TECH Clean California's Heat Pump Market Transformation Approach: Lessons Learned in Year 1

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ABSTRACT

In the United States, over 90% of direct carbon emissions from the residential sector come from fossil fuel-fired space and water heating. A critical strategy to decarbonize this sector is adoption of high-efficiency electric heat pumps. However, the market share for heat pumps for both technologies is less than 10% in most states and will need to scale exponentially over the next decade to meet greenhouse gas reduction targets.

TECH Clean California is a multi-year market transformation initiative focused on accelerating adoption of heat pump technology for space and water heating by driving down costs, finding new value streams, and scaling successful approaches through market and policy changes. The initiative includes three simultaneous efforts: 1) Motivating the supply chain through midstream incentives that make heat pump installations attractive, providing accessible workforce training, and stimulating consumer demand; 2) Demonstrating scalable solutions to key market barriers through pilot projects; and 3) Using sales and meter data from TECH installations to create a public database that can inform an equitable, transformative long-term policy framework for building decarbonization.

This paper discusses the theory of change for TECH Clean California and how this initial strategic investment is intended to put the state on a path to achieving its aggressive decarbonization goals. It will also review the lessons learned in the first year of implementation, as well as recommendations for states considering broad heat pump deployment.

Meeting California's Climate Goals Through Building Decarbonization

California has ambitious climate goals: a greenhouse gas (GHG) emissions reduction target of 40% below 1990 levels by 2030 (California Senate Bill 32), statewide carbon neutrality by 2045 (California Executive Order B-55-18), and a commitment to 100% carbon-free electricity by 2045 (California Senate Bill 100). Residential and commercial buildings are together responsible for 24% of total statewide greenhouse gas emissions, including emissions from direct fuel combustion, electricity use, and refrigerants. Space and water heating are responsible for 91% of the direct emissions for this sector – meaning proactive, committed decarbonization of these sectors is an essential component of the state's overall GHG reduction strategy (Kenney et al. 2022). In recognition of this opportunity for deep carbon emission

reductions, in July 2022 California Governor Gavin Newson sent a letter[1] to the Air Resources Board setting clean energy targets for buildings including:

- 6 million heat pumps in buildings by 2030;
- 3 million climate-ready and climate-friendly homes by 2030;
- 7 million climate-ready and climate-friendly homes by 2035;
- And with at least 50 percent of funding to meet these goals directed toward disadvantaged communities.

As of 2021, California has over 14.5 million housing units (Census Bureau 2022), and thus achieving the six million heat pump target and carbon-free homes by 2045 will require a significant increase in market scale and a rapid shift towards clean heating technologies.

California's First Heat Pump Market Transformation Initiative

California Senate Bill 1477 created the Technology and Equipment for Clean Heating program, now known as TECH Clean California (TECH). The initiative is a $120 million market transformation effort to kickstart California's market for heat pump space and water heating and lay the groundwork to meet its ambitious building decarbonization targets and climate goals. TECH aims to leverage this initial investment to identify key lessons learned, drive down costs, support the development of long-term project finance approaches and inform California's broader building decarbonization policy framework, setting the state up to maximize the effectiveness of future investments.

In developing the TECH approach, the TECH team conducted over 40 interviews with market actors, policymakers, and other key stakeholders, creating a logic model mapping key barriers to heat pump deployment onto program activities and their potential outcomes. In addition, the team examined the underlying structures from the solar industry that enabled long-term market transformation and the success of the California Solar Initiative to identify the broad market development characteristics required for long-term market success. The goal of TECH is to provide sufficient information and market development to create a long-term structure that meets these market development criteria. These include, but are not limited to:

- **Sustained Investment:**
  - A long-term, simplified incentive structure that sends clear, consistent market signals that step down over time and achieve increasing leverage
  - Electric rates that create sufficient bill savings to attract heat pump investment
  - Mature project finance approaches based on rigorous impacts quantification, particularly for customer bill savings, peak load, GHG, and NOx impacts to attract investment and off takers of these value streams[2].

[1] https://www.gov.ca.gov/2022/07/22/governor-newsom-calls-for-bold-actions-to-move-faster-toward-climate-goals/

[2] Rigorously quantifying heat pump impacts can create long-term value streams of bill savings, health and safety, peak demand reduction, GHGs, and NOx, which can potentially create long-term program funding sources. For example, SMUD and Recurve used meter data to estimate that a HPWH installed in 2020 will achieve lifetime GHG savings of 11.0 tons, while an HP HVAC unit saves 22.8 tons (Blunk et al 2020).

    - Dedicated focus on ensuring equity, installation in low-income and disadvantaged communities
- **Clear and consistent market communication:**
    - Clear signals and roadmaps to supply chain, design community to help them plan for scale and influence their roadmaps, and support go to market strategies for new technologies (e.g. 120V HPWHs).
    - Consistent consumer messaging and educational resources to increase awareness, address concerns, and support the customer journey
    - Supply chain engagement to learn about new technologies, provide insights
- **Improved industry best practices to reduce soft costs, increase benefits**
    - Customer acquisition
    - Installation, such as permitting and risk reduction
    - Streamlined infrastructure upgrade process

In response to the market barriers identified in the logic model and the market characteristics necessary for long-term success, TECH developed three pillars of activities, depicted in Figure 1 and described in detail below.

Figure 1: The 3 pillars of TECH activities. *Source:* TECH Clean California.

These pillars fundamentally focus on 1) developing necessary core infrastructure for scale, such as consumer and contractor engagement, streamlined participation approach, project finance mechanisms, integrating heat pumps into existing low-income programs and the data infrastructure to inform long-term funding and policy decisions, and 2) approaches to reduce risk and decrease soft costs as deployment volume increases over time.

1. Spur the clean heating market

In the plumbing and HVAC markets, the vast majority of retrofits are replacement on burnout, and most customers opt for whatever technology the contractor recommends. Developing a strong contractor network is critical to heat pump program success (Opinion Dynamics 2022). Thus, scaling heat pump adoption requires contractors to see a clear value proposition as well as consistent customer demand for these products. This first tranche of TECH's efforts focused on jump starting the heat pump market by addressing installation cost disadvantages, and lack of education and training for contractors and customers.

Table 1: Key heat pump market barriers and the corresponding TECH solution

Market Barrier	**TECH Solution**
Heat pumps are more expensive than same-fuel option, may require infrastructure upgrades	Midstream incentives via contractors: TECH incentives set at a level to make heat pumps roughly equivalent in cost to the gas-fueled baseline unit and provide incentives to cover panel upgrades.
Limited coordination among supportive organizations and incentive programs creates inefficiencies	Layered incentives: TECH incentives are integrated with incentive programs offered by other California utilities and program administrators into a single application to simplify the application process.
Administrative complexities discourage contractor participation	Simple application processes align with contractor workflow: Program eligibility requirements that do not create cash flow problems for contractors or require significant time to complete.[3] In general, a TECH application should be able to be completed and submitted on a tablet during a house visit. On the multifamily side, similarly, payment processes should keep in mind contractor needs for rapid turnaround times.
Lack of training for contractors and technicians	Supplemental Heat Pump and Business Model Training: Increasing Building Electrification will require a long-term paradigm shift for HVAC and plumbing industries. TECH's training approach includes: • Collaboration with manufacturers and distributors to integrate electrification and California-policy-specific content into their existing training infrastructure • Provide electrification technical and sales training by experienced trainers. • Offer ongoing business model support to help contractors re-tool their businesses to integrate electrification

[3] For example, TECH requires permits to be pulled, but not necessarily closed, as part of the application. Requiring a closed permit prior to contractor payment could delay reimbursement by 2-6 months, creating cash flow issues and significantly reducing participation.

	• Eligible contractors and/or sales staff who demonstrate program engagement can receive a free heat pump water heater for installation in their home. This enables participating contractors and staff to get firsthand experience and serve as a testimonial to prospective customers.
Low consumer awareness and demand, concern about compatibility with existing infrastructure	<u>Statewide consumer inspiration campaign:</u> TECH leverages and supports the space and water heating activities of The Switch is On, a statewide consumer inspiration campaign which reaches customers through tested and tailored messaging delivered through a variety of channels (radio, TV, digital ads, community organizations), 2) educates consumers on the benefits of heat pumps, addresses concerns and serves as a central hub that contractors can refer prospective customers to, and 3) inspire action by making next steps easy (finding a contractor , financing solutions, rebates and an ambassador program). The site also hosts a dedicated low-income hub, contractor hub with training materials, and a public reporting component.

2. Create scalable models for equitable market transformation through regional pilots and Quick Start Grants

In addition to the broad statewide approach of the incentive and workforce development efforts, the innovation arm of the TECH initiative aims to assess potential solutions to discrete market barriers through six regional pilots. These include approaches to scale deployment infrastructure (such as project finance and increasing heat pump deployment in existing low-income programs), as well as a focus on soft cost reduction and consumer awareness and engagement. The solutions that prove effective will be incorporated into the overall framework of TECH and scaled into statewide approaches where feasible.

The focus areas for two of the six pilots were selected to address adoption barriers for market segments particularly important for supporting an 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 2 summarizes how each pilot addresses the market barrier and supports a pathway to scale.

Table 2: Key heat pump market barriers and the corresponding TECH pilot

Market Barrier	**Solution**
Existing low-income or EE programs have funding or programmatic barriers that prevent them from offering heat pumps	<u>Low-Income Coordination Pilot:</u>

	Work with existing low-income programs, such as the San Joaquin Valley Electrification Pilots or utility Energy Savings Assistance Programs, to provide funding for home repairs preventing installation of heat pumps. Through this work, evaluate opportunities for heat pump integration into low-income programs
Multifamily building technology is complex, and the upfront investment may be prohibitive	Multifamily Pilot: Develop individualized "roadmaps" for gradual retrofits of properties and provide deep technical expertise in system design and monitoring
Contractors do not have methods to identify customers who would save most on their bills or result in the greatest GHG reductions	Customer Targeting Pilot: Leverage electric meter data analytics to identify and conduct targeted outreach to households with the greatest propensity to save money and energy by installing a HPWH
Low-and middle-income customers have limited options to pay the upfront costs of electrifying	Tariffed On Bill Pilot: Implement a tariffed-on bill offering with a partner utility; provide capital and support to de-risk the project
Permitting heat pumps can take weeks, significantly discouraging installations; Lack of coordination and support for local permitting offices	Streamlining Permitting Pilot: Work with local code office to design and implement a model one-day permit process
Heat pump water heaters are not set up for optimal load shifting, leaving benefits for the grid and for owner cost savings on the table	HPWH Load Shifting Pilot: Leverage contractors as key players, providing education and incentives for mixing valves and DR program enrollment

In addition to the six pilots developed and implemented by the TECH team, the initiative also provides funding for additional pilots through the Quick Start Grant Solicitation, a two-year grant opportunity for heat pump deployment pilots. The selection criteria focused on finding and funding projects that had the potential to scale into statewide interventions, and that addressed barriers to heat pump deployment in low-income or historically excluded customer groups. Projects addressed barriers like enabling fuel-switching for emergency water heater replacements, installation in manufactured housing, and challenges reaching rural and remote

customers on unregulated fuels.[4] In the first year, 73% of funding went to support low-income households and disadvantaged communities (Energy Solutions 2022a).

3. Inform and support the development of data-driven policies through a public data reporting website

In addition to the market barriers listed above, a barrier to data-driven statewide policy is the conspicuous lack of empirical, installation-based data to inform these investment decisions. For example, most previous analyses of the GHG and consumer financial impacts of heat pumps have been limited to generalized modeling (*see, e.g.,* E3 2019, Walker et al. 2022). The crucial importance of heat pumps to addressing climate change and the level of necessary investment require a more robust, meter-based understanding of impacts to inform and unlock effective private/public investments at that scale. To fill this data gap, TECH will collect detailed information from three different perspectives:

- Program application data, including project characteristics and cost
- Customer and contractor satisfaction surveys, identifying whether the heat pump meets consumer and contractor needs
- Metering data, which quantifies heat pump impacts and whether the heat pump performance is delivering electrification value streams (bill savings, peak load reduction, GHGs, NOx impacts, etc.)

Integrating this information together creates a comprehensive perspective of heat pump performance and enables rapid feedback to inform program design and industry best practices. This data reporting website will launch in July 2022 and will house three categories of information: charts and graphs highlighting program summary statistics, downloadable public data sets containing installation and energy use data for every installation, and a series of reports analyzing the data and quantifying the value of electrification. By the end of 2022, this data set is expected to contain 10-20,000 installations, laying the groundwork for a data-driven approach to wide range of building decarbonization policy decisions.

Table 3: Key heat pump policy barriers and the corresponding TECH data set

Policy Barrier	**Solution**
Unknown customer bill impacts of heat pump measures; little or no customer bill savings at current rates	Customer Bill Impact Analysis illuminates customers who currently save money after switching to heat pumps and how rate reform can expand this group
Deficiency of markets to monetize grid or carbon value; Lack of data to support long term mandatory/voluntary policy adoption	Energy and environmental impact data calculated including electrical load, gas consumption, GHGs, and NOx

[4] More information on the projects run by existing grantees, as well as the 2023 solicitation, can be found at https://energy-solution.com/tech-qsg/.

Unknown per unit cost for low-income retrofit programs in homes that may have deferred maintenance	San Joaquin Valley Low Income Pilot gathers cost of home upgrades needed to enable electrification
Lack of data on customer and contractor experience to support long term policy adoption	Customer satisfaction surveys track satisfaction with new appliances; Contractor surveys track program experience, heat pump business integration

Lessons Learned from the First Year of Implementation

Robust Heat Pump Incentives Help Drive the Market

Statewide TECH incentives launched in December 2021. The initial phase of the program was focused on contractor engagement through existing supply chain channels including manufacturers, manufacturers' representatives, and distributors and quickly deploying generous incentives (a base incentive of $3,000 per HP HVAC unit and $3,100 per HPWH, with additional funding for supplemental measures).[5] Initial contractor enrollment and market demand was highly successful and accelerated far faster than anticipated. In less than six months, TECH enrolled over 900 contractors, reserved or deployed heat pumps for over 20,000 households, with a 10x increase in the rate of application submissions from month 1 to month 5 (see Figure 2).

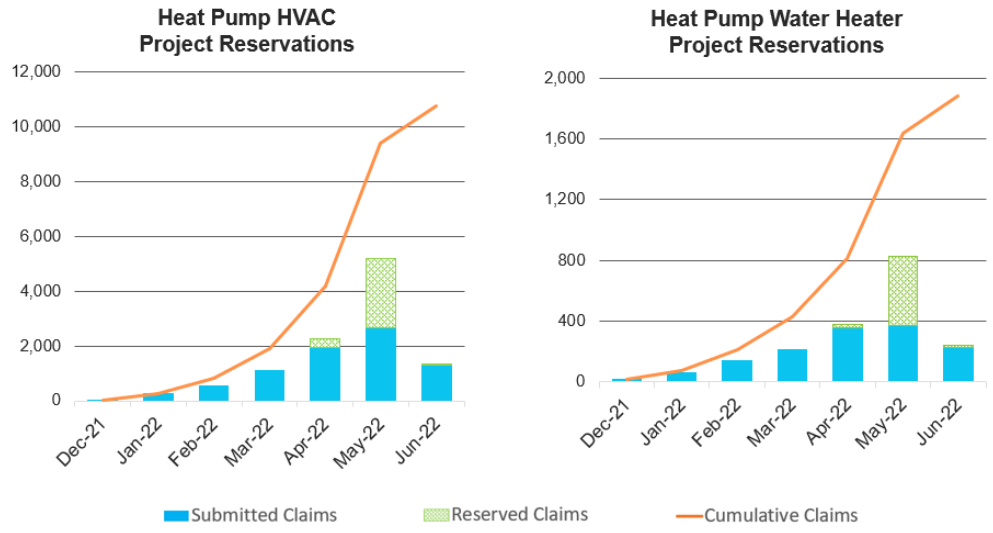

Figure 2: Single-family Heat Pump Installations / Reservations Over Time. The lack of reserved claims in June and decrease in overall program activity is due to the suspension of market rate program incentives in May.

[5] These incentive levels informed by existing California heat pump programs, including SMUD's highly successful program. Nationally, TECH's incentive level is somewhere in the middle and significantly lower than the high end of heat pump incentive offerings in Colorado, New York, and Massachusetts.

The relatively high incentives played a key role in driving initial adoption. In a consumer survey, TECH evaluator Opinion Dynamics identified that 93% of TECH participants said that the incentive was at least somewhat important in their decision to get a heat pump. Of 596 survey participants, 39% of HVAC and 59% of HPWH customers stating they were either unlikely or would not have purchased a heat pump without an incentive (Energy Solutions 2022b)

Overall, the number of applications for both HPWHs and HVAC heat pumps grew significantly, with initial single-family sales dominated by HVAC (~7 to 1 ratio of HVAC heat pump installs to HPWHs). This dramatic success of HP HVAC is likely due to a few reasons: 1) compelling initial incentives which successfully addressed the key first cost barrier; 2) selling on increased comfort and a combined heating and cooling solution, and 3) the California single-family HP HVAC market is somewhat more mature than the HPWH market. While HP HVAC had higher volume, both product categories experienced similar exponential growth patterns. For single family HPWHs, the vast majority of installs took place in the Bay Area and Sacramento regions, which already had existing programs and had built a more mature installer network. This suggests that HPWH programs in new areas should include robust investment in supply chain engagement and training, which can take time to build up a set of qualified and motivated contractors.

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

Panel Upgrades Were Lower Than Anticipated

Opinion Dynamics' (2022) recent heat pump market study identified both consumer and contractor concerns about panel upgrades. TECH offered up to $2,800 for panel upgrades for HPWHs in select regions throughout the state. However, less than 10% of TECH participants applied for panel upgrade incentives, even though over 40% of HPWH of customers had panel sizes of 125 amps or below. This suggests that panel upgrade concerns are somewhat limited and that the majority of initial HPWH customers with smaller panels did not require or opt for upgrades. It is uncertain whether or not prospective customers were considering a heat pump but were dissuaded due to the panel upgrade. Further analysis and a broader sample size is necessary to better understand panel upgrade needs, particularly for comprehensive electrification. The recent introduction of 120V HPWHs into the market may lessen the need for panel upgrades related to HPWH installs.

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 current market-rate incentive funding being exhausted in much of the state by May 2022, well ahead of expectations. However, the pace represented by this enthusiastic response is still far below the annual installation numbers and growth rates required

to achieve the state target of 6 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/air conditioners are installed each year in California. While these incentives attracted contractor attention, addressed financial barriers and created the market shifts necessary to rapid uptake, given the scale of the California market, TECH did not have sufficient funding to move the market alone for a prolonged period. Achieving the level of scale needed to meet state targets requires a long-term source of private and public investment and decreasing incentives over time to sustain significant transformation. The lessons learned from the pilots and data from the 20,000 projects deployed through TECH incentives should provide a robust data set to inform development of a longer-term funding approach that aligns with California's 2030 heat pump goals and is broadly applicable to other states looking to scale heat pump adoption.

A market shift toward heat pumps will require large-scale shifts in equipment production towards lower emissions products. To ensure that 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. As noted in Governor Newsom's letter to the California Air Resources Board, California plans to invest significant resources to achieve its six million heat pump goal by 2030.

Consumer Education and Outreach is an Important Complement to Incentives

TECH's consumer education website and outreach efforts, through www.SwitchIsOn.org and its ambassador program, played a crucial role in supporting consumers at each point of the customer journey from initial information to installing a heat pump. Website summary data indicates that visits scaled with TECH project installations, with the most popular pages being the Rebate Finder tool and the Find a Contractor page. Anecdotal evidence from contractors suggests that the website provided critical support for contractors to help educate prospective customers. These findings are broadly consistent with recent research highlighting the importance of consumer resources to build awareness and demand (Opinion Dynamics 2022). 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.

Providing Statewide Support and Creating Consistency Among Multiple Heat Pump Programs

There are numerous heat pump programs within California, and a project may be eligible for multiple programs since the NOx, 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 NOx reductions, while a utility is focused on efficiency and peak load reduction.

A large-scale, statewide initiative brings significant benefits by simplifying contractor participation and program communication. To address this need, TECH integrated its application process with multiple other heat pump programs, offering a consistent overall statewide TECH incentive and then worked on the back end with each individual program on the exact portion that the partner program would contribute based on their existing program offerings.

While streamlining multiple incentive applications provided benefits to create standardized incentive amounts across the state, the integrated incentive approach had some important implementation challenges due to differences in program eligibility. For example, differences in eligibility criteria across programs made it difficult for contractors to understand the exact TECH incentive amount a customer might be eligible for.

Overall, it is strongly preferred to have a single robust statewide baseline incentive, sufficient to move the market. Numerous contractors noted that the statewide simplicity across utility borders was a major benefit and made participation fairly 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. Having a single, statewide baseline level enables local programs to participate and drive local adoption. Where there are multiple incentives, layering them into a single application is highly desirable. Even in the case where local and regional organizations are not offering incentives, their collaboration is critical to increasing customer awareness as a trusted local partner.

Robust Data Access and Rapid Feedback Cycles Are Critical to Driving Market Transformation

TECH's data collection approach covers all three key aspects of heat pump installation: 1) detailed project installation information, including location, model, price; 2) surveys evaluating the contractor and customer experience; and 3) meter-based performance. Figure 3 provides an overview of the existing status of the TECH datasets and timeline of future updates. Each data collection component provides critical information to inform program performance and enable rapid iterations of program design. For example, the TECH team provides the program evaluator, Opinion Dynamics, with installation details in a bi-weekly basis, enabling Opinion Dynamics to send customer satisfaction surveys to participants within just a few weeks of installation. These surveys have achieved very high response rates (over 25%), likely in part to the short amount of time between installation and survey. This rapid feedback analysis helps monitor consumer satisfaction and assess any potential issues proactively as they first appear. Overall, customers were generally very satisfied with their heat pump installation purchase, with 91% of HPWH and 96% of HP HVAC customers stating they were "satisfied" or "very satisfied" with their experience (Energy Solutions 2022b).

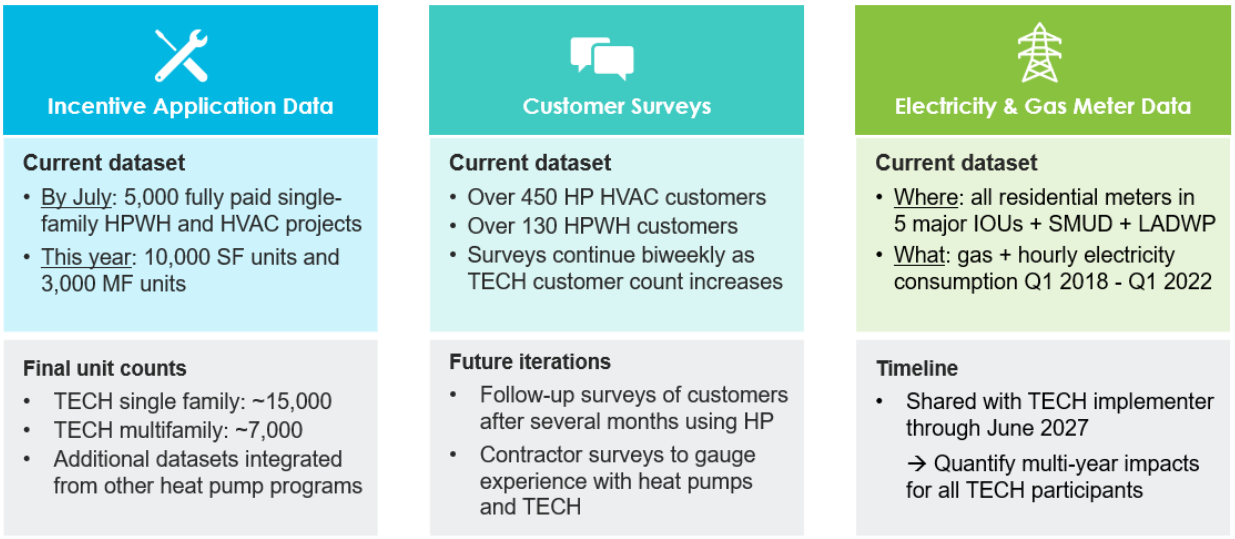

Figure 3: TECH's three-part data collection approach covering installation details, consumer and contractor experience, and meter data. Incentive application and meter data analysis is conducted by the TECH team, while Customer and Contractor Surveys are conducted by TECH program evaluator Opinion Dynamics.

TECH's access to statewide residential customer gas and electricity meter data is particularly vital to creating a holistic market transformation approach. Comprehensive meter data enables TECH to quantify the impacts of installing heat pumps on both the gas and electricity side of the meter and link it to installation characteristics. This gives TECH the ability to not only monitor progress in real time but also inform long-term California decarbonization policy, project finance and new business models. In addition, meter data access enables targeting customers with the highest potential bill savings and/or GHG impacts based on their historical gas and/or electricity consumption. Meter-based customer targeting is more effective than using secondary characteristics such as building vintage to target high impact customers, since two identical houses can have radically different energy consumption and value propositions depending on the behavioral patterns of the occupants (Scheer 2017).

This type of comprehensive database does not yet exist in any state. Obtaining and centralizing customer meter data access across utilities to create a statewide reporting website required significant collaboration between the CEC, California Public Utilities Commission (CPUC), the state's investor-owned utilities, and the TECH team. This multi-step process required roughly one year to complete for TECH. The process began when CPUC outlined authority to share customer meter data with the TECH implementer in its decision authorizing TECH. Upon program startup, the TECH team then had to identify the simplest and most feasible method of accessing meter data from the major California utilities and complete all necessary contractual privacy agreements. Ultimately, the TECH team decided to execute a data sharing contract directly with the CPUC while the CPUC meanwhile pursued an interagency data sharing agreement with the CEC. In other states, a similar arrangement is feasible but will likely

also require significant time on par with the year the TECH team and CPUC spent preparing, vetting, and executing all necessary contracts.

Flexibility to Support Heat Pump Market Development

California's ambitious six million heat pump goal requires supply chain market actors to actively shift their business practices to integrate heat pumps into their standard business practices at unprecedented scale. In many utility programs, cost-effectiveness or other program requirements can limit the flexibility to drive towards aggressive installation targets. TECH does not have cost-effectiveness requirements (only GHG targets and other market transformation metrics), and thus is focused on market maturity rather than the cost-effectiveness of a single unit. For example, TECH was able to provide funding for projects that were limited by low-income program funding constraints that would otherwise not allow customers to install heat pumps. Given the speed and scale needed to achieve heat pump deployment targets, building flexibility to support a nascent market is important.

Integrating Dedicated Equity-Based Approaches are Critical

TECH began with an internal target of 40% program benefits going to low-income households and disadvantaged communities ("DACs").[6] As of June 2022, the program is trending slightly below that target, projected to be between 30-40%. By June 2022, approximately 7% of market rate single-family incentives were distributed in DACs, while over 60% of multifamily incentives going to DACs and low-income households combined.[7] For the Quick Start Grants program, 73% of Year 1 funding ($2 million) went to projects focused on low-income or historically underserved groups, and Year 2 has a target of 100%.

Multi-family and Quick Start Grant projects had far higher participation rates for low-income households and disadvantaged communities, likely because 1) these projects were led by organizations with more capacity and resources to participate rather than individuals and 2) low-income utility customers receiving discounted energy rates are eligible for the Energy Savings Assistance (ESA) program and no-cost appliance upgrades, and thus qualified customers should generally be steered towards these assistance programs where possible. Thus, customers in low-income communities are more likely to participate through ESA and other similar programs rather than TECH. TECH initially currently does not require income qualification documentation, and so participation of single-family low-income households is likely somewhat undercounted.

The TECH low-income pilot is meant to address the limitations of a market rate single family approach in supporting DACs ad low-income households by collaborating with existing

[6] Because single-family household income was not collected by installing contractors, TECH assigned incentive recipients in this category if the household address was in a zip code associated with the highest 25% scoring census tracks identified by CalEnviroScreen 4.0. For multi-family housing, a property was assigned to this category if it was deed-restricted affordable housing or located in a CalEnviroScreen-designated disadvantaged community.
[7] For the single-family applications, this does not include low-income applicants because income was not a question listed on the application and therefore unable to validate. Because of this difference, household income is much easier to classify in multi-family buildings than single-family.

low-income programs to integrate TECH resources and heat pump offerings within their existing infrastructure. Long-term, full integration of heat pump offerings into ESA and other low-income programs are an important path to increasing heat pump adoption in DACs and low-income communities. To date, TECH has collaborated with multiple low-income single-family programs. A key opportunity has been layering incentives or leveraging TECH's funding flexibility to support projects that would not occur due to the other program's more rigid structure or inability to cover incidental repair costs. In addition to continued ongoing integration with low-income programs, the TECH team is considering possible integration of an income-based incentive adder into future single-family market rate program, as well as more targeted outreach in DACs.

In the Quick Start Grants process, stakeholder consultation with groups representing areas and constituencies historically underserved by energy programs significantly improved the process to make it more inclusive to smaller organizations with limited proposal development capacity. For example, based on feedback, the second year of the solicitation will provide the opportunity to present project ideas in a "pitch session" in addition to a written proposal, since smaller organizations may be less experienced writing formal grant applications.

Recommendations for Other States with Heat Pump Deployment Goals

Create a dedicated focus on market development activities to complement incentives: We recommend that states or regions looking to scale heat pump deployment adopt a similar market development approach if there is not already a convening market transformation organization or player. For example, the Northwest Energy Efficiency Alliance plays this role in the Northwest. Because TECH is specifically tasked with integrating with other incentive programs, it is able to devote significant resources to provide this "umbrella support" and see the state appliance incentive market as a whole. Any state with broad goals for heat pump adoption or building decarbonization should strongly consider funding some version of an overall program coordinator that can tie broader efforts together and serve as the "director" of the overall decarbonization effort and focus on critical activities not directly tied to incentives. Without it, the responsibility of critical overarching roles such as building consumer awareness, workforce education and training, comprehensive data collection and analysis, which do not fall to a single entity or utility program, will simply likely not get done. Where feasible, this program role should be tied as close as possible to actual implementation.

Incorporate meter-based data reporting into all fuel-switching programs: For any state serious about decarbonization, having a centralized database of meter-based analysis is critical for identifying opportunities for and quantifying impacts of building electrification. Otherwise, it is impossible to quantify impacts, make informed program decisions, and attract the public / private capital necessary to scale heat pump adoption. Therefore, it is critical to give fuel-switching program implementers access to gas and electricity meter data for their entire eligible population for at least one year prior to program start and for the duration of the program. This will facilitate identifying the most cost-effective opportunities, quantifying impacts for program participants, and creating a long-term funding mechanism.

Provide sufficient statewide funding and structure to stimulate long-term market investment: Scaling heat pump adoption requires long-term, simplified incentive structures that send clear, consistent market signals that step down over time (similar to the California Solar Initiative). Achieving this will require a mix of increasing state and federal levels of investment, as well as decreasing project costs, and creating markets for the value streams (peak load reduction, GHG, bill savings, health and safety and NOx). Ultimately, this level of investment will require a blend of large-scale declining block incentive programs as well as, electrification rate structures that create sufficient bill savings to attract private investment and encourage 3rd party business models.

Create a dedicated focus on equity, for both low- and moderate-income households: Many existing low-income, direct install programs do not actively focus on heat pump installations. Incorporating heat pump measures at scale into these existing programs ensure that low-income households can benefit from heat pumps. For moderate-income households that do not qualify for low-income direct install assistance but still may have limited cashflow and means to participate, consider models income-based incentive adders or tariffed-on-bill investments that are cashflow positive and do not require traditional debt financing.

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