TECH CLEAN CALIFORNIA

ANNUAL REPORT 2022–2023

YEAR TWO
SEPTEMBER 2022–AUGUST 2023

Energy Solutions · ARDENNA ENERGY · ASSOCIATION FOR ENERGY AFFORDABILITY · BUILDING DECARBONIZATION COALITION · ELECTRIFY MY HOME · ENERGY OUTLET

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Contents

Tables

Figures

Executive Summary

TECH Clean California is a market transformation initiative authorized by Senate Bill 1477 and designed to increase the adoption of high-efficiency, low-emissions space and water heating technologies. Energy Solutions, along with its partners comprising the TECH Clean California team, was selected following a competitive proposal process and launched the program in 2021.

In July 2022, Governor Gavin Newsom announced a goal of installing six million heat pumps by 2030, with 50 percent of benefits flowing to low-income households and disadvantaged communities.[1] TECH Clean California's strategy is based on three strategic pillars that will help California meet its heat pump goals:

GOAL:

TECH Clean California will put the state on a pathway to six million heat pumps by 2030 and carbon-free homes by 2045.

Figure 1: The Three Pillars of TECH Clean California

1 Office of Governor Gavin Newsom. 2022. "Governor Newsom Calls for Bold Actions to Move Faster Toward Climate Goals." https://www.gov.ca.gov/2022/07/22/governor-newsom-calls-for-bold-actions-to-move-faster-toward-climate-goals/

Pillar One: Spur the clean heating market through statewide incentives, training, and consumer engagement

In Year Two, TECH Clean California relaunched several initiatives to enable multi-program incentives and strengthened partnerships with contractors, distributors, and industry experts across the heat pump HVAC and heat pump water heating markets. TECH Clean California continued its focus on low-income, disadvantaged, and hard-to-reach communities, with 40 percent of funding directed towards equity customers. A rigorous outreach campaign focused on contractor enrollment, workforce education, and market engagement led to the following high-level achievements during Year Two:

741+ enrolled contractors

Over 741 new and reenrolled contractors are participating in the program as of November 2023; including 46 different HVAC and heat pump water heater distributors, covering more than 550 locations statewide.

140 local ambassadors

The team worked with 140 local ambassadors to garner awareness and support for home electrification.

5,240 single family reservations

Single family HVAC incentives were relaunched, with 5,240 reservations and submissions from 300 separate participants.

9 multifamily reservations in 9 minutes!

Multifamily incentives were relaunched, with all available reservations filled within 9 minutes.

35 heat pump units donated to schools

Donated 35 heat pump units to schools for students to learn about installation and operations.

+39% favorability

A media campaign to increase home electrification awareness, favorability, and perception was launched. Using targeted customer data, the campaign increased favorability towards heat pump technology and home electrification by 39% — this means more engaged and relevant customers.

PLUS:

The Switch Is On website was updated to enhance user experience based on feedback from consumers, contractors, and website analytics.

Partnerships were created with colleges, trade schools, and training centers statewide to add heat pump training to new and existing curricula.

Figure 2: Year Two Achievements

Pillar Two: Address adoption barriers and create scalable models through regional pilots

Six regional pilots address key barriers to heat pump adoption on a smaller, targeted scale. In Year Two, the team documented progress for all six pilots (outlined in the Regional Pilots and Quick Start Grants section).

Key Takeaways on Pilots

MARKET READINESS FOR HEAT PUMP WATER HEATER LOAD SHIFTING PILOT

Begun as a bonus incentive program to motivate contractors and initiate customer demand response enrollment, the learnings from this pilot will now support the new Self-Generation Incentive Program (SGIP) heat pump water heater incentives. With an ever-changing and evolving market, pilot requirements such as thermostatic mixing valves are now mandated for SGIP participation.

HEAT PUMP WATER HEATER PERMITTING PILOT

Jurisdictions have different processes for permitting heat pump water heaters, which can take multiple days or even weeks and ultimately prevent any opportunity to streamline permits. Using its learnings to date, this pilot is currently focusing on outreach and educational efforts to tailor information to regional needs, while ensuring educational resources are available at varying levels appropriate to city staff expertise.

CUSTOMER TARGETING PILOT

This pilot focuses on outreach strategies to drive demand among customers for whom the value of electrification is greatest. Campaigns experienced an open rate of more than 50 percent, showing that personalized messages are effective when targeting homeowners who are 'above average' in their monthly energy or dollar savings. The results of this pilot are being incorporated into the *Switch Is On* awareness campaign. Proposals to scale the results will be presented to utilities statewide in the coming months.

INCLUSIVE UTILITY INVESTMENT PILOT

This pilot team actively participates in the Joint Tariff On-Bill (TOB) Working Group, which meets weekly and was created in response to the California Public Utility Commission (CPUC)'s ruling on the Clean Energy Financing Options proceeding. During the weekly sessions, the Working Group cultivates common ground to share knowledge across investor-owned utilities (IOUs) and create a joint IOU TOB proposal for CPUC approval. Participants have determined key program design elements, including eligible measures, funding sources, and consumer protections. The Working Group has established a visible and credible position around this program and the finance discovery concept, which is poised for expansion. By answering questions collaboratively and producing a joint proposal, the IOUs and Silicon Valley Clean Energy will be in a better position to navigate a complex regulatory environment and scale a TOB to offer statewide. Findings will

benefit all parties involved, including utilities and the CPUC. While the learning curve is steep, support from this Working Group is necessary to balance competing concerns from a diverse group of stakeholders, which often present a challenge to achieving California's decarbonization goals.

SUPPORTING LOW-INCOME PROGRAMS' TRANSITION TO ELECTRIFICATION

Since remediation costs vary widely, programs should anticipate, offer, and deploy a flexible funding approach. To ensure the broadest customer participation, program implementers and contractors need the flexibility to move remediation funds between properties, rather than be constrained to strict per-home funding limits. The San Joaquin Valley Disadvantaged Community project has seen the most movement throughout the year due to engaged contractors and an accepting community. Other projects within the pilot continue to build their pipelines for work to be completed next year.

MULTIFAMILY PORTFOLIO PILOT

Pre-project monitoring is necessary in multifamily buildings to accurately assess hot water demand and set the appropriate central heat pump water heater system size. Many infrastructural issues in a multifamily hot water system can be masked by a gas boiler. Without pre-project evaluation, inadequately-sized central heat pump water heater systems might be installed, falling short on efficiency performance and dissatisfying residents. Multifamily building retrofits are complicated, and upfront investment might be prohibitive. Pre-project monitoring and cost of retrofitting equipment are the main barriers identified by program learnings thus far.

Quick Start Grants

The Quick Start Grants program is designed to fund targeted projects that test approaches to overcoming market barriers to heat pump space and water heating adoption. The program promotes developing and refining interventions that can be scaled into statewide solutions. Projects cover four overarching areas:

Figure 3: Quick Start Grants Program

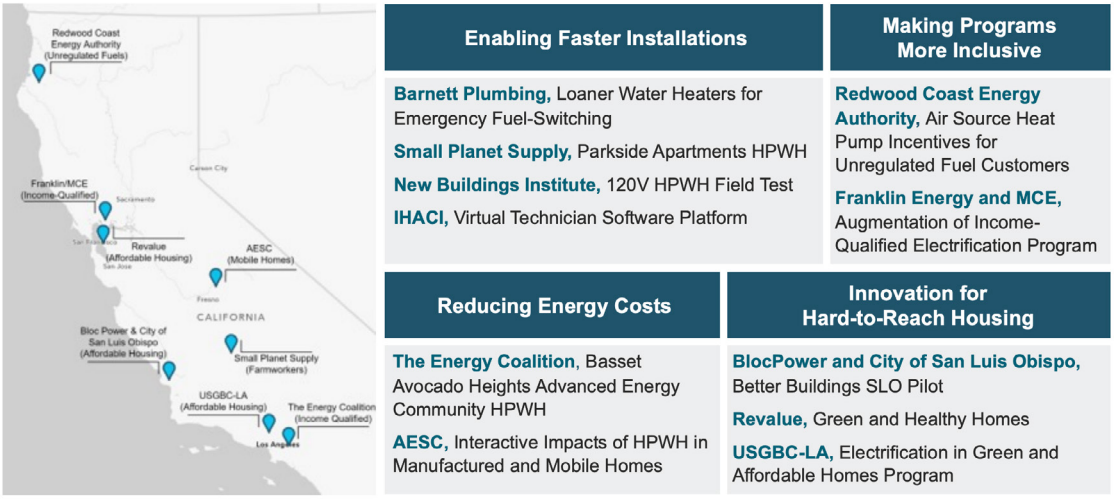

Figure 4: Quick Start Grants 2022 Projects

Six of the first-round Quick Start Grants projects will complete milestone achievements and fully wrap up by Q4 of 2024. As these projects finish their intended implementation periods, TECH Clean California will review outcomes and assess projects for potential scalability. The following projects highlight accomplishments and takeaways in Year Two:

LOANER WATER HEATERS FOR EMERGENCY FUEL-SWITCHING

Barnett Plumbing

If a water heater fails, customers are often unwilling or unable to wait for the potential electrical or infrastructural upgrades, permits, or other alterations that may be required to switch from gas to heat pump water heating. To overcome this, Barnett Plumbing installed a loaner gas water heater at no cost to bridge the time needed to do any electrical or home infrastructure upgrades for customers who were interested in switching to a heat pump water heater.

- Barnett Plumbing experienced a 17 percent increase in customer conversions from gas water heaters to heat pump water heaters during the first 13 months of the project, with 149 heat pump water heater installations and 127 gas loaner installations.
- They added new 120V plug-in heat pump water heaters as an alternative to gas loaners.
- Combined, these two options led to an increased conversion rate of 52%, indicating customers are interested in the opportunity to have a more efficient system, especially given Barnett's approach of allowing sufficient time to complete electrical upgrades prior to installation.

VIRTUAL TECHNICIAN SOFTWARE PROGRAM

Institute of Heating and Air Conditioning Industries (IHACI)

One of the biggest problems contractors face when properly installing heat pumps is finding qualified personnel. IHACI has developed Visual Service, an internet-based software system that allows one service manager to assess and support multiple field technicians. The software allows a remote master technician to supervise the work of multiple field technicians in real time.

- IHACI recruited 37 technicians to use Visual Service software in the field, with over 300 systems documented.
- An overall increase in equipment efficiency and performance was observed when HVAC technicians used smart tools in conjunction with Visual Service software.

PARKSIDE APARTMENTS: STANDARDIZED CENTRAL HEAT PUMP WATER HEATER DESIGN

Small Planet Supply

There are limited options for central heat pump boiler systems to serve small multifamily buildings, which are especially common in rural areas.

- Key findings showed that design knowledge and products that serve multifamily buildings are lacking.
- Small Planet Supply developed a standardized, modular, pre-engineered, and pre-packaged central heat pump water heater retrofit unit to minimize design requirements, installation, costs, and challenges inherent to existing practice. The "plug-and-play" design allows for scaling production volume to meet market demand.

120V HEAT PUMP WATER HEATER FIELD TEST

New Buildings Institute (NBI)

Switching from gas water heating to a heat pump water heater often triggers expensive and time-consuming electrical upgrades, including panel upgrades and home rewiring to accommodate a new 240V appliance. Emerging 120V heat pump water heater technology is a potentially game-changing retrofit solution, as it uses existing wall outlets.

- NBI installed and monitored 120V heat pump water heaters for 32 customers in various climate zones across California, resulting in a broad range of learnings and important insights for manufacturers, utilities, policymakers, and installers.
- Analysis showed that compelling technology can have a great impact on decarbonization and electrification goals.

AIR SOURCE HEAT PUMP INCENTIVES FOR UNREGULATED FUEL CUSTOMERS

Redwood Coast Energy Authority (RCEA)

- Unregulated fuels such as propane, fuel oil, and wood have typically been ineligible for energy efficiency or fuel-switching incentives. For the RCEA project, rebates for heat pump water heaters and heat pump HVAC were distributed to rural areas working with local contractors.

GREEN AND HEALTHY HOMES

Revalue

- The Revalue project focused on remediation of home health hazards or code violations in low-income households, while providing focused training for contractors and adding projects to their pipeline.

The second round of Quick Start Grants were awarded to eight projects that will explore creative solutions to known market barriers in California, with a particular emphasis on equity. The new cohort has a heightened focus on supporting low-income, disadvantaged, and hard-to-reach communities.

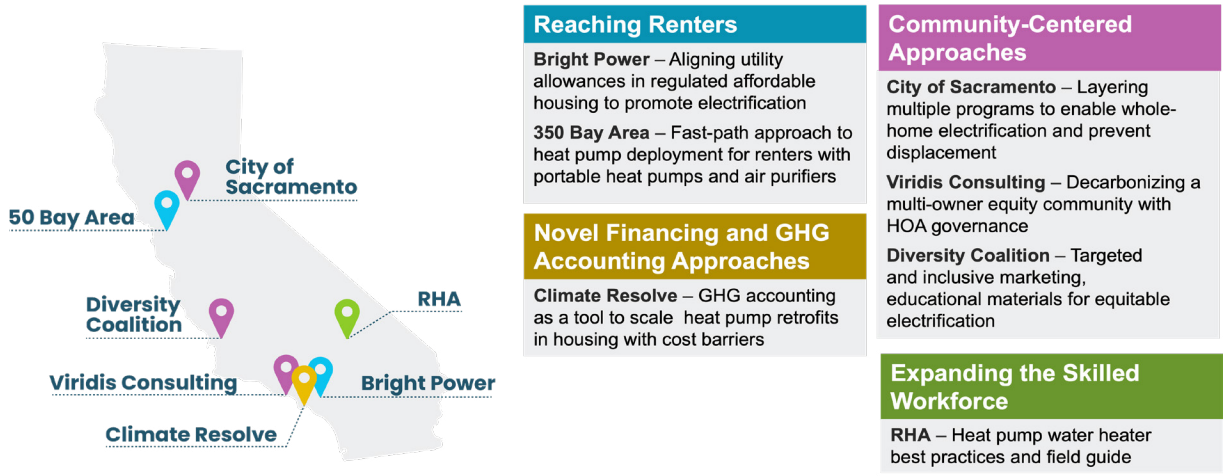

Figure 5: Quick Start Grants 2023 Projects

GOGREEN HOME FINANCING EXPANSION

TECH Clean California also partners with the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) to expand access to the GoGreen Home financing program by providing credit enhancements for customers in non-IOU territories. The objective is to ease the financial burden on those who seek to make energy-efficient upgrades in their homes and effectively enable a statewide offering. Since the inception of TECH Clean California and its partnership with CAEATFA, loan enrollments for heat pumps and heat pump water heaters have increased 400 percent. Notably, projects completed by contractors enrolled in TECH Clean California account for the majority of this uptick. This initiative continues to support CAEATFA in finding a long-term funding partner to maintain GoGreen Home's success as TECH Clean California funds are depleted.

Pillar Three: Inform California's long-term building decarbonization framework

Pillar Three focuses on combining project sales, energy consumption, and survey data and making this available via the public reporting site, techcleanca.com, with both downloadable datasets and rigorous analysis quantifying the decarbonization impacts.

Figure 6: techcleanca.com Impacts

California has aggressive decarbonization targets, and TECH Clean California's data and learnings can inform decisions for a wide range of stakeholders. Achieving this vision requires developing a robust data-to-policy pipeline as visualized in Figure 7. Pillar Three accomplishments in Year Two include:

- Building software tools enabling rapid and scalable analysis of meter-based impacts for thousands of TECH Clean California projects
- Completing meter-based energy impacts analysis for the first tranche of projects and creating what is already the largest dataset of meter-based impacts for heat pump retrofits
- Increasing the breadth and depth of information accessible on the public reporting site, including downloadable TECH Clean California single family and multifamily project data sets, interactive site features enabling quick analysis, and dedicated informational webpages for all regional pilots and Quick Start Grants
- Building a multivariate regression model to identify major drivers of heat pump HVAC retrofit project costs
- Using logistic regression to find the project features that most strongly affect the probability of an electrical panel upgrade
- Developing an equity community definition and an Equity Budget Report to show the portion of incentives spent in equity communities
- Acquiring HVAC shipment data to track the growth and transformation of the California heat pump HVAC market
- Contributing to critical decarbonization policy decisions via working groups and ongoing conversations with the agencies driving these

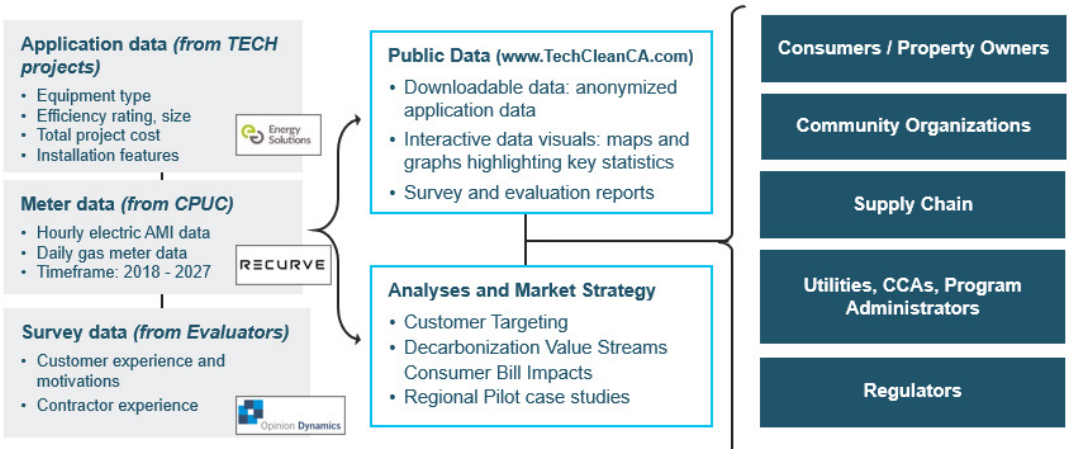

Figure 7: TECH Clean California Data-to-Policy Pipeline

In Year Two, TECH Clean California continued to focus on core objectives outlined above in the three pillars. To date, enrolled contractors have installed 19,421 units (3,424 heat pump water heaters and 16,277 heat pump HVAC). There were 12,787 installations in total, the majority being in single family units. Demand in the multifamily market remains high, challenging TECH Clean California to keep pace.

With unprecedented public reporting and data analysis, especially meter-based energy impact analysis, TECH Clean California will focus on further informing decisions for a wide range of policy makers, program implementers, and stakeholders.

While California's electrification goals are ambitious, TECH Clean California is making great strides to transform the market and help put California on the path to meet its six million heat pump goal by 2040. This Annual Report provides insight into key objectives, successes, and learnings as TECH Clean California continues to support California on its path to a carbon-free future.

Overview

TECH Clean California is the state's flagship market transformation initiative for heat pump HVAC and water heaters. To achieve lasting scale, the initiative will publish program results and learnings to support widespread heat pump deployment.

To meet the initiative's goals within the timeframe specified, TECH Clean California employs strategies to drive significant increases in market scale and a rapid shift towards clean technologies. Through a combination of market incentives, supply chain engagement, workforce development, consumer education, regional pilots, and Quick Start Grants, TECH Clean California is enabling the installation of low-emissions space and water heating technologies, as well as collecting and publishing energy and greenhouse gas (GHG) impacts with market data to inform California's long-term decarbonization framework.

The Initiative Framework – The Three Pillars of TECH Clean California

- **Pillar One:** Spur the clean heating market through statewide incentives, training, and consumer engagement
- **Pillar Two:** Address adoption barriers and create and test scalable models through regional pilots
- **Pillar Three:** Inform California's decarbonization decision-making with public data, analyses, and case studies

PILLAR ONE

Spur the Clean Heating Market Through Statewide Incentives, Training, and Consumer Engagement

Single Family Incentives Relaunch

In Year Two, TECH Clean California relaunched single family heat pump HVAC incentives with a new incentive structure of $1,000 per unit (reduced 66 percent from $3,000 to $4,800 per unit previously) and requirement that the heat pump HVAC unit to only meet code minimum efficiency levels. These adjustments were well received and ultimately made it easy for other programs to layer incentives. Heat pump water heater incentives remained unchanged during this time at $3,100 per unit. While new contractor enrollments in Year Two were not as high as in Year One, participation remains strong for the single family heat pump HVAC program despite the reduced incentive amount. This is evidenced by the exponential growth in reservations and submissions, shown in Figure 8. The program's success from Year One can be seen in Figures 8 and 9 and should serve as a baseline for what Year Two will accomplish. Based on the number of heat pump HVAC claims submitted in Year Two thus far, Figure 8 shows that TECH Clean California has already surpassed the number of average monthly submissions in Year One.

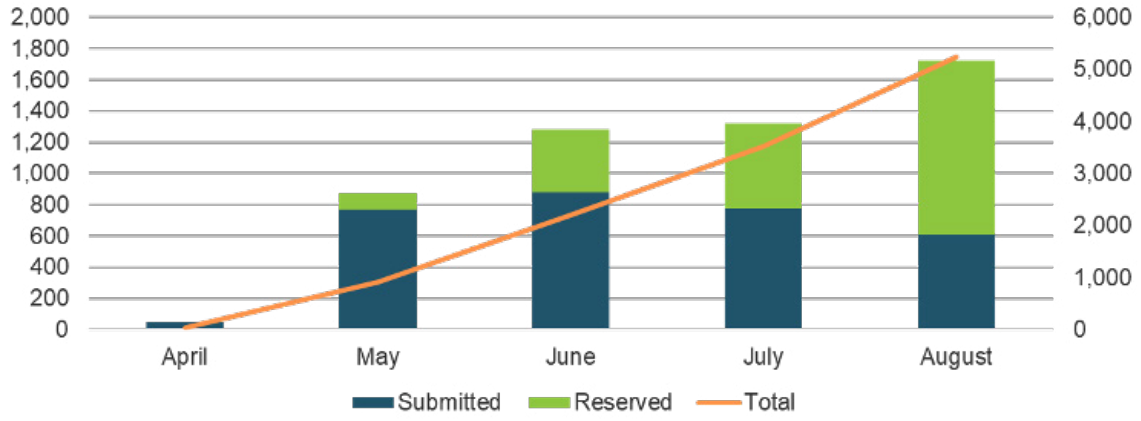

Figure 8: Heat Pump HVAC and Heat Pump Water Heater Claim Submissions Since Incentives Relaunched

For current incentive data and trends, please see the TECH Clean California Public Reporting website.

Incentive Reservations

TECH Clean California continued the reservation process implemented in Year One and made two changes that proved beneficial to contractors. To reserve incentives, contractors are now required to upload a customer-signed contract, which allows budget to be allocated for confirmed jobs, versus setting aside funding for speculative bids. Additionally, an automatic 90-day rejection rule was set in place to ensure abandoned jobs would not reserve budget unnecessarily.

Figure 9: Cumulative Units and Incentives from September 2022–August 2023

Single Family Incentive Layering

TECH Clean California's single family offering was designed to encourage layering directly with an enhanced measure structure in regions where a partner program existed. The incentive structure set up three distinct methods of incentive layering that could be leveraged to stack multiple incentives for a single claim submission. These included:

1. Stacking both incentives on a single claim form, with a single check paid to participants.
2. Stacking both incentives on a single claim form, while incentives were paid out separately by each program.
3. Operating both programs separately, but data was shared on the backend between program implementers to reduce participant burden.

TECH Clean California discontinued the third option of integration as operating it proved to be an administrative burden that did not significantly reduce participant burden.

Four programs layer directly with TECH Clean California — BayREN's Midstream Heat Pump Water Heater Program, Central Coast Community Energy's Electrify Your Home Program, the Quality HVAC Program, and the new SGIP offering. The SGIP Heat Pump Water Heater Program integrated with TECH Clean California heat pump water heater incentives in the fall of 2023 to create a single, combined offering and reduce market confusion.

"TECH Clean California funding was really important for retrofits, it has allowed us to get into decarbonizing our existing portfolio. We don't have unallocated capital to invest in energy efficiency improvements, let alone fuel-switching. TECH Clean California allowed us to bridge that gap."
- Macallan Mitchell, Energy Services Analyst Coordinator, National Community Renaissance

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Multifamily Incentives

Multifamily incentives relaunched in June 2023 with the same incentive structure in place. Reservations for all incentives were exhausted in just nine minutes. Initially, 75 percent of the budget was set aside to support affordable housing properties. Demand was higher than expected, and 81 percent of the funding was allocated to support equity customers. The multifamily option will continue to be an important vehicle for supporting low-income communities and serving equity customers. More than 100 projects are currently on reserve, which will also provide further opportunities for workforce education and training.

Table 1: Budget Allocation for Multifamily Incentives

Release 1 (July 13, 2023)	Release 2 (September 6, 2023)
Total Incentive: $4.2 million	Total Incentives: $2.8 million
Affordable Housing Budget: $3.15 million	Affordable Housing Budget: $2.1 million
Market Rate Budget: $1.05 million	Market Rate Budget: $700,000

TECH Clean California Incentives and Equity

As California decarbonizes and embraces an all-electric future, it is critical that electrification is accessible and beneficial for all customers. Income-constrained customers and renters face the most significant challenges in upgrading their living spaces due to lack of funds. These same Californians are disproportionately affected by severe weather events and rising energy rates. California's low-to-middle-income residents are being left behind as the rest of the state invests in electric vehicles, solar panels, and all-electric appliances.

81 percent of multifamily incentives go to low-income, affordable housing, and disadvantaged communities.

The bulk of multifamily incentives are directed to low-income properties, where they provide critical funding for rental units that frequently do not receive the benefits of energy efficiency upgrades. Multifamily incentives were distributed fairly evenly between Northern California and Southern California, but primarily concentrated in the major urban regions of the Bay Area, Sacramento, and Los Angeles. With a higher incentive budget in future years, TECH Clean California's goal is to target smaller property owners who are more predominant in underserved areas of the state to better spread the benefits outside of the major urban areas where these programs tend to concentrate. About two-thirds of units were for heat pump water heaters, with the vast majority being central heat pump water heaters. The remaining one-third was for HVAC units, with the majority being individual apartment HVAC replacements.

SINGLE FAMILY EQUITY STRATEGIES FOR OWNERS AND RENTERS

Home improvement projects can be costly, and most single family customers who meet income-qualified criteria lack the financial resources to undertake them and are unlikely to participate in an incentive program such as TECH Clean California. Many of these customers are also renting their homes and require permission or funding from the property owner to participate. Programs to reach low-income residents are usually direct install, meaning free to the income-qualified customers.

While market rate incentives are not a viable method of reaching and bringing this vulnerable population along on the electrification journey, TECH Clean California is committed to its strategy using pilots funded by TECH Clean California to integrate with existing low-income direct install programs and shift the implementation models of existing direct install programs towards electrification.

California's existing direct install programs, such as Energy Savings Assistance (ESA) and the Low-Income Home Energy Assistance Program (LIHEAP), are the source of almost all gas furnace and water heater replacements for low-income customers in California. These programs combined have installed approximately $40 million dollars of gas appliances for low-income customers yearly and have restrictions on fuel substitution replacements that inhibit heat pump adoption. The results are that gas appliances continue to be installed, leaving this vulnerable group of residents behind.

EQUITY SINGLE FAMILY PILOTS

For five of the six equity pilots listed below, TECH Clean California supports existing programs with additional funding for extra costs such as remediation associated with heat pump projects. Remediation often includes additional electrical work, water heater relocation, and other costs which exceed caps set by their respective programs.

Table 2: Equity Single Family Pilots

Program	Federal/IOU	Budget	Funded costs
San Joaquin Valley Disadvantaged Community	IOU/CPUC	$858k	Remediation costs associated with heat pump installation
Southern California Edison Energy Savings Assistance Main	IOU/CPUC	$700k	Remediation costs associated with heat pump installation
Southern California Edison Energy Savings Assistance Building Electrification	IOU/CPUC	$700k	Remediation costs associated with heat pump installation
Pacific Gas and Electric Company Energy Savings Assistance Main	IOU/CPUC	$400k	Remediation costs associated with heat pump installation

Program	Federal/IOU	Budget	Funded costs
Low-Income Weatherization Program Farmworker	CA Federal	$450k	Remediation costs associated with heat pump installation
Pacific Gas and Electric Company Energy Savings Assistance Strategic Early Retirement	IOU/CPUC	$8M	Direct installation of heat pump HVAC, heat pump water heater, remediation

Contractor Engagement

TECH Clean California supports contractors through training, assists with enrollments and applications, and disseminates information on new incentive opportunities. In Year Two, the team focused on communicating the value of TECH Clean California beyond just incentives, prioritizing how to better support contractors with claims and create more transparency around upcoming incentives for continued participation. The team made process improvements to streamline communications and add value for contractors. Activities included:

- Sharing new resources, collateral, and opportunities that better serve contractors' customers
- Meeting contractors where they are by using multiple methods, including texting, and sharing information at an earlier, more defined cadence, especially when new opportunities like additional incentive programs arise
- Gathering feedback on program experiences via surveys and phone calls
- Reengaging previously enrolled contractors to understand their reasons for not reenrolling
- Providing additional support from account managers to select opportunity contractors or those who may traditionally be considered part of a disadvantaged group
- Connecting with contractors via one-to-one emails and personal phone calls to share free and low-cost training opportunities in their area

The team also increased in-person connections with contractors through extensive fieldwork and by attending trade shows. Fieldwork included "counter days" at distributor locations and tabling at manufacturer and distributor events. The team continued the successful pairing with IHACI by increasing TECH Clean California's presence at their annual conference in 2022 and 2023. The team took an unprecedented step at this HVAC-based trade show event, adding an exhibit of heat pump water heaters to promote the Contractors State License Board ruling that HVAC contractors are licensed to install heat pump water heaters. Including this equipment helped set the stage for relaunch of the heat pump water heater incentives, as well as emphasized to HVAC contactors the value of adding heat pump water heaters to their service offerings. TECH Clean California also offered live training to promote the educational offerings available for TECH-enrolled contractors.

Contractor Enrollment and Reenrollment

In Year Two, TECH Clean California participants included over 741 contractors (total of new and reenrolled contractors combined), exceeding the goal of 400 contractors for the second year in a row. Contractors who previously participated in TECH Clean California largely chose to reengage

in the program. While 381 contractors chose not to participate in Year Two, TECH Clean California continues outreach to these contractors to gain feedback about their experiences and have them reenroll in the program.

Contractor Participation Improvements

TECH Clean California streamlined its communications and reduced application processing timelines to expedite incentive payments. The team expanded communications by offering program updates to contractors via text and extended office hours during the week to provide contractors with an opportunity to have their questions answered in live chat. Adjusting office hours has resulted in the team receiving quick and valuable feedback to inform future program design decisions. TECH Clean California also introduced weekly emails to contractors with outstanding correction requests.

Contractors Play an Important Role

Contractors who reenrolled in Year Two were responsible for 77 percent of the HVAC claims and 95 percent of the heat pump water heater claims submitted in Year One.

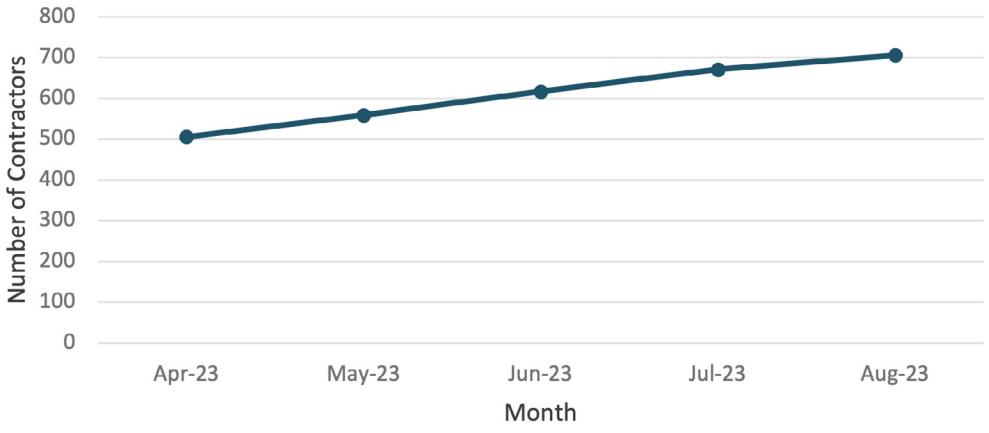

Figure 10: Number of Contractors Reenrolled for Year Two

Supply Chain Engagement

Engaging manufacturers, manufacturers' representatives, distributors, and other industry stakeholders, such as Energy Raters, was a key focus for the team. Manufacturers and distributors provided the team with input on program design and process to ensure that the approach aligns with the evolving needs of the market and California's goals. By engaging existing supply chain relationships and expanding these relationships statewide, the team gained insight on supply chain constraints and other market insights.

TECH Clean California continued to keep manufacturers and distributors up to date with key program changes, allowing market actors to pivot their practices to align with a changing program landscape and ensure these important announcements would spread rapidly throughout the supply chain. The team provides continual updates via email and schedules one-on-one

presentations throughout the year for TECH Clean California's distributor partners and supports distributors across the state by attending dealer events and providing co-branded marketing materials.

TECH Clean California worked with:

Figure 11: Supply Chain Engagement

Consumer Education and Outreach

The *Switch Is On* is a statewide consumer awareness, inspiration, and education campaign, promoting home electrification across California. This campaign serves as the link between the incentive offerings and the consumers.

Updates to the Switch Is On Website — The "One-Stop Shop" for Electrification Incentives

Informed by market research from Opinion Dynamics as well as independent website audits, Switch Is On was redesigned to enhance its user experience. The most popular consumer tools - Incentive Finder and Contractor Directory - are now easily accessible from the home page for all users. Pages that offer technological breakdowns of heat pumps and heat pump water heaters now incorporate easy-to-find buttons such as "Explore Incentives" and "Find a Contractor" that communicate the benefits of the technology.

> *Strengthening Website User Engagement*
>
> Following a redesign, the Switch Is On bounce rate decreased by 14.83 percent and the pages per session increased by 0.84 percent.

The contractor section of the website was redesigned to provide a one-stop resource for contractors to build their electrification business, enroll in TECH Clean California, and find training and tools. The TECH Clean California Training Hub showcases training sponsored by TECH Clean California from the Association of Energy Affordability (AEA), Electrify My Home (EMH), ENERGY STAR® Heat Pump Water Heater Manufacturers Action Council (ESMAC), and the National Comfort Institute (NCI). A list view and calendar view are also featured, with easy filtering options for in-person, field, on-demand, and live training.

Paid Media Campaign

A refreshed and targeted paid media campaign — "Cleaner. Safer. Smarter." — ran from April 17 to June 30, 2023 in the Bay Area, Central Valley, Inland Empire, and Southern California. These areas were selected based on climate zone and high cooling degree days, layered with contextual and

behavioral spending data. The campaign media flight aligned with the launch of new heat pump incentives and generated awareness and favorability (electric switching intent) among household decision-makers, those with less home electrification experience, and those who intend to own a home in the next two years. The campaign highlighted the following:

- Central Valley inhabitants were 26 percent more likely to switch to electric appliances and had more positive perceptions of home electrification after exposure to the campaign ads
- An eight percent increase in awareness occurred among those who live in Southern California
- A strong positive impact among non-heat pump users, with a 10 percent increase in campaign awareness
- An 18 percent increase in favorability towards electrification among customers with solar panels

A second flight of the campaign ran from July 24 to September 30, 2023. This time, using learnings from the Customer Targeting Pilot 8.6, the team directed the paid digital media to customers in the Southern California Edison (SCE) service area who had been identified as favorable targets for electrification due to high cooling costs or solar overproduction. This more targeted flight saw even higher increases in campaign metrics.

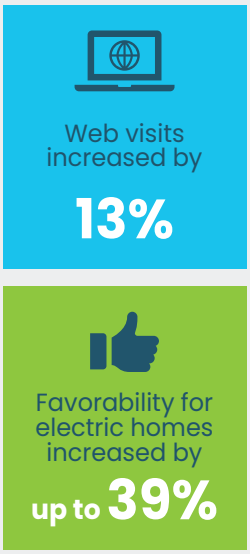

Figure 12: Website Campaign Metrics

Thirty community events were held with ambassadors and partners in the Bay Area and in Southern California, covering more than 10 cities, with an estimated audience reach of over 13,000 visitors. One of the many highlights included an ambassador-led home tour with Congresswoman Katie Porter and Department of Energy Secretary Jennifer Granholm to showcase the benefits of heat pumps, heat pump water heaters, and induction cooking.

An ambassador-led home tour inspired Congresswoman Porter to become the 51st member of the Electrification Caucus.

During the April launch the marketing team pitched TECH Clean California stories to over 50 news media outlets resulting in multiple pick-ups. A partnership with the Los Angeles Department of Water and Power (LADWP) resulted in a Telemundo piece where a Spanish-speaking Ambassador shared the benefits of heat pumps and how to find incentives using the incentive finder on the Switch Is On.

A social media packet for local government and community choice aggregation partners to promote the new incentives was developed. The campaign also engaged the building community to offer education on the value of all-electric homes.

SOCIAL MEDIA

Consumer-facing social media channels for the *Switch Is On* campaign include Twitter (X), Facebook, and Instagram. These channels reached over 750,000 Californians, with an engagement of nearly 10,000 from August 2022 to July 2023. In April 2023, TECH Clean California launched pages on Facebook and LinkedIn targeting TECH Clean California-enrolled plumbing and HVAC contractors and a secondary audience of stakeholders. The channels are used to push out information with consistency and accuracy to keep enrolled contractors informed and engaged, while also recruiting new contractors to enroll in the program.

INFLUENCE OF PAID MEDIA ON WEBSITE TRAFFIC

Paid media continues to be the top driver of traffic to the Switch Is On. During the April 17 to July 3, 2023 paid media campaign, the website received over twice the typical web traffic. Figure 13 below shows the trend of total visitors and new visitors with and without paid media.

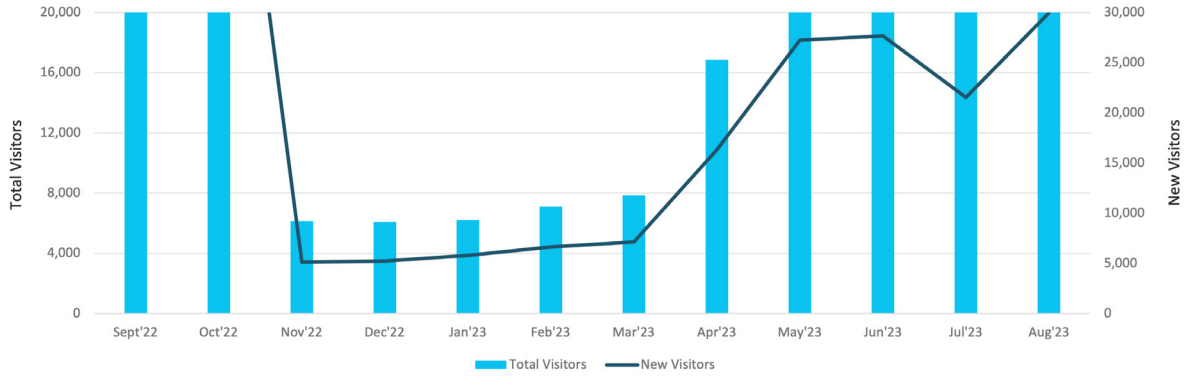

Figure 13: Switch Is On Website Traffic

CONTRACTOR DIRECTORY PERFORMANCE

Referring to contractor feedback from Year One, the team developed new channels, synched up outreach efforts, and increased communications to the contractor audience by introducing social media and multi-layered communications on training opportunities and incentive launches. A substantial increase in quotes requested correlates with the external communications as well as the availability of contractors enrolled in TECH Clean California.

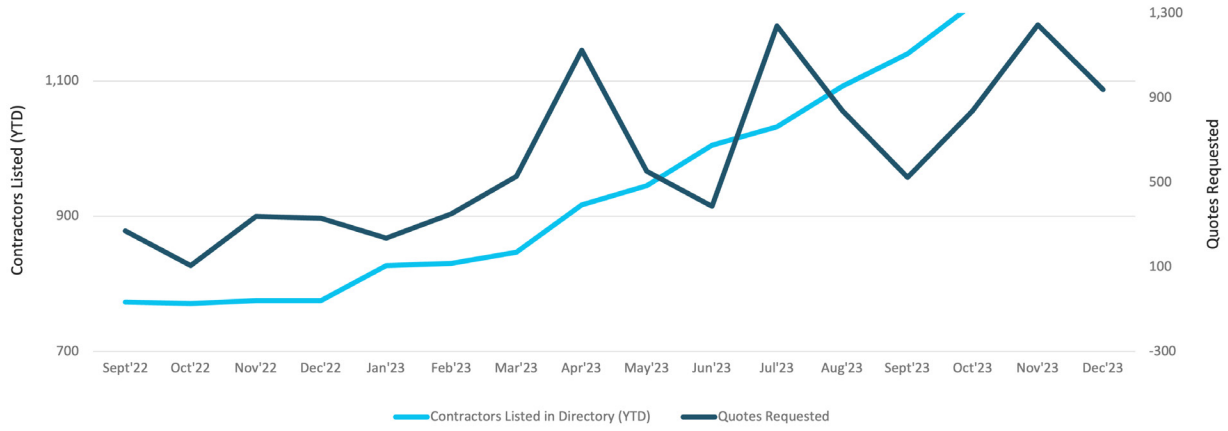

Figure 14: Contractors Enrolled in Contractor Directory and Quotes Requested

Workforce Education and Training

In Year Two, TECH Clean California launched an online knowledge base that allows contractors to quickly search and engage with program information, requirements, and resources.

The TECH Clean California Learning Management System Platform

After working on rebuilding the TECH Clean California Training Hub on the Switch Is On, TECH Clean California was able to offer a more robust and easier experience for contractors to navigate. TECH Clean California's Learning Management System (LMS) was also adapted to interact with Frontier Energy's Salesforce platform, providing the ability to connect contractor records in both systems.

Figure 15: TECH Clean California-Sponsored Courses

There have been 1,873 unique registrants in the LMS. Of those, 57 percent reside in high unemployment (HUA) zip codes, and approximately 63 percent of the companies that employ these users have offices located in HUA zip codes. TECH Clean California provided:

- 301 TECH Clean California Overview Training Events
- 287 Incentive Clearinghouse Training Events
- 174 Load Shifting Training Events

Table 3: Contractor Training and Business Model Support

Course	Description	Structure	Year Two Achievements
Residential Space Conditioning and Water Heating Electrification Course	Robust introduction to residential building electrification	Three-day course	• Provided six, three-day courses • 101 Certificates of Completion awarded
Residential Electrification Master Class Cohort Series	Subject matter experts provided insight and strategic solutions to support contractor firms looking to make electrification their primary service	Weekly sessions spanning a 10-week timeframe	• Two, 10-week series offered • 21 contractor firms engaged
Residential HVAC System Performance Series	Training series offered in both Northern and Southern California intended to elevate contractors and technicians from basic proficiency levels to high-performance leaders in their field	10 total classes offered over a six-month period	• 88 Residential System Performance Certifications awarded • 103 attendees from high unemployment zip codes

Table 4: Multifamily Building Industry Training and Education Model

Event	Description	Structure	Year Two Achievements
Multifamily Electrification Training Plan Webinars	Webinars to engage multifamily stakeholders	Eight total webinars	Total of 253 participants

Table 5: Low-Income Training

Event	Description	Structure	Year Two Achievements
Train-the-Trainer Workshop	In-depth "Train-the-Trainer" seminar that included tools, resources, and content for attendees to learn how to successfully train members of their staff at their own facilities	Two-day workshop	Trained representatives from seven contractor firms, many of which operate in high unemployment areas

INTRODUCTION TO HEAT PUMP WATER HEATER EDUCATION

TECH Clean California partnered with the ENERGY STAR® Heat Pump Water Heater Manufacturer Council (ESMAC) to develop and deploy a manufacturer-led heat pump water heater webinar focused on proper heat pump water heater installation, service, maintenance, troubleshooting, and sales to the California market. The team has cohosted 22 webinars, accounting for 424 companies and more than 700 attendees. Post-training feedback surveys are issued following the session, and overwhelmingly positive responses have been provided.

Industry Collaboration Garners National Recognition

TECH & ESMAC training was approved by the Department of Energy as a "Recognized Heat Pump Water Heater program."

HEAT PUMP WATER HEATER LEARN & EARN

TECH Clean California deployed a "Learn & Earn" workforce development strategy that brings together first-hand knowledge and experience of heat pump water heater technologies. Staff of participating contractor firms are eligible to receive a personal heat pump water heater for their own office after attending both TECH & ESMAC and manufacturer trainings. By creating training opportunities and supplying units, this program provided over 245 heat pump water heaters to contractors enrolled in TECH Clean California, as well as invaluable educational experience that will help contractors move clean heating initiatives forward through heat pump water heater adoption.

Collaboration with Workforce Education Programs

TECH Clean California collaborated with training centers across the state to support outfitting their labs with heat pump technologies. Outreach and partnership included utility training centers, joint apprenticeship training centers, community college programs, trade schools, and 502(c)(3) training facilities. Throughout the process, the team worked closely with manufacturers to provide product training and support. Where feasible, TECH Clean California developed and deployed the training sessions in collaboration with manufacturers.

Figure 15: Heat Pump Water Heater Training Center – DeHart Technical School

TRAINING PARTNERSHIPS

TECH Clean California created partnerships with colleges and other trade training schools, setting up 14 training centers and funding heat pump water heaters to ensure students are learning on the equipment of the future. These colleges include:

- DeHart Technical School
- Cypress College

- Mt. San Antonio College
- College of the Desert
- Cabrillo College
- Riverside City College
- Fresno City College
- Cosumnes River College

TECH Clean California also funded training units for:

- Cypress Mandala Training Center
- UA Local 228-Yuba-Shasta
- California State Pipe Trades Council
- Southern California Edison (SCE)
- The Wollin Group
- Electrify My Home

"The heat pump water heater was a smooth installation, and we were able to test out some of the venting options for the unit, which was a great learning experience for understanding how we can get these units into more homes. This program has definitely helped us better understand the different tiers, from 120V builder model to 240V with leak guard, and ways to install these into different sections of the home. Thank you for the great opportunity."

– John Owens Services

PILLAR TWO

Create Scalable Models Through Regional Pilots

Project Financing Pilot

TECH Clean California customer surveys indicate that about one quarter of single family homes financed their heat pump installation, demonstrating the critical role financing plays in equipment adoption.

Yet, credit score and home ownership requirements make financing an expensive and inaccessible option for many Californians. To achieve lasting market transformation, affordable financing must become more widespread and appealing for residential heat pump, HVAC, and heat pump water heater retrofits.

Heat pump loan enrollment nearly doubled from 2022 to 2023, resulting in TECH Clean California funding an additional $391,327.63 of credit enhancements for 134 loans between July 2022 and June 2023.

To demonstrate and scale viable financing options that will enable all Californians to invest in decarbonization at minimal upfront cost, TECH Clean California partnered with CAEATFA in 2022 to expand their GoGreen Home financing program statewide. This resulted in a marked increase in the rate of loan enrollments, shown in Table 6. Initially, GoGreen Home was limited to IOU customers, with different financing eligibility throughout the state which made it challenging for contractors. TECH Clean California collaborated with GoGreen Home to fill in coverage to create a statewide program, enabling much needed consistency to support contractor uptake of the program.

Table 6: Summary of GoGreen Home Heat Pump HVAC Loans Q1 2022–Q3 2023

TECH Clean California Contribution	Loan Origination Year	Number of Loans	Average Project Cost	Average APR	Average Loan Term (Months)
Full TECH Clean California Contribution	2022	18	$16,993.39	4.08	92
	2023*	73	$16,758.30	4.95	95
	Total	91	$16,804.80	4.78	95
Partial TECH Clean California Contribution	2022	20	$29,052.48	4.17	121
	2023*	21	$22,324.07	5.02	111
	Total	41	$25,606.22	4.60	116

TECH Clean California Contribution	Loan Origination Year	Number of Loans	Average Project Cost	Average APR	Average Loan Term (Months)
No TECH Clean California Contribution	2022	217	$23,097.996	4.35	118
	2023*	300	$25,717.62	4.90	116
	Total	517	$24,618.09	4.67	117
Grand Total		649	$23,584.97	4.68	114

* 2023 data represents loans issued through Q3 2023

Table 7: Summary of GoGreen Home Heat Pump Water Heater Loans Q1 2022–Q3 2023

TECH Clean California Contribution	Loan Origination Year	Number of Loans	Average Project Cost	Average APR	Average Loan Term (Months)
Full TECH Clean California Contribution	2022	2	$18,770.00	3.22	48
	2023*	4	$15,306.11	5.37	105
	Total	6	$16,460.74	4.65	86
Partial TECH Clean California Contribution	2022	9	$35,269.41	4.16	133
	2023*	4	$29,943.71	4.70	129
	Total	13	$33,630.73	4.33	132
No TECH Clean California Contribution	2022	30	$28,758.56	4.18	126
	2023	30	$36,333.62	4.89	119
	Total	60	$32,546.09	4.53	112
Grand Total		79	$31,502.93	4.51	121

* 2023 data represents loans issued through Q3 2023

Using GoGreen Home loan data, the team assessed both the impact of TECH Clean California's credit enhancement contributions to GoGreen Home and the impact of other TECH Clean California market interventions, such as the availability of TECH Clean California incentives, on GoGreen Home enrollments. Notably, the increased rate of heat pump HVAC loan enrollments was sustained, even after TECH Clean California incentive payments paused for single family homes in November 2022.

Financing Partnership Increases Enrollment

Analysis showed a 400 percent increase per month when incentives and credit enhancement funding were available concurrently, compared to pre-partnership levels.

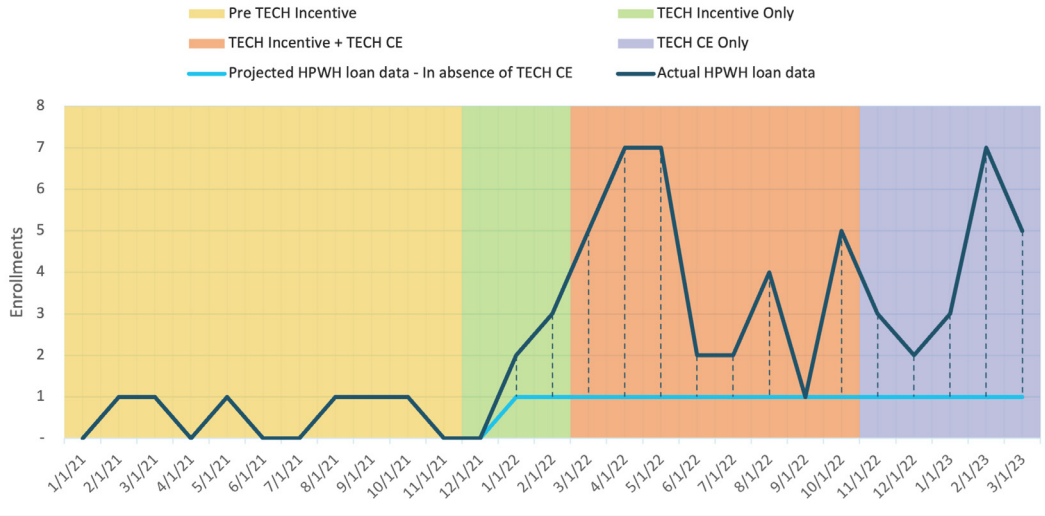

Figure 16: Actual vs. Projected GoGreen Home Heat Pump Water Heater Loan Enrollments

The network of contractors enrolled in TECH Clean California also buoyed GoGreen Home participation, as shown in Figure 17. Contractors who submitted at least one application for a TECH Clean California incentive were responsible for the majority of the increase in GoGreen Home heat pump HVAC loan enrollments compared to the baseline rate. Similar trends were observed for heat pump water heater installations and contractors performing them.

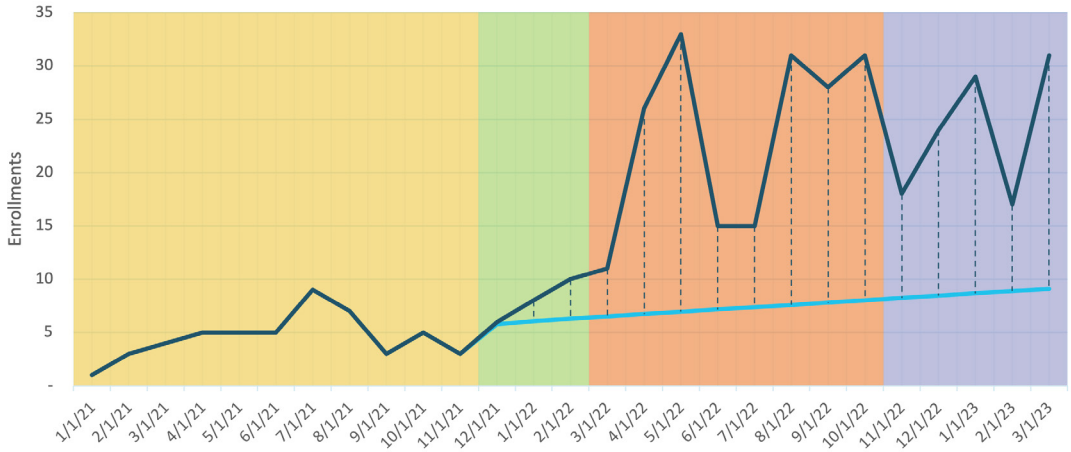

Figure 17: GoGreen Home Heat Pump HVAC Loan Enrollments, Contractors Enrolled vs. Not Enrolled in TECH Clean California

The accelerating rate of GoGreen Home participation means TECH Clean California will likely meet its initial goal to fund $1.4 million of GoGreen Home loan credit enhancements before the end of 2023.

Regional Pilots and Quick Start Grants

Six regional pilots (summarized in Table 8) are designed to test potential solutions to discrete market barriers, including impediments to widespread technology deployment and meeting California's GHG reduction goals. The solutions that prove effective will be incorporated into the TECH Clean California framework and scaled to statewide approaches where feasible.

Table 8: Summary of TECH Clean California Pilots

Pilot	Objective	Outcome/Result
Inclusive Utility Investment Program	Launch Tariffed On-Bill program with partner utility to expand access to financing.	Continuing to work on a joint proposal, while finalizing a contract for program operator. Continuing to work on a joint proposal, while finalizing a contractor for program operator. This pilot is set to begin in 2024 pending final decision.
Low-Income Integration	Collaborate with existing low-income programs to more fully incorporate heat pumps.	San Joaquin Disadvantaged Communities continues to make progress, and there will be ongoing project recruitment for other programs. Startup will be in 2024.
Multifamily Housing	Provide deep technical support in designing building systems that reduce the perceived risk of electrifying.	All three components of pilot are ongoing. Existing properties completed sign-up and are in progress. Finish recruitment by end of 2023.
Heat Pump Water Heater Load Shifting	Target contractors as key market actors to maximize heat pump water heater load shifting.	Continue supporting through end of 2023. Pilot will wrap up by April 2024.
Streamlining Permitting	Design code-compliant, one-day heat pump water heater permit process.	Make assessments across different jurisdictions to understand how different jurisdictions approach heat pump water heater permitting. Pilot wrapped up in October 2023.
Customer Targeting	Identify and engage customers who can benefit most from heat pumps.	Continue email distributions based on targeting tool. Results show higher click through rates/ email opens. Pilot wrap up December 2023.

Inclusive Utility Investment Program

The goal of the Inclusive Utility Investment Pilot is to demonstrate and expand the Tariffed On-Bill (TOB) or Inclusive Utility Investment (IUI) model through a partnership with a load-serving entity. TOB/IUI is a proven model for energy efficiency that has yet to be applied to electrification. The model allows utilities to pay for cost-effective energy improvements, such as home heating and cooling units, at a specific residence. Costs are recovered for improvements over time through a dedicated charge on the utility bill that is less than the estimated savings from the improvements. TOB/IUI is more inclusive and allows longer cost recovery terms.

TECH Clean California executed a Memorandum of Understanding with Silicon Valley Clean Energy (SVCE) and developed and filed a program proposal with the CPUC Clean Energy Financing Options (CEFO) Proceeding. The proposal represented the culmination of significant external stakeholder engagement as well as a series of TECH Clean California workshops. The team continued implementation planning activities, including measurement and verification research related to risk mitigation. Ultimately, this research will allow TECH Clean California to reliably predict customer bill savings. To support the measurement and verification research along with other project planning and implementation activities, TECH Clean California issued a Request for Proposals for a Program Operator and selected a winning proposal through competitive selection. The TECH Clean California team and the awardee have since agreed on a scope of work and await a Final Decision from the CPUC to execute a planning phase contract. In 2023, the CPUC Proceeding issued a Proposed Decision and directed the IOUs and SVCE to collaborate and file a joint TOB proposal based on TECH Clean California's submission. The CPUC will issue its Final Decision at the end of 2024.

Low-Income Integration Pilots

SAN JOAQUIN VALLEY DISADVANTAGED COMMUNITY PILOT, PG&E AND SCE ESA MAIN PILOT, SCE ESA BUILDING ELECTRIFICATION PILOT

The San Joaquin Valley Disadvantaged Community (SJV DAC) pilot program stems from a commitment to bridging the energy divide that ensures low-income households are not left behind in the transition to cleaner energy solutions. The primary goal is for low-income households to leverage additional funding in minor home repair costs into the PG&E and SCE SJV DAC pilot program, the ESA program, the Low-Income Weatherization Farmworker (LIWP FW) program, and the SCE ESA Building Electrification Pilot to ensure maximum customer participation and access to new heat pump water heater and HVAC systems. By collaborating with IOUs and other low-income program implementers, these pilots will provide equitable solutions that cater to the unique needs of underserved communities.

In addition to the TECH SJV DAC pilot, TECH Clean California has leveraged funding from three ESA programs shown in Table 9 to support 21 customer homes in 2023. Since the Low-Income Pilot program launch in June 2021, the team has gained insight into the importance of continuous engagement, collaboration, and adaptability. These experiences have underscored the need for flexibility in TECH Clean California's approach, emphasizing the importance of understanding local community need, and the value of strong partnerships with IOUs and other stakeholders.

Table 9: Homes Funded by TECH Clean California in Low-Income Pilots

	SJV DAC	PG&E ESA	SCE ESA	SCE ESA BE	LIWP FW
Number of Homes Funded by TECH Clean California	89	3	7	11	0
Activities	Currently electrifying homes in 11 San Joaquin Valley disadvantaged communities.	Leveraging additional funding in minor home repair costs in support of new heat pump HVAC and water heater installations.	Leveraging additional funding in minor home repair costs in support of new heat pump HVAC and water heater installations.	Leveraged additional minor home repair funding in customer homes in support of new heat pump HVAC and water heater installations.	
Total TECH Clean California Funds Spent	$449,283.93	$3,482.12	$10,926.89	$38,674.64	$0

The team has conducted a total of 10 in-person TECH Clean California trainings with PG&E and SCE ESA contractors to ensure they are aware of the initiative's offerings.

Multifamily Housing Pilot

The Multifamily Housing Pilot addresses barriers with electrification and energy efficiency upgrades in multifamily properties by reducing the perceived risk of heat pump systems and providing technical support in building system design. The objective is to increase market familiarity with technologies, build capacity within design teams at multiple levels — from owners and architects to mechanical, electrical, and plumbing engineers to accelerate the learning curve, and reduce the time and cost for developers to transition to all-electric buildings. The pilot consists of the following components:

Central Heat Pump Water Heater Technical Support. This decreases risks in converting to centralized heat pump water heaters by providing pre- and post-installation technical support and system-based monitoring. Progress includes five recruited properties with pre- and post-installation monitoring plans completed. This component highlighted the need for progress payments for high-cost projects with longer implementation periods as well as the importance of covering upfront design work necessary for system sizing and selection.

Property Electrification Readiness Plan. This component provides an 'upgrade-at-change-out' approach to address in-unit water heating and HVAC equipment. Technical assistance for properties were identified, resulting in five low-income properties participating in the pilot and achieving target goals. A widespread recruitment approach included trainings, flyers, and email

delivered to building owners. The pilot structure was then presented to interested owners to understand if this solution would be suited for their properties. Three projects are in the process of defining an approach to electrification readiness and evaluating options. For another two projects, the team is developing an implementation strategy that will include more extensive learning over the next year. This component revealed multiple approaches to phasing upgrades, such as by system type, by building, or based on available funding. Considerations for defining "electrification -ready" also became apparent; for example, whether or not to include elements such as space modifications or venting.

Portfolio-Level Electrification Advisor. This component adjusts owner / developer practices by supporting multifamily property owners in developing a prioritized, portfolio-level approach and a roadmap for electrification. It surfaced multiple prioritization factors for heat pump adoption at different properties, including technical, financial, and equity considerations, as well as difficulties related to accessing data on energy consumption and building characteristics. So far, this initiative has received the commitment from four affordable housing owners and has presented a draft roadmap to one owner. The team continues to recruit participants.

Heat Pump Water Heater Load Shifting Pilot

The Heat Pump Water Heater Load Shifting Pilot establishes market readiness and ensures that the full load shifting benefits of a heat pump water heater can be realized. The pilot provided contractors with important resources to enable heat pump water heaters to shift load at the time of installation. The pilot also discovered tactics that were most effective for contractor engagement.

The Heat Pump Water Heater Load Shifting Pilot began by testing whether a $50 bonus incentive could motivate contractors to initiate customer enrollment in a demand response or load shifting program. And, because load shifting potential greatly expanded with the installation of a thermostatic mixing valve (TMV), a $200 bonus incentive was offered for installations including a TMV.

The pilot focused on contractor education and the value of load shifting for the overall grid. The team created a heat pump water heater load shifting training curriculum, which was added to the onboarding and training required. Training was periodically updated to include details about additional qualifying demand response programs. TECH Clean California also worked with Caleffi Hydronic Solutions to develop a TMV-specific training to support the TMV requirement for all heat pump water heater incentives.

As market conditions quickly evolved, the strategy for a load shifting program remained agile. TECH Clean California funding was successfully deployed for heat pump water heater installations in almost all regions. The SGIP heat pump water heater initiative announced a requirement to include a TMV on all heat pump water heaters. To align with this standard, TECH Clean California consulted with contractors to ensure market readiness, made TMV installation a requirement for the incentive, and discontinued the $200 bonus. These changes prompted a shift in the team's approach from product and incentive management to collaboration and consultative work in establishing market readiness for heat pump water heater load shifting.

Contractor interviews identified top barriers and challenges that discourage enrollment, and the team gathered additional load shifting and demand response program feedback from contractors. The team will continue to collaborate with high-participation contractor companies and include them in key program decisions around load shifting benefits.

Streamlining Permitting Pilot

Current permitting processes for heat pump water heaters can span multiple days, deterring both homeowners and installers from transitioning from gas water heating to electric heat pump water heaters. In emergency replacement scenarios, longer installation periods caused by such permitting delays create an even more significant barrier. This pilot addresses closing the gap between permitting times required for natural gas water heaters and those for electric heat pump water heaters via the development and widespread adoption of a single-day heat pump water heater permitting process for single family homes where code compliance can be easily and effectively demonstrated.

The TECH Clean California team sought input and developed a permit guidance package intended to support building permit offices and contractors seeking to expedite their heat pump water heater permitting. The resource package was downloaded by 43 unique users between January 2023 and July 2023 from the TECH Clean California Permitting Pilot and BayREN websites. The team also provided this resource package to 17 jurisdictions through direct outreach.

The original pilot scope included collaboration with an implementation partner to develop and deploy a streamlined heat pump water heater permit process. The City of Pleasant Hill was selected for this effort. However, the jurisdiction lacked a sufficient volume of heat pump water heater installations to effectively complete pilot scope activities and the partnership was discontinued. Despite the early conclusion of the partnership, the team was able to gain valuable insights concerning data transfer opportunities, incentives, reporting, and performance metrics that ultimately helped shape the understanding of additional factors that may increase future adoption of a simplified Heat Pump Water Heater Permit Supplement Template.

In 2023, TECH Clean California also conducted jurisdictional outreach and analysis of statewide heat pump water heater permitting data to gain further insight into permitting trends on statewide and local levels. Key findings and recommendations focus on tailoring outreach and educational efforts to regional needs, ensuring that educational resources address the varying levels of staff expertise, and providing experiential learning options. TECH Clean California sees the benefit of additional research into the contractor experience and Authorities Having Jurisdiction (AHJs) with a high volume of projects to further inform educational tools. Finally, supporting AHJs through any permitting questions or challenges during processing of their first 20 projects may support heat pump water heater permitting.

Customer Targeting Pilot

This pilot addresses two key market barriers hindering adoption of heat pumps in California and identifies outreach strategies to drive demand among customers who would benefit the most. In Year Two, this pilot completed the development of a customer targeting dashboard that uses

electricity consumption data from over two million SCE customers. The team worked with SCE to send more than 130,000 emails to targeted SCE customers promoting heat pump water heaters and heat pump HVAC, and created a database of the recipients from email campaigns which enables analysis of the customers who respond most strongly to these campaigns. The team also helped SCE select a target customer cohort for their newly launched ESA Building Electrification Pilot.

By collaborating with SCE, the targeted email campaigns achieved an open rate greater than 50 percent. Moreover, the team observed a higher engagement rate from customers who received emails with personalized messaging, informing the targeted customers that they in particular are paying more in energy costs than similar homes. The team's findings apply to programs and utilities beyond this program. The results indicate that it is possible to improve the efficacy of customer outreach by using metered data to find the best customers for electrification and tailor the message to these particular customers.

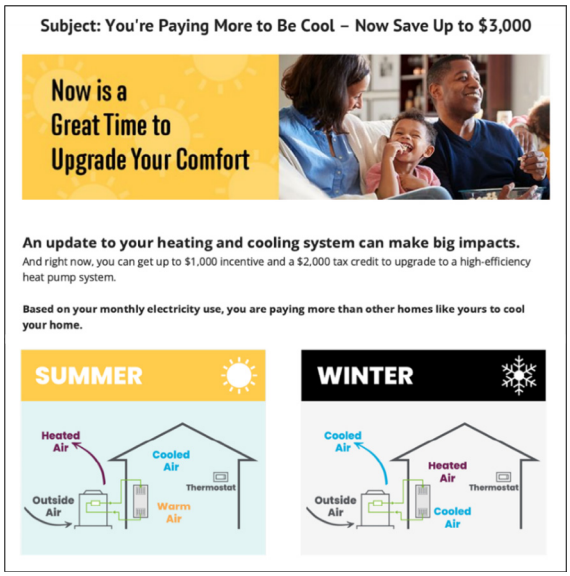

Figure 18: Excerpt from the Email Campaign Promoting Heat Pump HVAC Systems to SCE Customers

Quick Start Grants

Along with other TECH Clean California pilots, the Quick Start Grants program identifies and funds targeted innovative pilots to test approaches to overcome market barriers to heat pump deployment. The Quick Start Grants program aims to promote the development and refinement of interventions that meet the following solicitation criteria:

- Tests solution to a barrier to residential building decarbonization
- Has the potential to scale up to become a statewide solution
- Ensures feasibility within the budget proposed and can be implemented within roughly 18 months

By fall of 2023, seven of the Quick Start Grants pilot projects will achieve their timeline milestones and have completed their pilots. Final reports and recorded webinars, which include recommended next steps and learnings, are available at techcleanca.com. The second group of awarded projects, launched in early 2023, and continues to make progress in hitting individual milestones. Key achievements are outlined below in Table 10.

Table 10: Quick Start Grants Milestones

Grantee	Location	Description	Milestones Achieved – Key Success, Learnings
The Energy Coalition	Bassett and Avocado Heights, California	Incorporate heat pump water heater into a California Energy Commission-funded solar + storage pilot in a low-to-moderate-income advanced energy community. Study the impact of solar on post-electrification energy bills.	• Final heat pump water heater design, six inspections completed. • One energy assessment, four resident referrals, four inspections. • 16 resident referrals, 16 water heater inspections.
Barnett Plumbing	Tri-Valley area, Contra Costa, Alameda counties	Fuel-switching enablement through temporary gas water heater emergency replacements – "gas loaner."	• 77 overall heat pump water heater installs (36 loaners, 41 non-loaners) within two milestones. • Final Report submitted, recorded webinar. • Heat pump water heater installs increased from <1% to 17.1%.
IHACI	Southern California	Expansion of Visual Service software, enabling real-time virtual collaboration between master technician and less experienced installer.	• Three group milestones of 30 Visual Service installations (90 installations total captured). • Final Report submitted, recorded webinar. • Focus on support/ mentorship, as well as providing trainings in Spanish.
Franklin Energy	Marin Clean Energy (MCE)	Complete home repairs preventing electrification in existing MCE retrofit program.	• Two group milestones of 10 homes completed (20 homes total). 26 heat pumps installed.
Revalue.io	West Oakland, California	Remediate home health hazards or code violations in multifamily affordable housing through electrification.	• 35 installations completed by Quarter 1.25 homes sign green leases, 35 homes complete construction (70 homes total).
Diversity Coalition	San Luis Obispo County	Targeted and inclusive marketing and educational materials for equitable electrification.	• Project Start – staffing job description/posting. • Outreach at two community events with baseline messaging to 115 community members.

Grantee	Location	Description	Milestones Achieved – Key Success, Learnings
RHA	SCE service territory, California	Heat pump water heater best practices and field guide.	• Best practices finalized and field guide rough draft documentation. Available for download.
Redwood Coast Energy Authority	Humboldt County, California	Expansion of outreach and electrification support to rural and Native American communities in Humboldt County.	• Five completed installations. • Project completion of heat pump installations.
Goodwill	Inland Empire, Southwest service territory, California	Workforce placement and preparation in the HVAC trades, with a focus on heat pump technologies.	• Project launch activities – attend meetings, Council events.
350 Bay	San Francisco Bay Area	A fast-path approach to heat pump deployment to improve health and reduce natural gas use in an area heavily burdened by particulate matter.	• Project launch activities. • Project Study Design Document, Installation Plan complete.
Viridis/ Heather Village	Fox Hills, Culver City, California	Decarbonizing a multi-owner equity community with HOA governance.	• Project launch activities – attend meetings, educational kick-off, materials in development.
Climate Resolve	San Pedro, Wilmington Communities, Port of Los Angeles	Scaling heat pump retrofits in housing with cost barriers.	• Project launch activities – attend meetings, discuss scope of work.
Small Planet Supply	Delano, California	Install packaged, natural refrigerant central heat pump boiler in a 40-unit low-income farmworker community.	• Final Report submitted, recorded webinar. • Industry is not positioned for a decarbonization shift away from natural gas boilers (centralized heat pump water heater).
Bright Power	SoCalGas territory	Aligning utility allowances with electrification.	• Project launch activities – attend meetings, evaluation monitoring/learning strategy.

Grantee	Location	Description	Milestones Achieved – Key Success, Learnings
New Buildings Institute	Statewide	Field test of emerging 120V heat pump water heaters at 32 sites.	• 120V heat pump water heater installations (32 total), final field study summary complete. NBI (Full) Final Report. • Final Report submitted, recorded webinar. • Installer education for proper installation is a must.

PILLAR THREE

Inform Long-Term Building Decarbonization Framework

The third pillar of TECH Clean California uses learnings from implementation to inform and improve the state's long-term building decarbonization framework. Since the end of Year One:

- California Energy Commission (CEC) committed $922 million to equitable building decarbonization and introduced new heat pump baselines in the proposed 2025 Title 24 building energy codes
- CPUC established Viable Electric Alternative Working Groups to manage the transition of gas energy efficiency incentive funds to decarbonization measures
- Bay Area Air Quality Management District (BAAQMD) and California Air Resources Board adopted rules or plans that will require zero emission appliances

While California continues to lead states in building decarbonization investment, the federal Inflation Reduction Act (IRA) will infuse approximately $300 billion into energy and climate reform measures, including $9 billion for rebates on efficient equipment like heat pump HVAC and heat pump water heaters, as well as corresponding contractor training and education. Learnings from TECH Clean California will be invaluable in guiding other programs within California and across the nation created in response to the IRA.

Data Collection, Analysis, and Reporting

The vision for TECH Clean California data collection, analysis, and reporting is to bring a variety of data sources together and integrate them into a robust and scalable data pipeline whose outputs offer novel visibility into the California heat pump market. To achieve that, TECH Clean California compiles and analyzes data from both internal and external sources, reviews experience gained, and makes findings known to key decision-makers either directly or via TECH Clean California's public reporting website. This requires close collaboration with partners across the initiative who specialize in policy advisement.

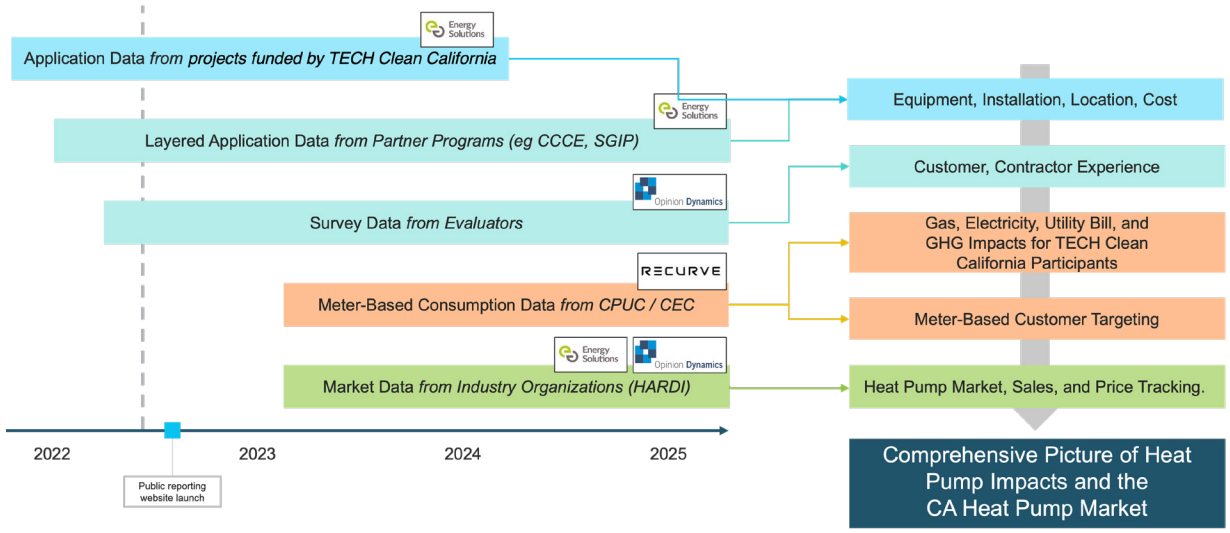

Figure 19: TECH Clean California Data Timeline

Figure 19 illustrates the collection timeline and preeminent use case for each major data type collected. In Year Two, TECH Clean California pursued and secured previously missing data types and continued to improve and connect the existing data pipeline. TECH Clean California is now closer to its mission of building a comprehensive picture of the California heat pump market. TECH Clean California will continue to acquire new data types and improve the ability to combine data and use it for analysis.

In Year Two, TECH Clean California focused on constructing a meter data impacts-analysis pipeline, improving incentive application data collection, joining key data sources, and filling data gaps necessary to measure market transformation. TECH Clean California's Year Two public reporting accomplishments include:

- Building software tools that enable rapid and scalable analysis of meter-based impacts for thousands of TECH Clean California projects
- Completing meter-based energy impacts analysis for the first tranche of TECH Clean California projects, creating what is now the largest dataset of meter-based impacts for heat pump retrofits
- Increasing the breadth and depth of information accessible on the public reporting site, including:
    - Downloadable TECH Clean California single family and multifamily project datasets
    - Interactive site features enabling quick analysis
    - Dedicated informational webpages for all regional pilots and Quick Start Grants
- Building a multivariate regression model to identify the major drivers of heat pump HVAC retrofit project costs
- Using logistic regression to find the project features that most strongly affect the probability of an electrical panel upgrade
- Developing an equity community definition and an Equity Budget Report to show the portion of TECH Clean California incentives spent in equity communities

- Acquiring HVAC shipment data to track the growth and transformation of the California heat pump HVAC market
- Contributing to critical decarbonization policy decisions via working groups and ongoing conversations with the agencies driving these

The initiative's accomplishments have also unlocked further opportunities for improvements shown in Table 11 below.

Table 11: TECH Data Growth and Outputs in Year Two

Data Type	Scope in June 2022	Scope in June 2023	Data Products	Next Steps
Project Application Data	Market-rate single family projects only; projects funded by Cap-and-Trade funds	Market-rate single family projects, low-income single family direct install projects, and multifamily projects; projects funded by both Cap-and-Trade and State Budget	• TECH Working Data Set - Single Family • TECH Working Data Set – Multifamily • Tableau dashboards • Panel upgrade analysis • Heat pump HVAC cost driver analysis • Quarterly manufacturer reporting	• Incorporate SGIP heat pump water heater application data • Publish low-income single family project data • Improve project cost prediction model • Incorporate building vintage data
Electricity and Gas Meter Data	Accessible but not in use	Population- and participant-level analysis ongoing using meter data through end of 2022 available for four major California utilities	• Meter-based targeting dashboard (internal) • Meter-based impacts dashboard (internal) • Electrification Value Stream Analysis	• Create and publish GHG Impacts Data Set • Incorporate GHG impacts into public reporting site
Equity Spending Data	N/A	Summarized by category of incentives	• Equity Budget and Spending webpage on public reporting website	• Incorporate equity requirements for new TECH Clean California funding

Data Type	Scope in June 2022	Scope in June 2023	Data Products	Next Steps
Evaluation Studies	TECH Evaluation Plan, Heat Pump Market Characterization	Customer and Contractor Surveys, Interim Evaluation, Training Evaluation	• Evaluation Studies webpage on public reporting website	• Publish six-month post-installation customer survey results
Heat Pump Water Heater Retailer Data	Two quarters' worth tracking five models	Six quarters' worth tracking seven models	• Heat pump water heater retailer stocking and pricing analysis	• Continue tracking stocking and pricing trends
Sales Data	N/A	HVAC shipment data delineated by efficiency, equipment type, and month of shipment Q1 2013 –Q1 2022	• None yet developed	• Publish data visuals to reporting website • Acquire water heater shipment data including heat pump water heaters

Meter Data Collection

Meter-based gas and electricity consumption data enables TECH Clean California to perform both near-term customer targeting and long-term impact forecasting for homes in which heat pump HVAC and heat pump water heaters were installed. In Year Two, TECH Clean California built a data pipeline that connects project data collected from contractors enrolled in TECH Clean California with meter data provided by the CEC. The team performed a Normalized Metered Energy Consumption analysis of electricity and gas usage to estimate the electricity, gas, GHG, and bill impacts. The pipeline allows for analysis of a variety of projects, including the approximately twenty thousand heat pump water heater installations to be funded by SGIP.

Currently, limitations to TECH Clean California's ability to publish meter-based impacts are mainly the availability of sufficiently recent meter data, and the requirement that meter-data-based impact estimates be published for groups of no less than 100 distinct homes per CPUC Decision 14-05-016. Despite these barriers, the team is estimating impacts for the first tranche of TECH Clean California projects.

Sales Data Collection

Sales data provides an expanded view of heat pump HVAC and heat pump water heater markets, allowing the team to measure both the portion of the market represented by equipment funded by TECH Clean California and the influence that the initiative has on the market overall. TECH Clean

California had the opportunity to purchase sales data from Heating Air Conditioning Refrigeration Distributors International (HARDI) that summarizes shipments of all HVAC equipment to California from Q1 2013 through Q1 2022. The data is disaggregated by month of sale, equipment type (heat pump HVAC, furnace, and air-conditioning; ducted versus non-ducted; split versus packaged system, etc.), efficiency, capacity, refrigerant type, and fuel type.

Data Analysis: Participation and Projects

Electrical Panel Upgrades

There is broad interest in understanding the need for electrical panel upgrades in building decarbonization. Using incentive application data collection, TECH Clean California developed a logistic regression model to identify factors that predict when a heat pump HVAC retrofit project in a single family home requires a panel upgrade.

The model identified three significant relationships between the likelihood of a panel upgrade and other project features. First, the home age: projects in census tracts with an average home age of over 50 years required panel upgrades at roughly twice the frequency of the opposite, as shown in Figure 20. For every 10-year increase in the average age of homes in a census tract, the odds of needing a panel upgrade alongside a heat pump HVAC retrofit increased by 13 percent on average.

Second, the model identified that the installed heat pump HVAC equipment type may impact the need for panel upgrades. Ducted multi split installations occurred alongside panel upgrades at a far greater rate than any other equipment type: the odds of completing a panel upgrade for ducted multi splits were 64 percent greater than for ducted mini splits, for example.

Finally, furnace status after installation has a significant relationship with panel upgrade frequency. Projects where furnaces were fully decommissioned post-installation resulted in a panel upgrade four to six percent of the time, depending on equipment type, while panel upgrades occurred less than three percent of the time when the furnace was left to use the blower only or as a backup heating source such as a dual-fuel system.

Meanwhile, the model found no clear relationship between the frequency of panel upgrades and several features that the team expected to be significant, including disadvantaged community status, project location in a hard-to-reach community, and installed equipment capacity. The relationships this model identified as significant and insignificant are important considerations for building electrification incentive programs and policy planning. The added cost of a panel upgrade may prevent homeowners from opting for equipment that

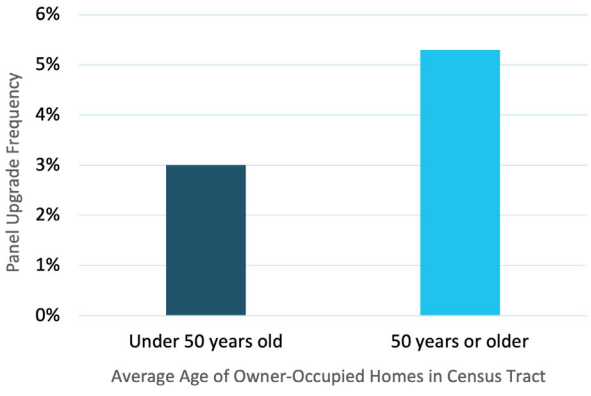

Figure 20: Frequency of Panel Upgrades According to Age of House

could entirely support their home's heating and cooling needs.

The team recommends that agencies planning decarbonization investments in California collect specific data in order to better predict how many electrical panel upgrades will be required in their jurisdiction. This would include the distribution of home ages, the intended type of heat pump HVAC equipment to be installed, and the portion of dual-fuel versus all-electric HVAC systems that will be installed.

That is not an exhaustive list of the features that significantly affect panel upgrade frequency; while the model can help understand the relationship between panel upgrade frequency and the variables available, there is a need to increase sample size and collect more variables before the team can fully quantify the probability of a panel upgrade alongside a heat pump HVAC installation.

Heat Pump HVAC Cost Drivers

Heat pump HVAC incentive applications received during Year One revealed a wide variance in the total project cost, shown in Figure 21 below. For policy planning exercises, this variance makes predicting the total cost to decarbonize HVAC across California homes difficult.

To better understand heat pump HVAC cost drivers, TECH Clean California developed a multivariate linear regression model to measure the average impact of several project features on the cost of installing a heat pump HVAC system. A full write-up of methods and results was published on the Results and Reporting webpage in October 2023.

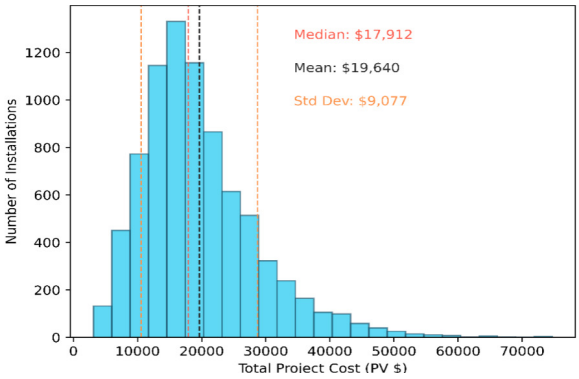

Figure 21: Histogram of Inflation-Adjusted Total Project Cost of TECH Clean California Heat Pump HVAC Projects (n = 9,744)

The model found that the disadvantaged community status of the census tract where the project was installed, the inclusion of a smart thermostat, and decommissioning the furnace in the home during installation do not have a statistically significant relationship with the total project cost. However, the model identified 12 project features that did have a statistically significant relationship with total project cost and estimated the average cost impact of each feature, shown in Table 12 on the next page.

Table 12: Heat Pump HVAC Cost Driver Model Project Features

Category	Field	Mean and Range	Average Relationship with Total Project Cost of an Average Three-Ton Heat Pump HVAC Installation
Installed Equipment Specifications	Seasonal Energy Efficiency Ratio ("SEER")	Ranges from 14.0 to 29.4, mean of 17.1	For each unit of SEER added to the installed heat pump HVAC equipment, the total project cost increases by $637 (+$48).
Replacement Equipment	Previous air conditioner type	None: 48 percent Present: 52 percent	Presence of an air conditioner in the home prior to the installation reduces the total project cost by $972 (+$192).
Quality Installation Measures	Electrical panel upgrade (T/F)	4 percent	Projects involving an electrical panel upgrade are $1,567 (+$525) more expensive.
Quality Installation Measures	Duct replacement (T/F)	15 percent	Projects involving a duct replacement are $2,926 (+$277) more expensive.
Quality Installation Measures	Manual D/J completed (T/F)	7 percent	Projects involving a Manual-D/ Manual-J Load Calculations are $1,847 (+$369) more expensive.
Installation Duration	Installation duration (Days)	Ranges from 1 to 366, mean of 5	Total project cost increases logarithmically with the installation duration. A 10-day installation costs $1,207 (± $109) more than a one-day installation.
Contractor Participation	Number of counties served by contractor who performed the installation	Ranges from 1 to 15, mean of 3	For each additional California county served by the installing contractor, total project cost increases by $72 (± $30).
Contractor Participation	Number of TECH Clean California heat pump HVAC projects performed by the contractor who performed the installation	Ranges from 1 to 406, mean of 89	Total project cost increases logarithmically with the number of heat pump HVAC projects performed by the installing contractor. Projects performed by contractors with 50 installations funded by TECH Clean California cost $863 (± $122) more than those with just one.

Category	Field	Mean and Range	Average Relationship with Total Project Cost of an Average Three-Ton Heat Pump HVAC Installation
Home	Home floor area	Ranges from 500 to 10,000, mean of 2,033 square feet	Total project cost increases by $69 (± $11) per 100 square feet of additional floor area in the home, holding the cooling capacity of the installed system constant.
Census Tract	Average age of owner-occupied housing in the census tract in which the project occurred	Ranges from 11 to 103 years, mean of 50 years	Adding 10 years to the average age of owner-occupied housing in a census tract adds $826 (± $59) to total project cost.
County	Number of contractors enrolled in TECH Clean California serving the county in which the project occurred	Ranges from 11 to 279, mean of 144	Total project cost decreases logarithmically with the number of TECH Clean California contractors serving the county. Projects in counties served by 100 contractors enrolled in TECH Clean California cost $1,031 (± $147) less than projects in counties served by 10.

Data Analysis: Meter-Based Consumption

Electrification is critical for decarbonization, and heat pump technology is at the forefront of this transition. TECH Clean California can better document outcomes of heat pump installations and better optimize future installations by harnessing the power of smart meter data analytics, ensuring maximum benefits for the grid and customers. This approach will drive both affordability and equity in California's energy systems. Heat pumps are crucial for transitioning to a low-carbon future but must be deployed carefully to avoid unintended consequences. As this technology is deployed at scale, TECH Clean California must navigate complexities around optimizing energy use, managing peak demand, and ensuring equitable outcomes.

PUBLIC REPORTING

The TECH Clean California Public Reporting (PRS) website, techcleanca.com, launched in July 2022. The website hosts three primary data types: project-level incentive application data, contractor participation data, and evaluation studies. Results and Reporting, TECH in the News, related programs, events, resources, all six regional pilots, and 19 Quick Start Grant recipients can all be found on the website.

Since launching, the public reporting site has grown in both breadth and depth. Ninety-one data fields on projects funded by TECH Clean California are now available in a single family and multifamily version of the TECH Clean California Working Data Set. The accompanying Tableau-based visuals highlight geographical and temporal trends as well as show how project components contribute to costs.

The Equity Budget and Spending page, available at techcleanca.com/public-data/equity-budget-and-spending, is a valuable addition to the public reporting site. It provides an overview of TECH Clean California's equity priorities, definition of equity communities, and the Equity Budget and Spending Report. This interactive Tableau dashboard tracks the budget allocation, expenditure, and remaining funds for various initiatives, along with the proportion spent in equity communities. Through this report, stakeholders can gain insights into TECH Clean California's fund allocation and progress towards the goal of directing 40 percent of incentive dollars to support equity communities.

Policy Advisement

Over the past year, policy advisement shifted from primarily tracking and assessing opportunities to provide TECH Clean California data to providing data, analysis, and learnings to policy decision-makers and stakeholders. This increasing overlap and integration between the data analysis activities led to critical policy-related accomplishments:

- Tracked more than a dozen proceedings, primarily at the CPUC and CEC, to identify needs for TECH Clean California data and learning
- Generated written or verbal comments in six proceedings and presented as panelists at multiple agency workshops or conferences
- Joined the Implementation Working Group for BAAQMD standards for zero-emission space and water heating appliances
- Joined and provided data analysis to CPUC Working Groups working on technical analysis of viable electric alternatives to gas appliances
- Continued engagement with a range of policy stakeholders to increase awareness of data resources development

TECH Clean California continues to seek opportunities to provide data and learnings to support informed decision making around market transformation modeling. In some cases, the teams submitted comments, data, and findings. Table 13 details policy engagement activities over the past year, highlighting areas of strategic focus.

Table 13: Policy Engagements in 2023

Agency	Proceeding Name	Proceeding Number	Activity
CPUC	Energy Efficiency Business Plans for the 2024–2027 Portfolio	A.22-02-005	The CPUC is examining several questions around ratepayer-funded incentives for gas appliances within utilities' energy efficiency portfolios. The Commission and stakeholders are evaluating the availability of viable electric alternatives to gas appliances. Team members submitted written comments in the docket with TECH Clean California heat pump equipment costs and bill impacts data. The team served on two CPUC Working Groups charged with identifying electric upgrade costs and developing a technical guidance document for viable electric alternatives. The team provided preliminary information about the frequency of panel upgrades and plans to provide deeper analysis on drivers of panel upgrades.
BAAQMD	Zero-Emission Appliance Standards for Space and Water Heating	Rule 9-4 and 9-6	In March 2023, BAAQMD adopted zero-emission standards for space and water heating appliances to phase in starting in 2025. Regulations call for examining and reporting on market readiness, equipment costs, and impacts of the standards, prior to their effective date. Team members have joined BAAQMD's Implementation Working Group, in addition to Technical and Equity subcommittees, to provide data, analysis, and learnings from across the TECH Clean California initiative. The information produced for BAAQMD is also intended to support the California Air Resources Board, which has decided to adopt related appliance standards on a slightly slower timeframe. South Coast Air Quality Management District also announced they will begin rulemaking for appliance standards as well.

Agency	Proceeding Name	Proceeding Number	Activity
CPUC	Energy Savings Assistance (ESA)	A.19-11-003 A.19-11-004 A.19-11-005 A.19-11-006 A.19-11-007	The TECH Clean California Low-Income Pilot is supporting three ESA-related Pilots (in addition to other pilot activities). These include the PG&E and SCE ESA Main Pilots and the SCE ESA Building Electrification Pilot, where TECH Clean California is leveraging additional funding into the PG&E and SCE ESA Main Program and SCE's Building Electrification Pilot to expand funding availability for participants, including funding minor home repair fees not covered by the existing program. The team continues to engage with IOUs on the development of electrification measures to adopt for the main ESA program, attend ESA Working Group meetings to share learnings, and are monitoring the ESA mid-cycle review. The team also submitted data from these pilots into the CEC Equitable Building Decarbonization Program.
CPUC	Clean Energy Financing	R. 20-08-022	TECH Clean California is participating in the financing proceedings with a focus on our partnership with Silicon Valley Clean Energy to launch an Inclusive Utility Investment (IUI) financing pilot with the objective of receiving approval for the IUI pilot. This includes approval for the relevant IOU (PG&E) to adopt a tariff and use limited ratepayer funds to cover certain program costs. Since June 29, 2022, the team has submitted four written comments, on proposals and the Proposed Decision. The IUI team meets with PG&E and SCE monthly to address regulatory needs related to the pilots and to lay the groundwork to scale up financing as part of broader market transformation. The team also filed comments with the CEC in response to a Request for Information (RFI) on barriers to scaling IUI.
CEC	2025 Building Energy Code	22-BSTD-01	The TECH Clean California team met with CEC Staff and the Statewide CASE Team to share data from the public reporting site and answer questions, to inform their research and analysis for the 2025 Building Energy Code proposals regarding space conditioning and water heating.
CPUC	Building Decarbonization	R. 19-01-011	Submitted written comments related to administration of TECH Clean California funds.
CPUC	Gas Long-Term Planning	R. 20-01-007	Monitoring proceeding to identify needs for TECH Clean California data and learnings.
CPUC	PG&E Zonal Electrification	A. 22-08-003	Monitoring proceeding to identify needs for TECH Clean California data and learnings.

Agency	Proceeding Name	Proceeding Number	Activity
CPUC	Self-Generation Incentive (SGIP)	R. 20-05-012	Submitted written comments to improve program administration and integration with TECH Clean California.
CPUC	Demand Flexibility through Rates	R. 22-07-005	Monitoring proceeding to identify needs for TECH Clean California data and learnings; evaluated rate proposals from parties to understand possible bill impacts for electrification.
CPUC	DER Program Cost-Effectiveness Issues, Data Access	R. 22-11-013	Submitted written comments related to barriers for data access.
CEC	Equitable Building Decarbonization Program	23-DECARB-02	Served on workshop panels.

Year Two Key Takeaways

Pillar One

To spur the clean heating market statewide, TECH Clean California created a statewide incentive program for heat pump water heaters and continued its commitment to targeting equity customers. Market actors and contractors provided valuable feedback on program design, and the team responded by flattening incentives to create more program stability. TECH Clean California began analyzing meter data from heat pump installations, which will help to target and inform future projects. The TECH Clean California team continued to grow partnerships with industry experts to educate the incoming and existing workforce.

Key Takeaways:

INCENTIVE PROGRAMS

TECH Clean California lowered the incentive amount following feedback from contractors and market actors. Valuable input from industry experts on program design also helped to shape the statewide incentive structure. Adjusting incentives will extend the incentive budget runway. This level of engagement and response underscores that long-term market consistency is critical for stability and market actors.

COMMUNICATION PROCESSES

TECH Clean California enhanced engagement and outreach efforts to keep contractors informed at an earlier, more defined cadence. By streamlining communications via text and email, and extending program office hours, the team reduced application processing timelines and expedited incentive payments. Fostering transparency and ensuring information about the program is easily accessible will help optimize productivity and allow contractors to build trust and confidence in TECH Clean California.

WORKFORCE EDUCATION

TECH Clean California collaborated with training centers across the state to support outfitting labs with heat pump technology and deployed trainings sessions with manufacturers. The team partnered with ESMAC to offer electrification trainings, while also launching the Learn & Earn Program to supply participating contractors with heat pump water heater units for educational purposes. The positive feedback from these trainings, along with expanding partnerships, indicates a tremendous opportunity for heat pump adoption and scaling electrification benefits when there is increased contractor awareness and opportunities with heat pump technologies.

Next Steps

FOCUS ON WORKFORCE EDUCATION AND TRAINING

TECH Clean California's Learn & Earn Program will continue to play an important role with the development of the workforce pipeline and support advancements into equity communities. Expanding further into California's training institutions and trade school networks will impact more students as they prepare for careers installing HVAC and heat pump water heaters. Evaluation studies show that trainees value the heat pump knowledge, technical skills, and sales strategies provided in their courses. Trainees have received promotions and pay raises as a result of new electrification responsibilities.

Workforce Education and Training currently funds training centers for Community Action Partnerships (CAP) across California, which will open training to residents in disadvantaged and hard-to-reach areas.

TECH will propose adding more training events at distributor and dealer meetings on variable speed heat pumps, panel optimization, and dual-fuel systems. These in-person events provide face-to-face opportunities to build relationships with both participating and non-participating contractors and gather feedback on program operations, training, equipment standards, and incentives.

With the statewide QHVAC Install and Maintenance Program launching, TECH Clean California will look at its current offerings to determine if any of these will be suited for that program. The team is also developing new offerings based on studying gaps in current training needs, such as electrical panel upgrades and electrification readiness assessments.

Pillar Two

Designed to address adoption barriers and test scalable solutions, the TECH Clean California pilots have yielded valuable insights. Three of the six pilots, the Low-Income Heat Pump Adoption Pilot, Multifamily Pilot, and Inclusive Utility Investment Pilot require continued years of support to further define successful long-term market transformation efforts, while the Heat Pump Water Heater Load Shifting Pilot, Permitting Pilot, and Innovative Customer Targeting Pilot have shown beneficial outcomes over the two-year period. TECH Clean California will continue to evaluate data and share learnings as well as recommend next steps throughout the pilots and Quick Start Grant project lifespans.

Key Takeaways:

PILOTS

- **Inclusive Utility Investment Pilot** will need more assistance than loan loss reserves to expand these offerings
- **Low Income Integration Pilot**, specifically San Joaquin Valley Disadvantaged Community project, shows traction to date in 11 communities, while remaining pilots continue to build and recruit for next year

- **Multifamily Pilot** had properties or affordable housing owners enrolled with work underway in all three components of the pilot
- **Heat Pump Water Heater Load Shifting Pilot** will look to support SGIP until Q2 2024
- **Streamlining Permitting Pilot** seeks continued education and outreach efforts, with a focus on increasing exposure as it finishes
- **Customer Targeting Pilot** demonstrates that enhanced, meter-based targeting can significantly increase the success of customer outreach strategies

QUICK START GRANTS

- The **first round** of **Quick Start Grants** yielded successes and the finalized reports provide important lessons and recommendations that can be used to inform future program designs and provide insight into overcoming barriers. By the end of 2023, seven of the first 11 projects will be fully complete.
- The **second-round** of eight **Quick Start Grants** began in early 2023 and has already shown good progress toward project milestones with strong findings. In particular, the RHA Pilot completed a manual that highlights best practices and an in-field checklist for retrofit installation of heat pump water heaters.

Next Steps

FOCUS ON EQUITY CUSTOMERS

To facilitate changing the rules of large low-income programs like ESA and LIHEAP to accommodate more electrification projects, TECH Clean California will implement the Strategic Early Retirement (SER) plan in conjunction with PG&E to target income-qualified customers who are good heat pump HVAC candidates. Customers will receive heat pump HVAC, heat pump water heaters, and other electric measures. Metered results from projects will build out the case to show that heat pumps are a cost-effective measure compared to a like-for-like replacement with gas fuel appliances. The team will also work to make these programs easier for both contractors and customers to participate in through standardization of specifications, remediation, and income qualifications.

TECH Clean California will also continue collaborating with utilities and other stakeholders on 2024 low-income initiatives. The team will identify how lessons from the pilots can be incorporated into program design and how these lessons can be shared with a broader set of market actors, including program implementers, contractors, and affordable housing providers.

Pillar Three

As TECH Clean California continues work to inform California's long-term building decarbonization framework, the importance of our data reporting and policy advisement is increasing as greater financial commitments to decarbonization are made at the state and federal levels, and building electrification continues to gain momentum.

Key Takeaways:

PUBLIC REPORTING WEBSITE IMPROVEMENTS

The TECH Clean California website now includes detailed project-level data on over 12,000 heat pump HVAC and heat pump water heater retrofits in single family homes and retrofits in multifamily homes; improved dashboard visualizations; an equity community spending report; and dedicated webpages for each regional pilot and each cohort of Quick Start Grants.

DATA COLLECTION

TECH Clean California improved the quality and quantity of data collected via applications submitted to the incentive clearinghouse. Meanwhile, TECH Clean California worked closely with the CPUC and CEC to maximize the utility of the Amazon Snowflake meter data warehouse. The team started to receive regular installments of HVAC product shipment data from HARDI.

METER-BASED TARGETING POPULATION ANALYSIS

Customers most likely to experience positive bill impacts from installing heat pump HVAC have high air-conditioning burden and low-to-moderate space heating consumption, and the ideal target cohort of "super coolers" comprises 10 to 15 percent of California homes. Meanwhile, customers likely to achieve the highest GHG savings have the highest absolute natural gas usage. Targeting the top 14 percent of these customers would yield disproportionately large GHG savings.

METER-BASED IMPACTS ANALYSIS

Over 500 heat pump water heaters and heat pump HVAC retrofits in PG&E territory were analyzed, garnering over one year of meter data. Customers experienced an average of 35 percent annual energy savings and 47 percent gas savings (203 therms) for homes in which heat pump HVAC systems were installed. Heat pump water heater installations yielded average annual gas savings of 37 percent (159 therms).

PANEL UPGRADE ANALYSIS

There is a clear relationship between frequency of panel upgrade installed and age of home. Homes over 50 years old required panel upgrades at almost twice the rate of homes less than 50 years old.

HEAT PUMP HVAC COST DRIVERS

Many project and site features documented in the TECH Clean California working data set have a significant measurable impact on the total project cost of heat pump HVAC installations that receive TECH Clean California incentives. For example, each additional unit of SEER increases the cost of a heat pump HVAC project by $637, on average, with a strong statistical significance. However, a linear regression model can only explain about 25 percent of observed variation in total project cost.

HEAT PUMP WATER HEATER RETAILER STOCKING AND PRICING

Availability of popular heat pump water heater models has been consistently increasing since August 2021 at Lowes and Home Depot locations across California. However, a recent sharp increase in gas water heater model availability was also observed. Price increases for both heat pump water heaters and gas water heaters at major home improvement retailers have mirrored inflation of the Consumer Price Index, except for one major retailer where prices for gas water heaters increased by 75 percent since August 2021.

POLICY ADVISEMENT

TECH Clean California shifted from primarily tracking and assessing opportunities to primarily providing data, analysis, and learnings to policy decision-makers and stakeholders. This included tracking over a dozen proceedings, submitting written or verbal comments at multiple agency workshops and conferences, and joining multiple implementation working groups to better inform proposed decarbonization decisions.

Next Steps

FOCUS ON DATA AND PUBLIC REPORTING AND POLICY ADVISEMENT

Access to a growing pool of heat pump water heater and heat pump HVAC project and survey data will allow TECH Clean California to expand and enhance the public reporting site. This data will show a more comprehensive picture of the California heat pump market, including meter-based impacts and HVAC market data. Deriving meter-based results for more program participants will allow the team to publish data on pre- and post-installation energy use, bill, and GHG impact data for both heat pump water heater and heat pump HVAC projects. This content will be available via the Greenhouse Gas Impacts Data Set and an interactive dashboard on the Maps and Graphs webpage. TECH Clean California will incorporate findings from meter-based analysis to trial new incentive structures, maximizing unit installs and encouraging installations that will result in significant consumer and grid benefits.

One of the biggest opportunities for policy advisement will stem from the growing dataset of post-install meter data and learnings from maturing Quick Start Grants and pilots. Continuing work from 2023 and through 2024, the policy task will continue to play an active role in providing data and insights about equipment and markets to state and regional agencies adopting or considering appliance standards. The team will actively monitor the fixed-charge rate proceeding to incorporate rates into projections of bill impacts from electrification.

Appendix A: Single Family HVAC

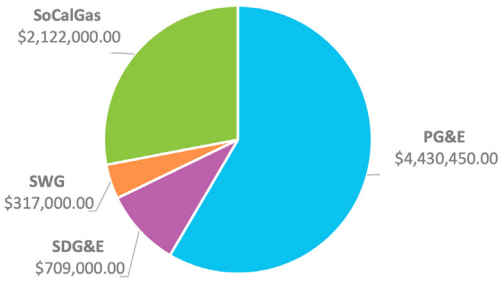

Figure 22: Single Family Heat Pump Incentives

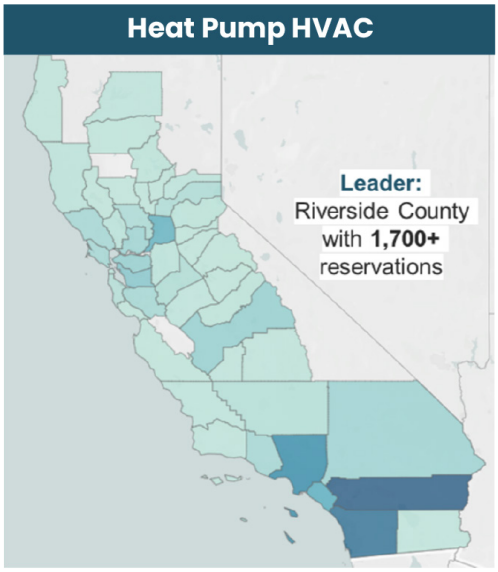

Figure 23: Participation by County (Single Family)

Table 14: Additional Installation Components

Installation Component	Percentage of Total
Ducts sealed/replaced	0.49%
Manual-J completed	12%
Full system performance test	0.09%
Smart thermostat included	873%

Table 15: Furnace Settings Post-Installation

Furnace Setting After Install	Percentage of Total
Decommissioned	47%
Setup as blower only	1%
Emergency backup only	15%

Table 16: Installed Unit Efficiencies

Efficiency	Percentage of Total
< 16 SEER	11%
16–18 SEER	52%
> 18 SEER	37%

Appendix B: Single Family Heat Pump Water Heater

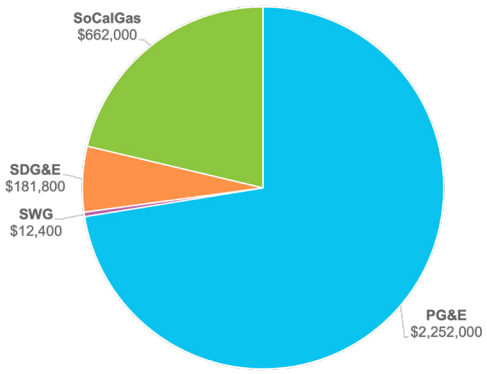

Figure 24: Single Family Heat Pump Water Heater Incentives

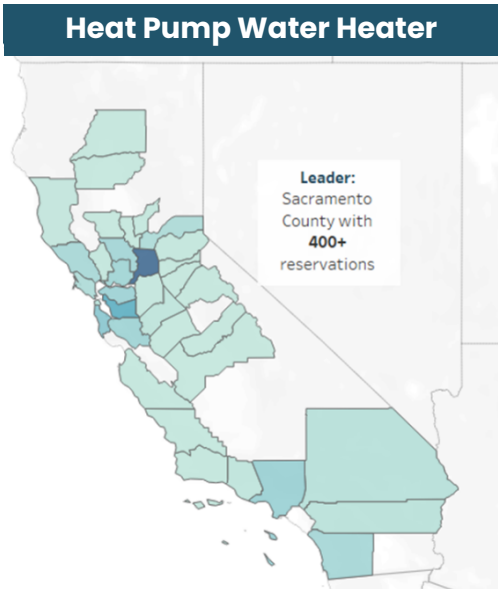

Figure 25: Participation by County (Single Family)

Table 17: Breakdown by Uniform Efficiency Factor (UEF)

UEF	Percentage of Total
3.00–3.50	54%
3.50–3.99	39%
4.00+	7%

Table 18: Heat Pump Water Heater Breakdown by Capacity

Heat Pump Water Heater Capacity (gallons)	Percentage of Total
40	5%
50	65%
65	20%
80	10%

Table 19: Heat Pump Water Heater Breakdown by Previous Fuel Type

Previous Water Heater Fuel Type	Percentage of Total
Natural Gas	96%
Electric Resistance	2%
Propane	2%

Table 20: Breakdown Electric Upgrades

Installation Component	Percentage of Total
Thermostatic Mixing Valve	59%
Water Heater Upsized	64%
Panel Upgrade Required	12%

Appendix C: Multifamily

Table 21: Multifamily Reservations by Building Type

Building Type	Percentage of Total Reservations
Disadvantaged Communities	55%
Affordable Housing	56%

Table 22: Multifamily Heat Pump Water Heaters Units by Type

Measure	Total Units Served	Properties	Percentage of Total
In-Apartment Heat Pump Water Heaters	2,389	25	20%
Central Heat Pump Water Heaters	3,709	42	31%

Table 23: Multifamily Heat Pump HVAC Units

Measure	Total Units Served	Properties	Percentage of Total
Individual Apartment HVAC	4,672	44	39%
Central HVAC	204	3	2%

Table 24: Multifamily Apartment Upgrades

Measure	Total Units Served	Properties	Percentage of Total
Individual Apartment Electrical Upgrades	974	20	8%