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# TECH Clean California: Paving the Way to Heat Pump Market Transformation

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## Abstract

In the United States, over 90 percent of direct residential carbon emissions come from fossil fuel-fired space and water heating [1]. A critical strategy to decarbonize this sector is scaling adoption of high-efficiency, electric heat pumps for space and water heating. However, the market share for heat pumps for both is less than 10 percent in most states in the U.S. and will need to scale exponentially over the next decade to meet greenhouse gas (GHG) reduction goals. TECH Clean California is a \$120 million, multi-year market transformation initiative focused on accelerating adoption of heat pump technology by driving down costs, finding new value streams, and scaling successful approaches through market and policy changes. The initiative includes three concurrent efforts: 1) motivating the supply chain through midstream incentives, providing accessible workforce training, and driving consumer demand; 2) demonstrating scalable solutions to key market barriers; and 3) using data from TECH installations to create a public database that can inform policy. This paper provides an overview of the initiative's theory of change and illustrates the relevancy of its results to resiliency, efficiency, and the heat pump industry at large.

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## 1. Overview

TECH Clean California (TECH) is a market transformation initiative aimed at driving market adoption of zero-emissions space and water heating technologies for existing single family and multifamily residential homes to help achieve California's goal of six million installed heat pumps by 2030 and carbon neutrality by 2045 [2]. In 2022, the California Air Resources Board (CARB) finalized their State Implementation Plan proposed a zero-emission standard for space and water heaters effective 2030 [3]. The initiative was created through the passage of California Senate Bill 1477 and is funded by revenues collected through California's Cap-and-Trade program.

TECH is designed to be a centralized flagship implementation program for all existing and potential heat pump HVAC (HP HVAC) and heat pump water heater (HPWH) programs and to create best practices to inform statewide consistency. To achieve lasting scale, the initiative will pave a path for favorable decarbonization policy and make heat pumps cost-competitive with incumbent technologies.

There are three main pillars to the initiative. First, to meet California's aggressive decarbonization goals, there must be a significant increase in market scale and a rapid shift towards clean heating technologies. To achieve this, TECH provides a combination of market incentives, supply chain engagement, workforce development, and consumer education. The second pillar of TECH leverages regional pilots and Quick Start Grants to address specific barriers to scale within specific markets, such as low income or multifamily, as well as and explore ways to push through existing barriers such as with identifying customers, project finance, streamlining permitting, and load control. Lastly, the third pillar of TECH informs long-term, building decarbonization policy frameworks by collecting, analyzing, and publicly publishing energy and GHG impacts

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and detailed program case studies, results and processes that can be used to inform long-term decarbonization planning.

## 2. Initiative Description

### 2.1. The initiative framework

#### 2.1.1. Pillar One: Spur the clean heating market for electrification through statewide strategies

Focus on contractors to prime the market: TECH Clean California employs several strategies to prime the market throughout the supply chain. TECH actively coordinates with manufacturers, distributors, contractors, and consumers to holistically support market transformation. TECH Clean California concluded that contractors would have the greatest impact on market transformation since they directly influence the sales process for most heat pump installations, including customer decisions on fuel substitution. To impact heat pump sales in the near-term, engaging these supply chain actors is critical. However, contractors are often hesitant to break away from their existing profitable sales model and invest time and effort to sell and install nascent technologies with yet-to-be proven demand [4]. Given these findings, this initiative is designed to train contractors on the technology, value proposition, and business model aspects of electrification; and to motivate contractors to sell heat pump technologies by providing contractor incentives, sales rewards, and bonuses.

Provide incentives for both single-family and multifamily residences: Providing incentives for both residence types helps ensure demand is supported across the market, including customer segments that can be hard to reach. TECH provides both HPWH and HP HVAC installation incentives for single-family residences, while encouraging best installation practices associated with each project. TECH also provides incentives installed in multifamily properties, thus reaching renters who may not be in charge of infrastructure upgrade decisions. Incentives are available for various equipment types that serve residential apartments as well as communal spaces used by residents and multifamily building staff.

Leverage existing marketing infrastructure to drive consumer demand: The Building Decarbonization Coalition (BDC) has played a prominent leadership role in consumer education, outreach, and engagement thus far. To drive demand, TECH integrates with and enhances their consumer inspiration campaign, the *Switch Is On*, which has been a key means of engaging in mass market communications for the initiative and has also been supported by heat pump manufacturers. This resource provides information for every step of the customer journey, such as guides to electrification, as well as resources that enable them to take direct action such as finding qualified contractors and available incentives.

#### 2.1.2. Pillar Two: Create scalable models for market transformation through regional pilots and focused outreach

Test strategies through regional pilots and Quick Start Grants: Six regional pilots are designed to address key barriers to heat pump adoption, in a small-scale targeted fashion. The focus for two of the six pilots is to address adoption barriers within particular market segments — low-income households and multifamily housing — important for supporting an equitable transition. The remaining four pilots address key barriers along the customer journey: identifying the customers most likely to save money by switching to heat pumps, enabling high-volume project finance structures, streamlining equipment installation, and managing the new electrical load once the appliance is installed. TECH Clean California launched these pilots and also funded seventeen Quick Start Grants. Pilot details are discussed further in section 2.5 below.

Target low-income, hard-to-reach, disadvantaged communities (DACs): Investments in impacted communities help fuel economic recovery and respond to the needs of those hit hardest by historical environmental and social inequities as well as the ongoing COVID-19 pandemic. TECH Clean California has deployed targeted strategies and localized investments to enable equitable, impactful decarbonization. The initiative has a goal to invest 40 percent of program incentives in low-income households and DACs. To promote program collaboration, with advisement of the California Public Utilities Commission (CPUC) Low-income Oversight Board (LIOB), TECH Clean California assembled a Low-Income Ambassador Panel, consisting of low-income regional representatives from across the state. The objective of these activities is to gather the requisite data and market experience to inform policies and program designs that will transition low-income weatherization programs towards electrification, ensuring that low-income households have access to the health and safety benefits associated with decarbonization.

### 2.1.3. Pillar Three: Inform long-term building decarbonization framework

**Public reporting drives policy:** As a market transformation program TECH Clean California's role is to support structural shifts through policy and market mechanisms, and create sustained, long-term impacts. The initiative provides a single source of heat pump market data for California through its public reporting website, [www.techcleanca.com](http://www.techcleanca.com), offering market transparency with program information on installation details, project prices, deployment progress, and meter-based impacts.

**Quantify the value of decarbonization:** A key barrier to decarbonization is the existing deficiency of the market to monetize grid and climate value. Many of the primary benefits of decarbonization are grid- and climate-related (bill savings are generally secondary), and thus a key near-term opportunity is using installation data from the initiative to quantify these values and support the development of more formal markets. Achieving zero carbon homes by 2045 will require significant public and private capital investment and robust project finance that supports this investment. By rigorously quantifying GHG impacts and all other decarbonization value streams for heat pumps by means of interval meter data, TECH Clean California hopes to achieve an actuarial level of impacts quantification required for large-scale project finance, similar to the wind and solar industry.

### 2.2. Demonstrating scalability

Like many other states, decarbonization efforts in California need to balance multiple priorities: 1) maximizing GHG reductions, 2) maintaining grid reliability, 3) ensuring equity and minimizing consumer bill impacts, and 4) achieving project cost declines and mature business models so that a large-scale transition is economically feasible. Programs like TECH Clean California can support scale to help pave the way for market transformation by demonstrating market demand and supporting a scalable process that can accommodate the high project volume needed to achieve California's heat pump goals. Within California, energy reliability remains an ongoing concern with respect to peak electricity demand in the summer. The California Independent System Operator (CAISO) conducted analyses and concluded that additional resources are needed to ultimately achieve long term reliability margins and need to consider growing risks of more extreme events stemming from climate change and supply chain disruptions. This stresses the need for approaches that support reliability and resiliency, such as HPWHs with load-shifting capability or customer targeting that maximizes peak load reductions [5].

In the United States, the Inflation Reduction Act is set to infuse approximately \$300 billion into energy and climate reform measures, including \$9 billion for rebates on efficient equipment — including HP HVAC and HPWH — and corresponding contractor training and education. The information gained from TECH Clean California will be invaluable in guiding other programs within California and nationwide as others create their own programs in response to the Act. The statewide initiative coordinates directly with the CPUC to deliver results across the four investor-owned gas utilities: Pacific Gas & Electric (PG&E), San Diego Gas & Electric (SDG&E), Southern California Gas (SoCalGas), and Southwest Gas (SWGAs). TECH Clean California has also layered \$5.4 million in incentives funded by partner utility programs, adding to the \$31.7 million paid through the Cap-and-Trade funding that directly supports the initiative. These partner utility programs include those offered by community choice aggregators such as Central Coast Community Energy, municipal utilities such as Sacramento Municipal Utility District (SMUD), and regional energy networks such as BayREN. This incentive layering strategy is especially important as the Inflation Reduction Act will soon launch new programs such as the High-Efficiency Electric Home Rebates Program (HEEHRA) and the Whole-Home Energy Efficiency Program (HOMES) throughout the United States. These programs will need to coordinate and layer with local, existing energy efficiency programs. The lessons learned from TECH Clean California and the data available through our public reporting site offer unparalleled value to state energy offices and implementers and will guide and support the future of the industry.

### 2.3. Incentive design

TECH Clean California is designed to provide a simplified and consistent statewide incentive structure that integrates with existing local heat pump programs. A large-scale, statewide initiative brings significant benefits by simplifying two key areas: contractor participation and general program communication. To support this, TECH developed the Incentive Clearinghouse to layer incentives across integrated programs. This approach enables multiple organizations to provide funding for a single product type. TECH Clean California has now integrated its application process with five additional heat pump programs.

TECH Clean California's single-family incentive structure was designed with two goals in mind: 1) stretch the incentive budget by encouraging layering with local programs, and 2) provide a baseline set of incentives everywhere to ensure an equitable rollout. TECH concluded that the best approach would be to provide a statewide level of baseline incentives focused on overcoming the financial barriers associated with fuel switching, while coordinating with local energy efficiency programs to enhance incentives.

Facilitating a truly seamless experience for the contractor requires that all programs adopt consistent eligibility rules and application processes. In the first phase of incentive layering integration, each program still had its own rules, which caused contractor confusion and uncertainty. TECH Clean California and the other programs continue to work to streamline requirements and processes.

In addition to single-family incentives, TECH Clean California provides incentives for HPWH and HP HVAC equipment installed in multifamily properties for both retrofit and new construction applications. Incentives are available for various equipment types that serve residential apartments and communal spaces. For multifamily dwellings or properties with five or more dwelling units, TECH opted for a single incentive structure available throughout the investor-owned utility (IOU) gas territories to make the program simple and consistent for building owners and property managers.

## 2.4. Progress-to-date

### 2.4.1. Single-family incentives

TECH Clean California launched statewide, single-family incentives on December 7, 2021, and enrolled contractors ramped up participation quickly and enthusiastically. This is evidenced by the month-over-month growth in submissions shown in Fig. 1 below. Within six months, TECH enrolled over 900 contractors (3.5% of total California HVAC and water heating contractors) and received over 20,000 completed projects or reservations.[6]

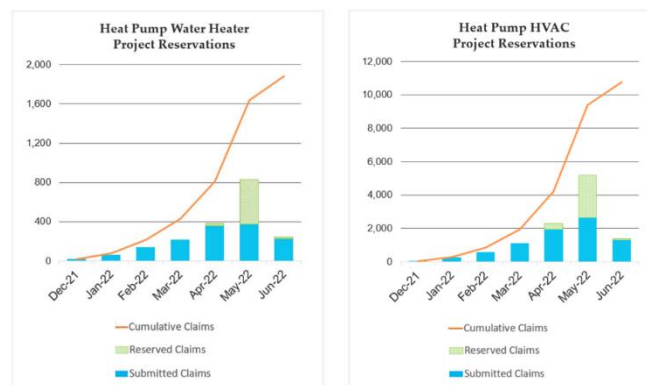


Fig. 1. Single-family incentives over time

Incentive spending in certain gas IOU territories gained momentum much more quickly than others, resulting in program suspensions due to budgetary limits required by the California Air and Resources Board funding allocations. These suspensions started with SDG&E on April 26, 2022, and extended to PG&E and SoCal Gas (HVAC only) on May 13, 2022.

To address the potential for exceeding the amount of available incentives, TECH Clean California introduced an incentive reservation system in May 2022 which allowed contractors to reserve incentives prior to project completion to ensure that funding would still be available when they were ready to submit applications for reimbursement. The team worked with participating contractors and energy raters to develop the reservation process and obtain feedback. The team sent out several communications to stakeholders to ensure that contractors were aware of the new system and in the span of a single week TECH received over 5,000 incentive claims, which quickly exhausted the remaining incentive budget and forced the program to suspend further incentive reservations.

Overall, both HPWHs and HP HVAC show significant growth, but initial sales were dominated by HVAC projects in single family homes: market-rate single-family TECH incentives applications had a 7.1:1 ratio of HP HVAC heat pump installations to those for HPWHs. This dramatic success of HP HVAC is likely due to selling on increased comfort and a combined heating and cooling solution, and the additional infrastructure

and complexity involved with HPWHs. For HPWHs, most installs took place in the Bay Area and Sacramento regions, which had existing programs and a more mature installer network. This suggests that HPWH programs in new areas should include robust investment in supply chain engagement and training, requiring time to build up a set of qualified and motivated contractors.

#### 2.4.2. Multifamily incentives

TECH Clean California launched multifamily incentives with an incentive reservation system to accommodate the long pre-construction and construction timelines, the need to track incentive budgets, and the need for a contractor to provide property owners and managers with firm pricing proposals prior to decision-maker approval.

The TECH Clean California incentives enabled owners to move forward with heat pump projects that they could not otherwise fund themselves. To date, reservations have been made for over \$12 million in multifamily incentives representing over 7,400 housing units, with the majority set aside for disadvantaged communities and affordable housing. In addition to the reserved incentives, about \$7 million worth of incentives are on the multifamily waitlist, representing projects in the pipeline that can be completed if funding becomes available from new sources, such as IOU energy efficiency programs and state funding, or from projects that do not materialize. These incentive reservations were mostly for projects in SoCalGas and PG&E territory with a smaller portion in SDG&E territory (see Fig. 2 for breakout).

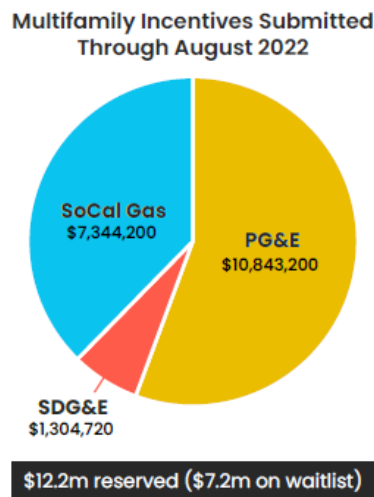


Fig. 2. Multifamily incentives reservations through August 2022

For multifamily installations, HPWHs comprised roughly 60 percent of projects. Of HPWH installations, 85 percent were in-unit installations, with 15 percent of units being served by central HPWHs. These heat pump investment decisions were often driven by project economics, or property owners looking to electrify to manage long-term fuel costs, decrease GHG impacts, and integrate with solar.

#### 2.5. Overcoming barriers

The six TECH Clean California regional pilots, summarized in Table 1, 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 into statewide approaches where feasible.

Two of the six pilots address adoption barriers for market segments that are particularly important for supporting equitable transition: low-income households and multifamily housing. The remaining four pilots address key barriers along the customer journey: identifying the customers most likely to save money by switching to heat pumps, financing the project, streamlining equipment installation, and managing the new electrical load once the appliance is installed.



Table 1. Summary of TECH Clean California Pilots

Pilot	Objective
Inclusive Utility Investment Program	Launch Tariffed On-Bill (TOB) program with partner utility to expand access to financing
Low Income Integration	Collaborate with existing low-income programs to more fully incorporate heat pumps
Multifamily Housing	Provide deep technical support for designing building systems that reduces the perceived risk of electrifying
HPWH Load Shifting	Target contractors as key market actors to maximize use of HPWH for load shifting
Streamlining Permitting	Design code-compliant, one-day HPWH permit process
Customer Targeting	Identify and engage customers who can benefit most from heat pumps

### 2.5.1. Inclusive Utility Investment Program

The Inclusive Utility Investment Pilot aims to demonstrate and expand the Tariffed On-Bill (TOB) or Inclusive Utility Investment (IUI) model through a partnership with a Load Serving Entity (LSE). TOB/IUI programs allow utilities to pay for cost-effective energy improvements, such as home heating and cooling units, at a specific residence. TOB/IUI also recover costs for improvements over time through a dedicated charge on the utility bill less than the estimated savings from the improvements. TOU and IUI are not forms of debt or lending, and cost recovery survives across successor occupants, making it more inclusive and allowing longer cost recovery terms. TOB/IUI is a new concept and exact impacts of a larger program are unknown. Results from this pilot can be used to inform the statewide framework to support future programs.

### 2.5.2. Low-Income Integration Pilot

The Low-Income Integration Pilot aims to expand access to building decarbonization technologies among low-income households by partnering with existing energy efficiency or income-based retrofit programs to ensure heat pumps are available in more programs and to more customers.

In 2019 the CPUC initiated the San Joaquin Valley Disadvantaged Communities (SJV DAC) Pilots, seeking to increase access to affordable energy sources and reduce use of fossil fuels for generators. A key focus is on creating pathways to electrification for low-income households. The TECH Clean California Low Income Integration Pilot team collaborated with this program to address issues in low-income homes that must be remediated before electrification can proceed. The SJV DAC program had a limited budget for pre-existing homes that was proving inadequate to cover unforeseen repair needs. The goal of the TECH Clean California collaboration pilot is to address 70 single-family homes that were not originally able to participate in the SJV DAC program, by providing each home with additional funding for remediation. As of June 2022, TECH Clean California has funded remediation on 13 homes in the San Joaquin Valley, with more in the pipeline. A central learning of the pilot is that the initial costs for retrofitting and repairs that are essential before installing heat pumps are often underestimated and the bill impacts of heat pumps are uncertain due to variables unique to each installation site. The lessons learned from this pilot will inform other equity-based programs throughout the state.

### 2.5.3. Multifamily Housing Pilot

The Multifamily Housing Pilot seeks to address barriers associated with electrification and energy efficiency upgrades in multifamily properties specifically by reducing the perceived risk of heat pump systems, by providing deep technical support in building system design. The strategy is to increase market familiarity with technologies and build capacity within design teams at multiple levels: from owners and architects to mechanical, electrical, and plumbing engineers. By accelerating the learning curve, the pilot will reduce the time and cost for developers to transition to all-electric buildings. The pilot has three tracks of activity:

- Project Specific and Portfolio Level Electrification Advising
- Central Heat Pump Water Heater Technical Support
- Property Electrification Readiness Plan

By addressing these multifamily housing barriers, this pilot can help provide a framework to support future efforts to transition properties to all-electric service.

#### 2.5.4. HPWH Load-Shifting Pilot

This pilot aims to establish market readiness and ensure that the full load-shifting benefits of HPWHs can be realized. It addresses this by motivating contractors to set up a HPWH to load-shift upon installation and encouraging them to sign customers up for demand response (DR) programs.

The initial focus of the pilot through 2021 and early 2022 was to educate contractors about the value of load shifting. The pilot team created an HPWH load-shifting training curriculum, and as of May 2022, more than 700 contractors had begun to enroll. Of these contractors, more than 150 had viewed the training video, and 75 percent of those who responded to the post-training survey reported that they had a positive view of the training, with only six percent being less than satisfied.

Initially, the pilot team also offered a \$200 incentive to contractors who installed a thermostatic mixing valve (TMV), a component that greatly expands the load-shifting potential of an HPWH. The pilot received and paid 209 TMV incentive claims, and early results from the launch of general TECH Clean California incentives revealed that about 70 percent of installs were already including TMVs as a matter of course. In the fall of 2021, the Self Generation Incentive Program (SGIP) announced HPWH incentives with requirements that included the inclusion of TMVs for all installations. To align the TECH Clean California requirements with SGIP, and after consultation with contractors to ensure the market was ready to include TMVs as a standard part of installations, TMVs were made a requirement for receiving standard TECH Clean California incentives, and TMV bonus incentives were discontinued on June 20, 2022.

With the discontinuation of TMV incentives, the pilot team expanded the portion of this pilot that encourages contractors to enroll customers in DR programs by providing an additional \$50 incentive for each customer enrolled. Originally, the HPWH Load Shifting Pilot focused on collaboration with PG&E's WaterSaver DR program; however, standard TECH Clean California incentives were exhausted in PG&E territory in May 2022. The team expanded its focus and now offers the \$50 incentive for enrollment in DR programs statewide and is currently collaborating with WaterSaver, SMUD's PowerMinder program, and OhmConnect, and open to other collaborations in the future. The pilot team will continue to educate contractors – and through them, customers – on the benefits of DR enrollment for both the grid and customer savings and will collect data on the barriers and challenges that dissuade contractors and their customers from enrolling in these programs.

#### 2.5.5. Streamlining Permitting Pilot

This pilot aims to close the gap in permitting times between natural gas water heaters and HPWHs, by adopting a single-day HPWH permitting process within single-family homes where code compliance could be demonstrated easily and effectively. The permitting process for HPWHs can currently span multiple days, deterring both homeowners and installers from making the switch from gas water heating to electric HPWHs. In emergency replacement scenarios, longer installation periods due to permitting delays are an even more significant barrier.

Throughout the second half of 2021 and into 2022, the pilot team convened numerous meetings with stakeholders to identify permitting challenges and solutions and help shape the potential goals of the pilot. Incorporating feedback from these sessions, the group reviewed a permit guidance package intended to aid building permit offices and contractors in creating a more expedited HPWH permitting process.

#### 2.5.6. Customer Targeting Pilot

This pilot seeks to identify and test outreach strategies to drive demand among customers for whom the value of electrification is most compelling. It addresses two key market barriers hindering adoption of heat pumps in California:

- A lack of large-scale data demonstrating which customers are most likely to benefit from upgrading to a heat pump, and how to motivate those customers to buy a heat pump instead of an alternative.
- Poor outcomes from recruitment of customers with low potential to save, which can have an outsize effect on adoption in early-stage technology markets. This highlights the need to recruit customers whose energy profiles indicate high potential to save.

This work transitioned from planning to implementation in early 2022 after receiving the necessary customer data from the utility. Working with SCE, the team devised an email campaign to be sent to SCE customers with a high likelihood of energy bill savings from installing HP HVAC systems. The pilot will compare the effectiveness of a general message about the efficiency and benefits of heat pumps to a specific

message stating that a customer's energy use indicates their household is a particularly suitable candidate. The lessons learned from this comparison will demonstrate the value of targeting customers based on energy use, which may be leveraged by future programs.

### 2.5.7. Quick Start Grants

Along with other TECH pilots, the Quick Start Grant (QSG) program aims to identify and fund targeted, innovative pilots that test approaches to overcome market barriers to heat pump deployment. The QSG program has funding for two solicitations annually. With these, the QSG program aims to promote the development and refinement of interventions that meet our solicitation criteria:

- Test solution to a barrier to residential building decarbonization.
- Have the potential to scale up to become statewide solutions.
- Ensure feasibility within the budget proposed and can be implemented within one year.

The first solicitation sought QSG pilots in the fall of 2021, received 35 grant applications and selected 11 projects for funding. Of the winning projects, 73 percent of overall funding went to projects expected to serve low-income households or historically underserved populations. The projects launched in early 2022. Since then, each of the grants has made progress in hitting individual milestones.

Fig. 3 provides a summary of the Quick Start Grants from the first solicitation.

The second solicitation was completed in the fourth quarter of 2022 and selected six projects for funding. Several changes were made to the second solicitation to reflect input from stakeholders as well as the implementation team's experience. These include expanding stakeholder outreach, extending the open time of the solicitation, adding an interview stage for grant finalists, and increasing the focus on projects addressing barriers in historically underserved communities.

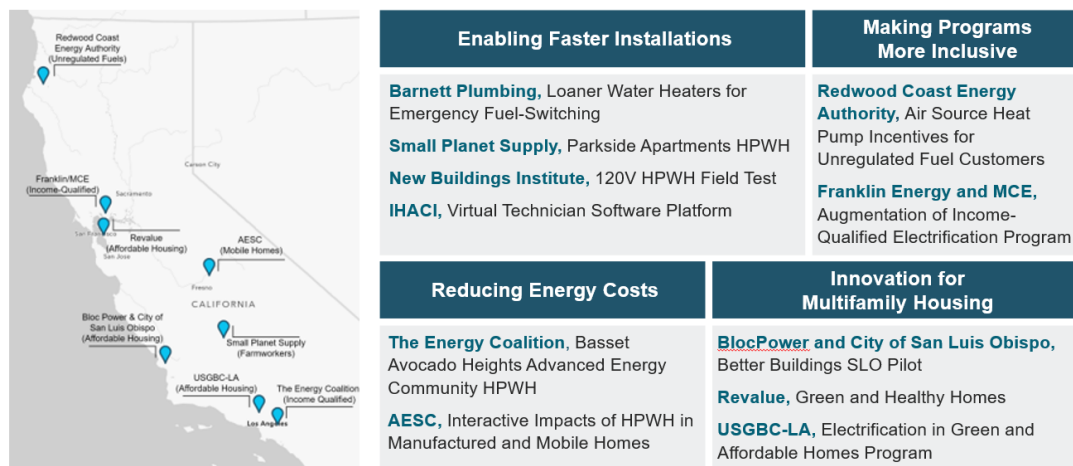


Fig. 3. Quick Start Grant summary

TECH will analyze the collected data, review the gained experience, and make the findings known to key decision makers through the public reporting website.

### 2.6. Public reporting

The vision for TECH Clean California public reporting is to bring a variety of data sources together and layer them into a robust and scalable data pipeline that offers novel visibility into the California heat pump market as shown in Fig. below. In the first year of implementation, TECH focused on building a core infrastructure to collect useful, actionable data. First-year accomplishments include building a robust incentive application data collection pipeline, unlocking access to historical meter data via CPUC to measure key participant outcomes, and launching the public reporting website to collect data and key findings, including anonymized project-level data and evaluation data as of July 2022.



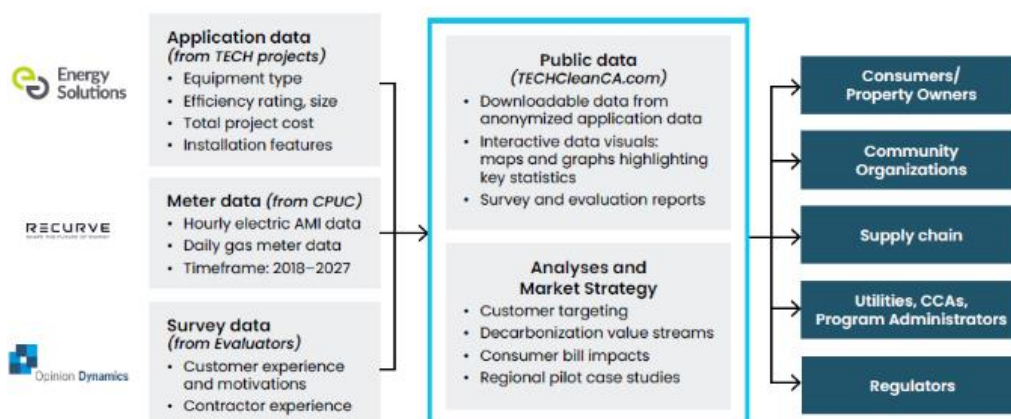


Fig. 4. TECH Clean California data mapping

The primary data pipeline starts with the Incentive Clearinghouse, where contractors submit incentive applications and data about project installation. An early focus area has been to outfit the Incentive Clearinghouse with all the features needed to fulfill TECH Clean California’s ambitious goals — programs for two distinct technologies, each with high data quality requirements, and each capable of layering with other partner programs — while making the combined incentive consistent enough for contractors to understand and predict. Once this functionality was in place, incentives for thousands of projects could be quickly deployed in just a few months, layered with four partner programs, each with a distinct layering structure. The Incentive Clearinghouse can continue to serve as a processing and layering center for new incentive programs anywhere in the state.

Concurrently, TECH worked with CPUC and California Energy Commission to gain access to statewide residential historical electricity and gas meter data (approximately 11 million meters) to understand the impacts of heat pump installations on the utility bills and GHG emissions of TECH Clean California participants. After collaborating with CPUC to resolve unforeseen legal barriers preventing access to the necessary meter data, TECH was able to start auditing the database that stores statewide residential electricity and gas meter data. TECH has started building a baseline understanding of residential gas and electricity consumption throughout the state and using this data to inform customer targeting and regional pilots. Meter-based results for TECH Clean California participants will become available starting one year after heat pump installation – the third quarter of 2023 for most TECH Clean California participants.

Finally, TECH has established regular data exchange with our evaluators, Opinion Dynamics, to further our understanding of customers’ and contractors’ experience with TECH Clean California and heat pumps in general. For example, Opinion Dynamics’ participant surveys [n=596] found that the TECH incentive was at least somewhat important to their purchase decision for 93% of customers, and that over 90% of respondents were satisfied with their contractor experience. This rapid feedback significantly helped inform ongoing program decisions. TECH is also working on data sharing arrangements with key market actors to obtain sales and product price data for the overall California heat pump market. Given the importance of this data to these companies’ business models, traction on this is still in progress and obtaining the data requires persistent and attentive negotiation.

With a data pipeline built atop the Incentive Clearinghouse, and integrated meter-based impacts and TECH Clean California participant surveys, TECH will publish data-driven insights to catalyze market transformation. These will be hosted on our public reporting website, which launched in July 2022. Hosting downloadable data and interactive data visuals, the public reporting site makes data engaging and impactful for both casual visitors as well as researchers. The site currently hosts application data from the several thousand market rate single-family projects that received TECH Clean California incentives since December 2021, and this data is updated monthly as more incentives are paid.

### 3. Key Lessons Learned

#### 3.1. Balancing the need for scale with consistent funding streams

A key challenge for TECH was balancing its market transformation mandate to drive adoption and send clear market signals, with its incentive funding limitations. The enthusiastic overall response led to incentive

funding being suspended in much of the state by May 2022, well ahead of schedule but still at a pace far below the annual installation numbers and growth rates required to achieve the state target of six million heat pumps by 2030. While TECH funding provided incentives to over 20,000 projects and exhausted funds relatively quickly, over 500,000 water heaters and 500,000 furnaces or air conditioners are installed each year in California. The inherent trade off was that high incentives were needed to initially attract contractor attention and create the market shifts necessary to rapid uptake, yet, given the scale of the California market TECH did not have sufficient funding to move the market alone. To achieve the level of scale needed, incentives per project need to decrease over time and long-term sources of private and public investment are needed to sustain significant transformation. The 20,000 projects deployed through TECH data should provide a robust data set to inform development of a longer-term funding approach that aligns with California's 2030 heat pump goals. As TECH integrates additional funding, the initiative will refine its offering by lowering incentives to match growing customer demand in support of market transformation.

As the number of incentivized technologies grows, and TECH gathers empirical data on their energy use, an analysis of what is driving — or impeding — heat pump adoption will become available. The first year of the program has produced key process-based lessons on the essential components of program design necessary to meet heat pump goals at the scale set by California.

### *3.2. Robust heat pump incentives drive the market*

A market shift toward heat pumps will require large-scale shifts in equipment production towards lower emissions products. To ensure there is sufficient equipment supply and manufacturers are incorporating these decarbonization goals into their product roadmaps, it is critical that the state outline investment strategies commensurate with these goals to send a clear signal to supply chain actors. California has recently begun to step up its public investment in decarbonization: through equipment incentive programs like TECH and SGIP which will provide \$80 million in incentives for HPWH; through incentives for all-electric new construction like the Building Initiative for Low-Emissions Development; and through the proposed \$1 billion investment from the legislature to support equitable building decarbonization. However, the state should establish a clearer, long-term funding roadmap.

### *3.3. Consumer education and outreach is an important complement to incentives*

TECH's consumer education website and outreach efforts, through [www.SwitchIsOn.org](http://www.SwitchIsOn.org) and its Ambassador Program, played a crucial role in supporting consumers at each point of the customer journey. The website achieved over 326,000 unique visitors and facilitated over 4,500 contractor quotes. Website visits scaled with project installations, with the most popular pages being the Rebate Finder tool and the Find a Contractor tool. Anecdotal evidence from contractors suggests that the website provided critical support for contractors to help educate prospective customers. In addition, the Ambassador Program, which focuses on individuals sharing their heat pump and home electrification journey with others, received over 100 initial ambassador volunteers throughout the state to promote and offer their experience as a resource to other prospective customers. These resources are particularly important when considering broader community engagement campaigns.

### *3.4. Providing statewide support and creating consistency among the many heat pump programs*

There are many heat pump programs within California, and a project may be eligible for multiple programs based on its location. A large-scale, statewide initiative brings significant benefits by simplifying two key areas: contractor participation and general program communication. To simplify the contractor experience and eliminate the need for applying separately for multiple programs, TECH integrated its application process with other five additional heat pump programs. This layering approach enables multiple organizations to provide funding for a single product. This approach is particularly important for decarbonization measures, since the NO<sub>x</sub>, GHG, energy efficiency, and peak demand benefits may have different funders or organizations interested in those respective values. For example, an air quality management agency may be interested in NO<sub>x</sub> reductions, while a utility is focused on efficiency and peak load reduction. Additionally, incentive layering equips programs with funding that can tackle key barriers seen through the TECH pilots, such as remediation costs, bill impacts, or cost effectiveness for low-income programs or split incentive challenge for multifamily programs.

While streamlining multiple incentives provided benefits to create standardized incentive amounts across the state, there were significant implementation challenges due to differences in eligibility criteria. These differences made it difficult for contractors to understand which programs they qualified for. The difficulty in communicating consistent eligibility requirements across programs was a sufficient barrier that the TECH program decoupled incentives from multiple programs. That made it easier to communicate flat amounts provided by each program. Ultimately, TECH believes the best approach is having a robust statewide baseline incentive, sufficient to move the market, with as-needed supplemental incentives in areas to drive specific adoption. Numerous contractors noted that the statewide simplicity across utility borders was a major benefit and made participation more straightforward. Scaling heat pump adoption is a statewide priority and thus it makes sense to have a statewide initiative rather than a patchwork of smaller efforts. It also requires significant non-incentive market development efforts, such as workforce education and training, consumer education and data reporting, all of which benefit from economies of scale at the statewide level.

#### 4. Conclusion

TECH Clean California has launched a combination of market incentives, supply chain engagement, workforce development, consumer education, regional pilots, and Quick Start Grants. TECH Clean California has resulted in the rapid deployment of heat pumps and has established data infrastructure to inform statewide consistency. Through these efforts, TECH Clean California has identified key lessons learned, including the effectiveness of incentives, importance of consumer and contractor engagement, and value of consistency among heat pump programs.

During the next year of TECH Clean California implementation, the focus of data reporting efforts will shift from building new infrastructure to scaling and improving the initiative. As the depth and breadth of the data increases over time, TECH will continue to refine its ongoing strategies to maximize impacts as well as conducting analyses that inform statewide decarbonization policies and investments. The initiative's goal is to make application data and meter-based results for every TECH-funded project easily accessible and comparable, in one place, to showcase important differences between the various TECH Clean California programs, such as single-family versus multifamily projects. In addition to public data, TECH has also initiated a process of customized quarterly reporting for key heat pump manufacturers, giving them critical insight into TECH Clean California participation. Manufacturers are just one key consumer of TECH Clean California data, though, and it will be critical for TECH to strategize where and how the initiative focuses its analysis and outreach to meet the most important needs for decarbonization policymakers and investors.

Funded with an additional \$50M through the California State budget, TECH Clean California will continue to enable the installation of zero-emissions space and water heating technologies and will collect and publish energy and GHG impacts with market data to inform California's long-term decarbonization framework and beyond.

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