battery storage load is assumed to occur during the mid-day off-peak hours, when the power supply comes from a higher percentage of renewables.

5.4 Customer Experience Survey Results

The experience of CPA customers' participation in the Power Response Program was assessed through a 15-minute Customer Experience Survey administered to program participants in November of 2020. Customers were offered a \$15 incentive to provide feedback through a survey which examined the program's impact in increasing awareness about the CPA brand, understanding of demand response, enrollment experience and sought input from customers about their participation experience, usage of the app and recommendations for this program's future offerings. The survey had an 85% response rate from customers with diverse demographic and socio-economic backgrounds. In general, respondents provided very positive feedback about the program, with 98% customers reporting with a positive response on their overall user experience (See Figure 13).

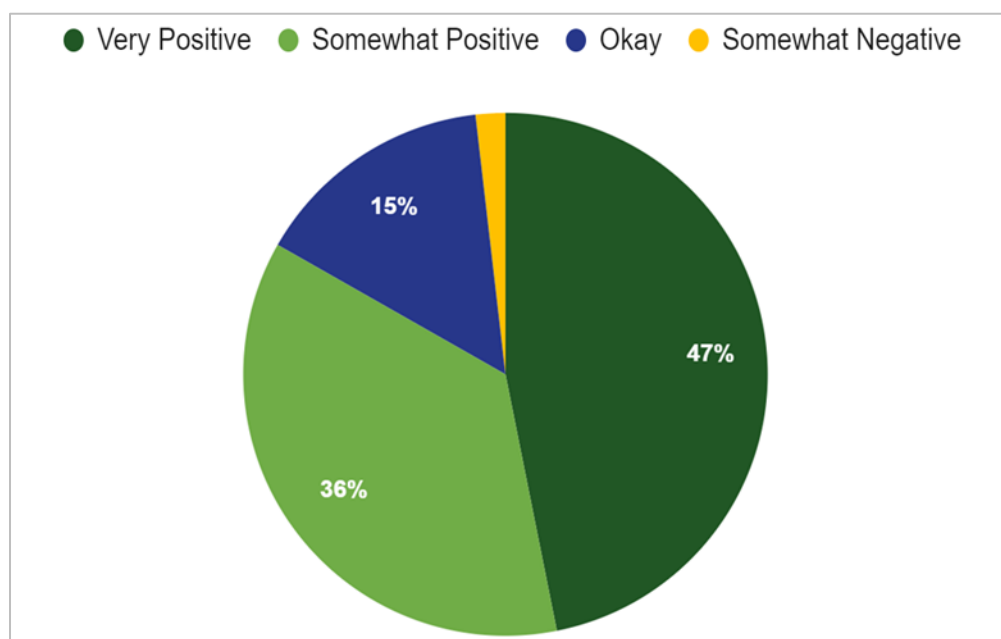


Figure 13: Residential Customer Ratings for Overall Program Experience

The Power Response Program helped customers learn more about the CPA brand, as reported by 86% of respondents. The program engaged with new customers, with 44% of respondents reporting having never participated or not being aware of DR programs prior to participation in Power Response. The survey results indicate that program participation helped 89% of understand the importance of peak energy consumption reduction and how to achieve it.

“You guys are doing a great job. Encourage us to go green and pay us for doing so.” –
Customer feedback

Respondents' favorite features of the program were the flexibility of accepting or rejecting events, receiving gift cards for participating, and making a positive environmental impact. Most

customers reported that participation in events was easy/very easy and the number of events scheduled were appropriate. Nearly all respondents (91%) reported that the day-ahead event notices are adequate. Over 90% of those surveyed felt the incentives offered were reasonable, and 28% called them generous. Participants were generally satisfied with the reward redemption choices and method of payment and appreciated receiving the electronic gift cards as incentive payments.

Overall, the Customer Experience Survey revealed that customers received the program well and had a positive experience participating in events. The program helped CPA customers learn more about the CPA brand, its offerings, DR, and how to achieve peak energy consumption reductions by joining. CPA customers would like to see future program offerings include more direct control of devices, more education about ways to save energy, expansion of the program to include other technologies and an online marketplace to purchase equipment.

6.0 Resource Aggregation and Market Participation

6.1 Market Integration Overview

One of the key objectives of the Power Response Program was to integrate DER aggregations for participation in the CAISO wholesale market, and this objective was met within the first year of program operations. The Power Response Program began participating in CAISO's Day Ahead Energy Market in May 2021 as Proxy Demand Resource (PDR) aggregations. Consistent with CAISO market requirements, resources were aggregated and evaluated by sub-LAP and were brought into the market after Olivine determined that a resource would have a maximum capacity that would meet CAISO's minimum participation requirement of 100kW. Olivine evaluated resources based on Summer 2020 aggregate retail event data that was scaled to incorporate capacity offered by enrollments added in the intervening months. The first resource to enter the market was an aggregation in the SCEC sub-LAP. In July, two more resource aggregations were brought into the market in the SCNW and SCEW sub-LAPs. The Power Response Program's CAISO market participation was notable because it was one of the first instances in which a CCA DR/DER program was integrated into the wholesale market. This ground-breaking effort by the Olivine/CPA program team is setting an example for other CCA programs to follow in integrating DER resources into wholesale electricity markets, providing critical grid services, and helping the state achieve its reliability, climate, and renewable energy goals.

6.2 Market Operations

Per the program terms and conditions, the Power Response Program was limited to no more than five events per month to balance the potential benefits of responsive load with the risks associated with customer fatigue. This event limit was maintained by a weekly analysis procedure performed to update market bidding prices and offer hours. Market bidding and program dispatches were ceased once the monthly event limit was met.

Market performance was settled based on a CAISO residential 5-in-10 baseline with a day-of-adjustment factor. Initially, the adjustment factor was capped at 140% as specified by the default baseline calculation methodology used for residential PDR resources. However, after evaluating historical event performance, Olivine determined that a baseline calculation without an adjustment cap is better suited to evaluate performance while accounting for extreme weather conditions that were frequently associated with this program's PDR events. Olivine petitioned the CAISO and was granted permission to remove the adjustment cap for the Power Response Program market resources. Figure 14 illustrates the difference the adjustment cap can have on performance calculations. For an event that occurred on 8/20/2020 performance calculated without an adjustment cap was 40% higher than the resulting performance measurement calculated with an adjustment cap.

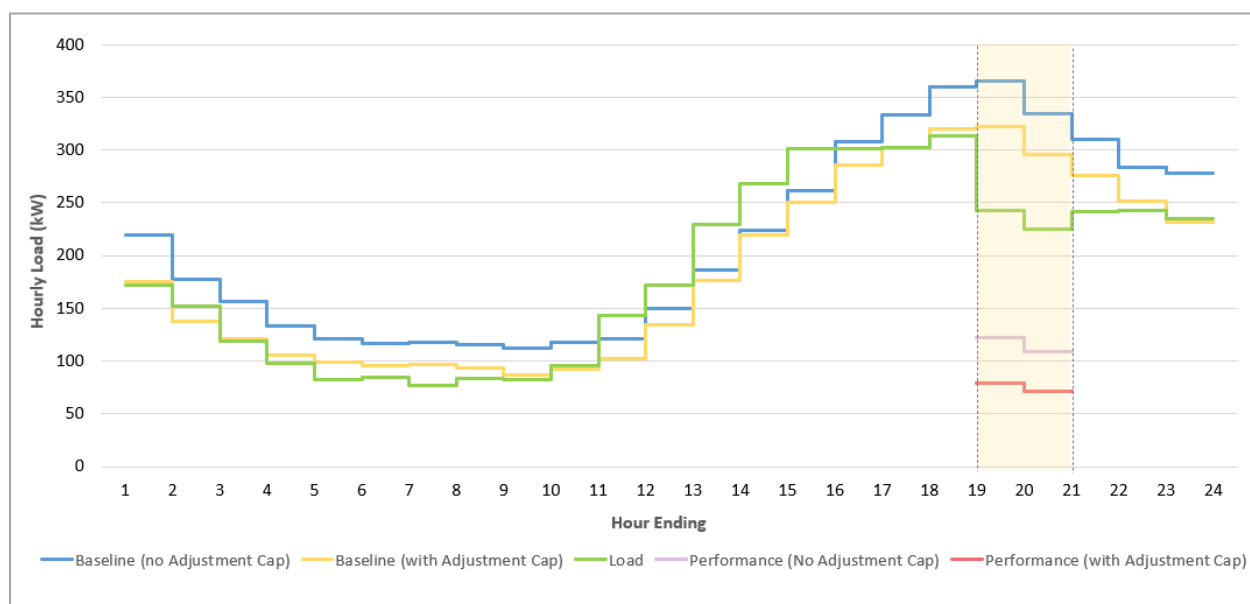


Figure 14: Baseline Calculation Methodology Comparison - SCEC Aggregation August 20, 2020 Event

Initially, the market participation strategy involved making monthly updates to bid quantities based on program enrollment totals. However, there was significant evidence that resource capacity was not only dependent on enrollment but was also highly correlated with temperature, as shown in Figure 12 (in previous chapter). After a number of events demonstrated fairly low performance in May and June, Olivine developed a regression model to predict resource capacity as a function of temperature for each sub-LAP. This model was used weekly thereafter to inform the capacity offered into the market for each resource.

6.3 Resource Performance

The first in-market award occurred on May 11, 2021, between 7-9pm, resulting in a market dispatch for the SCEC resource and a retail program event for all non-market locations. Since then, there have been 18 additional market awarded events that have also triggered events for retail program CPA resources. From May through the end of July, bid prices ranged between

\$45/MWh-\$215/MWh and the average overall bid price was \$126/MWh for all resources. Typically, CPA bidding strategies have been consistent across all resources each week, yielding events for the full in-market CPA fleet whenever a single market award is received. Table 11 summarizes the average bid and award price for each event that occurred for all in-market resources. The SCNW and SCEW resources have higher average bid prices because these resources only began to be bid into the market in July when system-wide prices were higher than they had been in May and June.

Resource Location	Average Bid Price (\$/MWh)		Average Award Price (\$/MWh)	
SCNW	\$	140	\$	217
SCEW	\$	140	\$	219
SCEC	\$	106	\$	196

Table 11: Average Market Bid and Award Pricing

Table 12 summarizes the event participation and performance for all in-market resources between May 11, 2021 – July 31, 2021. The resource in SCEC participated in the most events because this resource began bidding earlier in the season. Overall, in-market Power Response resources performed with an average performance rate of at least 70% and provided, on average, a total of 170 kW into the market when all resources were dispatched. The best performing event occurred on July 20, 2021, with in-market CPA resources delivering over 200 kW to the electricity system and an additional 50kW supplied through retail program dispatch during the event period.

Resource Location	Number of Events	Average Event Performance	Average Bid Capacity (kW)
SCNW	2	100%	40
SCEW	2	76%	53
SCEC	15	70%	77

Table 12: Market Resource Participation and Performance Summary

6.4 Future Opportunities

Wholesale market participation presents several opportunities for the Power Response Program. Active participation in the market is the first step toward being eligible to offer RA which would unlock an additional and highly valuable revenue stream for CPA and provide reliability value to the California electricity system. Providing this service is a topic that should be thoughtfully considered as the program grows. Continued economic viability and expansion of the program will be enhanced by CPA's ability to monetize RA capacity value.

Additionally, there are program design elements that may have the potential to increase the value of the Power Response Program. These elements include expanding the program to include weekend events, day-of dispatches, and participation in California's Emergency Load Reduction Program. All these participation avenues have the potential to allow the Power Response Program to better serve the needs of a stressed grid while also opening up additional

revenue streams. Several of these enhancements may be required in the future in order for the program to capture RA capacity value.

Another program design element that should be further investigated is the monthly event limit. While event limits are important to establishing trust and attracting new enrollments, the five event per month maximum also has the potential to result in missed opportunities during particularly supply-limited months. This is especially true when bidding strategies are adjusted early in the month, to preserve capacity in anticipation of future high prices that may ultimately never materialize. This exposes the program to risks inherent to estimating future market prices. The month-by-month limit may be unnecessarily constricting while a seasonal limit with additional restrictions on consecutive event days may better serve the program and address market variability.

7.0 Lessons Learned and Recommendations

The design, launch and implementation of the Power Response Program has positioned CPA as a leader in DER integration and management among California's CCA community. The pilot program implementation was successful in enrolling an adequate number of customers and devices and utilizing DERs to participate in the CAISO wholesale markets – all within only one year of commencing operations, and in the face of uniquely challenging COVID restrictions. The program's strategic design elements will allow CPA to continue to scale the program aggregations and diversify its offerings to more customer segments and DER technologies in the future. The program has also provided important qualitative benefits to CPA by creating increased brand awareness across service territory, establishing relationships with its customers and educating them about the methods and benefits of shifting and curtailing load to reduce their utility bills while providing critical grid services.

The implementation of the program imparted valuable lessons and provided key insights that informed the recommendations for the future enhancement and scaling of the program. Some of the important lessons learned and recommendations include:

- ***Customer meter data access challenges for CCAs:*** The Power Response Program, as a CCA run program, is at a disadvantage compared to IOU programs due to lack of direct access to its customer's meter data. Timely access to customer meter data is essential to track and report on event performance for a DR program. To overcome this barrier, Olivine had to expand the program's customer enrollment process to include an additional step wherein customers were asked to authorize Olivine to access their meter data. Customers were required to provide the program administrator their utility account number to complete this step, which they sometimes were unable to provide. This additional step is sometimes a burden on customers, complicates the customer experience, and is a key barrier for maximizing enrollments in CCA programs. This has been a known barrier for CCAs in California since their inception, and the implementation of this program has highlighted this issue once again.

It is recommended that CPA and other CCAs in California should continue working with their affiliated investor-owned utilities (IOUs) and the CPUC to collectively work on identification of potential solution(s) to facilitate customer meter data access for CCAs.

- ***Program enrollment challenges for CCA customers:*** The enrollment requirements for a CCA program include some additional steps for customers that make the enrollment process longer and more complicated than for investor-owned utility programs. These additional steps include the need to be verified as a CCA customer and the aforementioned requirement for customers to sign a utility meter data sharing authorization with the program administrator. The Power Response Program made progress in mitigating this barrier by integrating all enrollment requirements and steps into one seamless process via the Olivine app and advanced technology solutions built for this purpose; however, the customer enrollment data indicates that there were several instances where customers initiated but did not fully complete the enrollment process.

It is recommended that, like the Olivine technology solutions and enrollment app used in this program, all CCA DER programs should develop enrollment flows and processes that streamline all the enrollment requirements into a single seamless process and eliminate the more cumbersome multi-step enrollment journey for customers initially encountered during the Power Response Program launch.

- ***Technology Vendor Engagements:*** The vendor engagement efforts during the implementation of this program underscored the fact that identifying and partnering DER technology vendors for a DR program is time consuming and requires a lot of one-on-one engagement and technical work to a) secure their interest in partnering in a pilot program, b) facilitate direct control of their devices for the program, c) convince them to stand up program efforts with little monetary incentive. The majority of technology vendors contacted to partner with this program were reluctant to commit to a pilot program that may only be available for a limited timeframe, and thus this program was only able to partner with ecobee for direct control of devices. Technology vendors were also hesitant to market a program offering to their customers that is not guaranteed to benefit them in the long run. Thus, the 'pilot' status of the program proved to be a barrier in engaging technology vendors for the program. Olivine was able to mitigate this barrier by allowing a behavioral or manual control route to customers for participation in events. However, the performance analyses clearly demonstrated that the customers with automatic or direct control of their DER devices performed better than those customers participating via behavioral response. Thus, partnership with more technology vendors and facilitating direct control of devices for the program will benefit both CPA and its customers.

It is recommended that DR pilot programs can mitigate the above challenges by offering pathways for technology vendors to gain easy access to customers for marketing, access to marketplace/webstores to showcase and sell their devices and provide them with financial incentives to compensate them for their marketing and outreach efforts resulting in successful program enrollments.

- ***Lack of Demand Response Knowledge and Awareness:*** The implementation of the Power Response Program has highlighted the fact that most customers have limited knowledge and awareness about DR, which was identified as a barrier to increasing program enrollments, as well as limiting customers' ability to fully participate in events. Even large non-residential customers were unable to understand concepts such as 'minimum capacity commitments' during program enrollment, and this barrier was amplified during engagement and recruitment of underserved customers. Customers also reported their concerns about disruption to their building operations and privacy concerns about meter data sharing and device control authorizations. The program team attempted to mitigate these challenges by providing 17 potential C&I program participants representing over 34 sites with technical assistance, analyzing their load profiles, answering their queries and helping them generate more interest in the program. By continuing the ongoing customer engagement and technical assistance processes for C&I customers, the program team can make progress at removing these barriers for customers through outreach and engagement efforts, educational webinars on the program, and a one-on-one technical assistance—resulting in additional customer enrollments. These informational barriers are also expected to be resolved over time as more customers adopt additional DER technologies, learn about flexible load shifting and demand response, enroll in the program themselves and successfully participate in events.

It is recommended that the program team continues its customer engagement and education efforts. The team should also use customer feedback to develop and disburse marketing and educational collateral to educate customers about the opportunities and benefits of participating in DR programs.

- ***Engaging Underserved Customers:*** The program marketing activities implemented in the support of the Power Response Program underscored the fact that outreach efforts targeted to underserved customers should be defined early in the planning phases of the program design. Early and concentrated focus on this sector will aid in the development of effective plans, strategies, technologies and marketing collateral to mitigate the challenge of reaching hard to reach customers. The Power Response Program has benefited from a healthy participation rate from underserved customers, as this customer segment was identified as a priority early in the planning process. Based on this planning, the program's marketing and enrollment tools were developed in multiple-languages, higher incentives for underserved customers were built into the program design, CBOs were hired to engage underserved customers, processes were put into place to identify customers via their service addresses and rate structures as DAC residents and/or low-income customers, and the program reporting dashboards were designed to carefully track and report engagement of underserved customers.

It is recommended that the program continues its focus on underserved customers and continues to improve and find new pathways and communication channels for targeting and engaging this customer segment. For example, the team recommends that the

program makes a focused effort to identify and target potential customers that reside in DACs. This can be done by mapping existing customers, identifying DAC residents that are CPA customers, and conducting targeted marketing and outreach campaigns in geographic areas with a high concentration of DAC customers. The DAC targeted marketing efforts should be focused on residential and non-residential customers equally. Future program enhancements should include a 'Behavioral DR' option or pillar to expand the program's accessibility to a broad base of underserved customers who may not have yet adopted any DER technologies. These customers can still contribute to strategic load reduction through taking behavioral actions in their homes and buildings such as manually adjusting setpoints, switching off unused lights/appliances/ devices, not using heavy appliances or equipment such as washers and dryers during a program event, and other similar energy conserving behaviors.

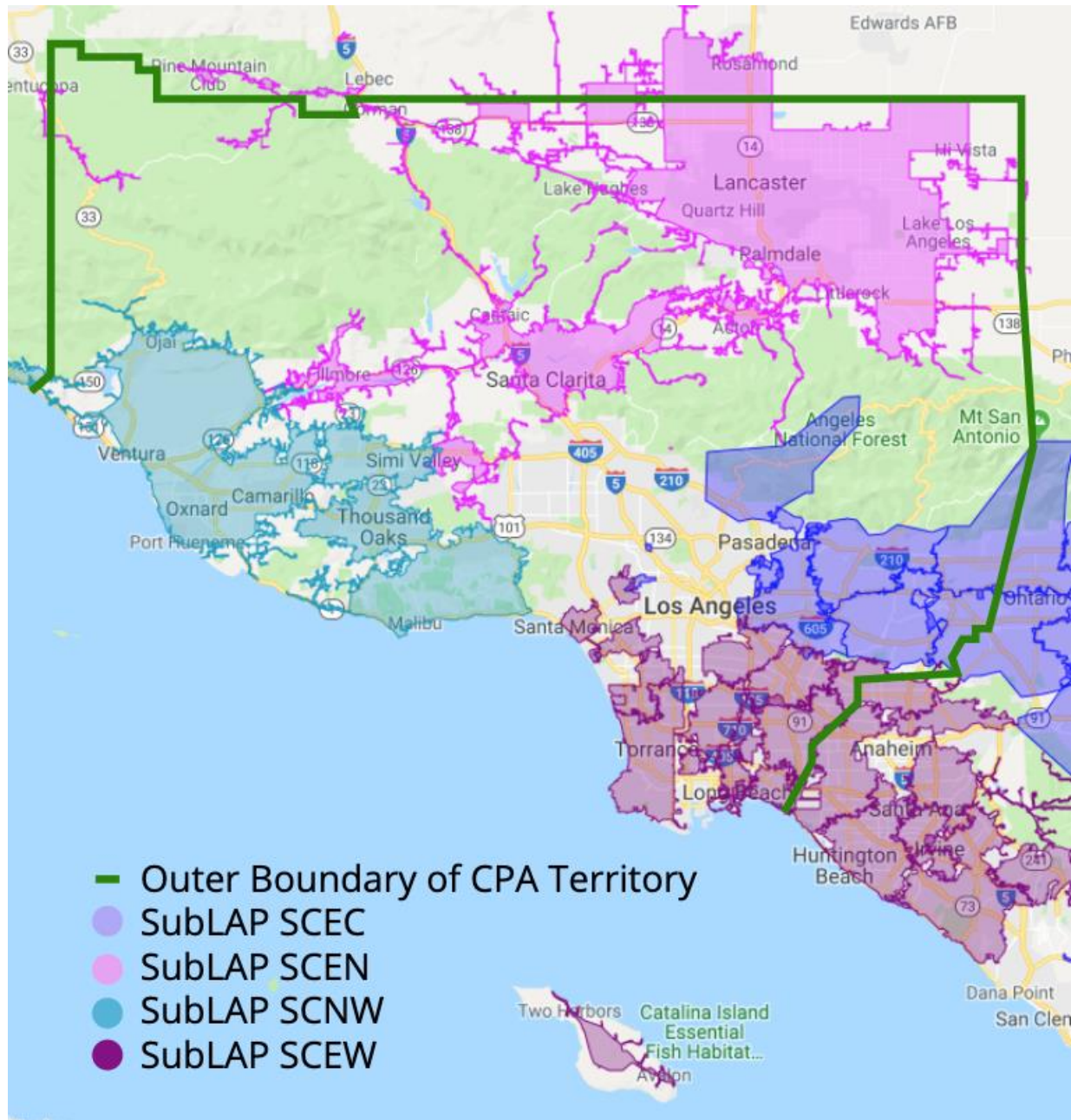
- **Market Participation for DR Programs:** This program has demonstrated that a CCA led DR program can successfully bring resources across multiple sub-LAPs into the wholesale market. It has also highlighted that there is unrealized potential available to these types of programs that is accessible through sustained market participation, bidding strategy refinement, and improved baselining and modelling techniques used to estimate resource capacity and measure performance. Further experience in market participation will enable greater revenue potential and pave the way for the program to monetize the value of RA. Furthermore, innovative DER management programs like Power Response will only continue to harness more value to the electricity system as the smart device ecosystem continues to grow. This growth will facilitate additional dispatchable capacity that can be thoughtfully managed and brought to market through software-based aggregation platforms like Olivine DER™.

Based on the analyses and information summarized in this final report, the design, launch, and operations of the Power Response Program was a successful collaborative effort between CPA and Olivine, and the program is well positioned to scale up into a larger DER aggregation by adopting the proposed recommendations. It is also recommended that the next phase of the Power Response Program be initiated as a multi-year program with a focus on enrolling customers through multiple pathways including direct outreach to targeted customers, marketing to targeted customer segments, via the program app, and through vendor partnerships via trade ally network. In addition to enrolling customers with existing devices (current phase), the program should expand enrollment pathways to bring in new devices purchased through a Power Response webstore and allow customers without DER technologies to enroll through a behavioral DR route. These strategies, along with a pronounced customer education and engagement campaign, will support expansion of the program's target customer base and allow enrollments and DER aggregation capacity to rapidly scale.

Appendix A: Acronyms/Terms List

C&I	Commercial and Industrial
CAISO	California Independent System Operator
CARE	California Alternate Rates for Energy
CBO	Community-based organization
CCA	Community Choice Aggregator
CPA	Clean Power Alliance
DAC	Disadvantaged Community
DER	Distributed Energy Resources
DR	Demand Response
EV	Electric Vehicle
FERA	Family Electric Rate Assistance
GHG	Greenhouse gas
KPI	Key performance indicator
LSE	Load Serving Entity
PDR	Proxy Demand Resource
RA	Resource Adequacy
SCE	Southern California Edison
sub-LAP	sub-Load Aggregation Point

Appendix B: Map of sub-LAPs within CPA Service Area



Appendix C: Program Cost Effectiveness Scenarios and Results

Summary of cost effectiveness scenario variables is shown below in Table 13.

	Performance Scenarios		
	Low Current thermostat control (15%) No direct control for Res storage C&I performs 25% below capacity commitment	Medium All Ecobees controlled (25%) Res storage performs at program target (1kW) C&I performs at capacity commitment	High All Ecobees & Nest thermostats controlled (85%) Res storage performs at avg customer load during events (2 kW) C&I performs at 25% above capacity commitment
Incentive Scenario			
High Maintain current levels	Scenario 1	Scenario 2	Scenario 3
Medium 25% reduction in participation incentives 50% reduction in enrollment incentive	Scenario 4	Scenario 5	Scenario 6
Low 50% reduction in participation incentive No enrollment incentive	Scenario 7	Scenario 8	Scenario 9
Mix 50% reduction in residential participation incentive, 25% reduction in residential enrollment incentive 25% reduction in C&I participation incentive, 100% reduction in C&I enrollment incentive	Scenario 10	Scenario 11	Scenario 12

Table 13: Summary of program cost effectiveness scenarios

Each of these scenarios was evaluated for their revenue potential over a ten-year period. Scenario 5 was selected as providing the best balance of cost reductions in the form of reduced

incentives to customers with overall program cost effectiveness. The overall performance of Scenario 5 along with other scenarios is shown below in Table 14.

	Residential & Small Business		Medium Business and C&I		
Scenario	Pillar I: T-Stat	Pillar II: Storage	Pillar II: Storage	Pillar III: EV Charging	Program Total
Baseline	0.91	0.82	1.26	0.95	1.1
Scenario 1	0.91	0.82	1.49	0.95	1.23
Scenario 2	1.01	0.96	1.49	1.15	1.3
Scenario 3	1.56	1.27	1.69	1.32	1.55
Scenario 4	1.07	0.92	1.48	1.12	1.29
Scenario 5	1.19	1.06	1.74	1.34	1.44
Scenario 6	1.8	1.37	1.74	1.51	1.78
Scenario 7	1.31	1.06	1.81	1.36	1.57
Scenario 8	1.45	1.2	2.07	1.59	1.8
Scenario 9	2.12	1.48	2.28	1.77	2.08
Scenario 10	1.31	1.06	1.48	1.12	1.34
Scenario 11	1.45	1.20	1.74	1.34	1.56
Scenario 12	2.12	1.48	1.94	1.51	1.83
Initial Target	1.05	1.21	1.21	2.07	1.21

Table 14: Program cost effectiveness scenarios by pillar