Lessons in Real Time: Evaluation of California's Building Decarbonization Push

Rory Cox, Enerelle Consulting, Slovenia, rory.cox61@gmail.com
Ellen Steiner, Ph.D., Opinion Dynamics, USA, esteiner@opiniondynamics.com
Abhilasha Wadhwa, California Public Utilities Commission, USA, abilasha.wadhwa@cpuc.ca.gov

ABSTRACT

California has identified greenhouse gas emissions from buildings as a leading target in efforts to curb global warming, as they comprise 24% of the state's emissions. Replacing gas-powered furnaces and water heaters has become a policy priority.

The state's flagship retrofit program—*TECH Clean California* (TECH)—aims to accelerate the heat pump market and create an equitable pathway to carbon-free homes. With a budget of nearly $400 million, TECH is using market transformation strategies such as contractor incentives and training, as well as marketing and outreach, to create a market for residential heat pump heating, ventilation, and air conditioning (HVAC) systems and water heater heaters.

Opinion Dynamics, TECH's evaluator working under the California Public Utilities Commission, has developed an innovative "developmental" approach to evaluation that is a departure from the traditional "summative" methods that have been practiced for decades in California. With summative evaluation, results do not become available until many months after the program period. This makes course corrections difficult.

The current evaluation process of TECH has a three-pronged approach which provides real-time feedback to stakeholders called "Whole Independent System Evaluation," or WISE™.

These include 1. "Market Watch"; 2. "Program Watch"; and 3. "Technology and Policy Watch." Among the tools are surveys and interviews of participants, rapid-feedback surveys, metering devices attached to heat pumps, and consumption analysis.

This paper and presentation will provide a review of this evaluation approach through a literature and policy review, as well as interviews with key stakeholders, shedding light on how this evaluation approach is impacting TECH's development and progress.

I. Introduction

With a population of over 39 million people and a GDP that ranks it in size as the fourth largest economy in the world, California's sizable economy is driven by increasingly clean electricity and efficiently built buildings. California is widely recognized as one of the U.S.' clean energy leaders (ACEEE, 2025). While California's clean energy policies number in the hundreds, a few key laws, regulations, and programs summarize the history of clean energy in California.

(1) **Energy efficiency:** The California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) pioneered a raft of policies that led to billions of dollars spent on energy efficient technologies, as well as some of the most stringent building codes in the United States (US). (CPUCa)
(2) **Greenhouse gas reductions; Assembly Bill 32 (2006):** Assembly bill AB 32 from 2006 required California to lower greenhouse gas emissions to 1990 levels by 2020. According to the California Air Resources Board (CARB), this target was met 4 years ahead of deadline in 2016. (CARB 2022)
(3) **Customer-owned solar:** California's first major solar program, the California Solar Initiative (authorized by Senate Bill 1, 2006), was a market transformation program designed to incentivize customer-owned

solar systems from 2006 to 2016 (CPUC, 2016). In 2009, the Net Energy Metering bill (Assembly Bill 920) was introduced, which allowed customers to receive compensation for the solar energy they sold back to their utility (CPUCa, 2023)

(4) **Building Decarbonization: Assembly Bill 3232 (2018)** directs the CEC to develop a plan to cut GHG emissions from buildings 40 percent below 1990 levels by 2030. **Senate Bill 1477 (2018)** requires the CPUC to create an incentive program for building decarbonization in existing buildings, and the CEC to offer incentives to build near-zero emission affordable housing. One of the programs authorized, "Technology and Equipment for Clean Heating Initiative," or TECH, is the subject of this paper.

(5) **100 Percent Clean Energy: Senate Bill 100 (2018)** sets a 2045 goal of powering all retail electricity sold in California and state agency electricity needs with renewable and zero-carbon resources.

In addition, there are programs and policies that favor electric vehicles, offshore wind, demand response, and energy storage, all with the goal of supporting a low carbon energy market. There are also a number of programs directed at low-income customers so they are not left behind or outpriced from the energy transition (CEC, 2021). In summer 2024, California hit a milestone when it chalked up 100 days where the state was powered by 100% renewable energy for at least part of the day (Lazo, 2024).

A number of factors, including the costs of these programs, which are funded by utility ratepayers, have caused substantial increases in many residential and business electricity bills. As a result of this, Governor Gavin Newsom issued an executive order in October 2024 requesting the CPUC to "identify underperforming programs" and to return any unused energy program funds back to ratepayers (Newsom, 2024).

The Executive Order could be considered a wake-up call for all public purpose programs, how they are evaluated, how evaluation results are communicated, and what lessons other regions could learn. According to the state's Legislative Analyst Office, average residential electricity rates in California have grown much faster than inflation in recent years, rising by about 47 percent over the four-year period from 2019 through 2023 compared to overall inflation of about 18 percent in the same period (Cal LAO, 2024). While only a small percentage of these increases can be attributed to public purpose programs, they are often the first target for cuts by decision-makers. This is because they are viewed as non-essential for providing electrical service, even though they play a crucial role in reducing greenhouse gas emissions.

This paper will first introduce TECH Clean California (TECH), and then cover details of how TECH is being evaluated using the "Whole Independent System Evaluation" (WISE) method of developmental evaluation. It will conclude with a discussion of lessons learned for other market transformation efforts.

From Zero Net Energy to Zero Carbon – The Policy Shift to Building Decarbonization

The current template for energy efficiency public purpose programs was set in 2008 when the CPUC published the "Energy Efficiency Long Term Strategic Plan," which, over 12 chapters, outlined a strategic plan that is still used as a basis for its energy efficiency portfolio. The leading "Big Bold Goals" included all new residential construction being "zero net energy" (ZNE) by 2020, and all new commercial construction being ZNE by 2030. ZNE, in the Plan, is defined as "…a general term applied to a building with a net energy consumption of zero over a typical year…typically envisioned as connected to the grid, exporting electricity to the grid when there is a surplus, and drawing electricity when not enough electricity is being produced." (CPUC EE Strategic Plan, 2008).

While this definition explicitly defines the role of electricity, 64 percent of California homes are heated by natural gas furnaces and water heaters (US EIA, 2020). The role of gas in the ZNE equation was vague in the Plan, and how to account for them became controversial. These direct emissions from homes and commercial properties account for about 24 percent of California's greenhouse gas emissions (CARB 2025). In 2016, the California Energy Commission passed a residential building code that, among other things, required solar panels be installed on all new buildings starting 2020, thus fulfilling the Strategic Plan's requirement that new homes at least have the potential to be ZNE (CEC, 2021).

At the same time, in the late 2010's, California decision-makers began to turn their attention away from ZNE due to cost effective concerns. This is reflected in a Legislative Analyst's Office report, which states "We find that a mandate for state buildings to be ZNE is not a necessary or cost-effective way for the state to achieve its GHG reduction goals. This is largely because the state has already adopted a cap-and-trade program that limits total emissions from large emitters, such as electricity generators. So, a ZNE mandate will not necessarily reduce emissions more than would otherwise occur." (Cal LAO 2017).

At the same time, lawmakers turned their attention to a different metric rather than energy used on-site, which is the actual greenhouse gas emissions from buildings, thereby pivoting away from the ZNE goal. Indeed, it was widely acknowledged that ZNE was the wrong target since replacing gas-powered appliances—mostly furnaces and water heaters—with electric models necessitates a greater demand for electricity. This set the stage for the passage of the Building Decarbonization laws (number 4 in the list on page 2 above).

II. TECH Clean California

Implementation Team

In 2020, after the approval of its initial $120 million, multi-year budget, the CPUC issued a competitive solicitation to implement TECH, which was won by Oakland-based company Energy Solutions (ES). ES assembled a program team of 13 sub-contracting companies that are responsible for different aspects of the program, including workforce training, data analysis, marketing, regional pilots, and financing pilots (TECHa, 2025). Notably, one of TECH's subcontractors, Recurve, has a role of "…providing [utility] meter-based analysis (that is) the backbone of the TECH program." Recurve identifies "high opportunity customers," based on their prior electricity and gas consumption, and also quantifies program impacts by using this meter data (TECH, 2021).

TECH's Theory of Market Transformation

TECH is operating in a market that will need to be drastically transformed in order to reach the state's goals of 6 million heat pumps by 2030. As shown in Figure 1 below, this requires going from a low baseline (less than 10 percent) of market share to 50 percent, in the space of 9 years.

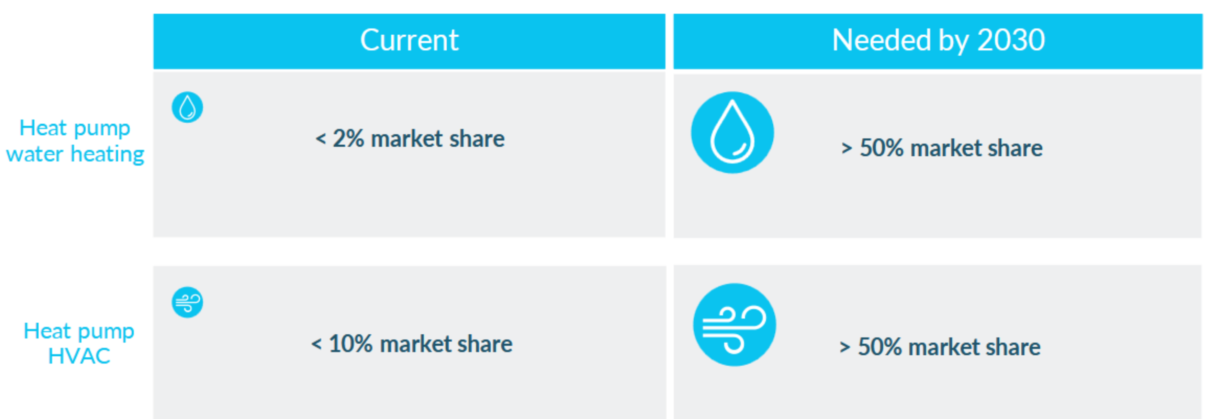

Figure 1. Chart from 2021 demonstrates need for market transformation (TECH 2021).

Branded to the public as "TECH Clean California," TECH has three broad pillars of activity that encompass their market transformation strategy. These are:

(1) Spur the clean heating market through statewide strategies. One of the most significant market barriers to heat pumps in California is a lack of knowledge among contractors. There are many accounts from customers who, when consulting with a contractor, are told that heat pumps aren't appropriate, or that they do not know how to install them. TECH is responding to this by training contractors on their installation, as well as having incentives go directly to contractors (TECHb, 2025). To date, 920 contractors have been trained on the installation and operation of heat pumps (TECHc, 2025). In addition, TECH is part-funder of a public-facing marketing campaign, "The Switch is On." The main features of the campaign's website are places for consumers to search for contractors, and to find out the available incentives in their postal code (Switch, 2025).

(2) Create scalable models through regional pilots. Because California is a young market for heat pumps, TECH has a portion of its budget dedicated to pilots to experiment with innovative approaches to market transformation. These have mostly been targeted at low-income customers. For example, in the Silicon Valley region, TECH is piloting an "inclusive utility investment" pilot where there is no upfront cost to the ratepayer for the appliances. The cost is recovered over time in small payments made on the customer's utility bill. This is one of the six regional pilots TECH is running (TECHd, 2025). Others are targeting permitting, customer targeting, load-shifting with water heaters, and pilots targeting low-income customers and those living in multi-family housing.

(3) Inform long-term building decarbonization framework. The TECH Clean California website is the home to a dashboard which makes public all types of data with regard to the heat pump market in California. TECH tracks data for heat pump sales in its program, and through other programs as well. The site, TECHCleanCA.com, includes a map where one can view activity at the county level, statistics on costs of heat pump installations as well as their cost per ton of cooling capacity (TECHe, 2025)**.** According to the staff at Energy Solutions, the goal of the data platform is to create the conditions for decarbonization to become an investment-worthy commodity. According to program manager Teddy Kisch, interviewed for this paper, "When I invest in a thousand heat pump decarbonization projects, with these parameters, this is the portfolio I would expect, or this is the kind of portfolio I see. We want to get to a public, investable understanding of how different parameters influence decarbonization, because we want to get to a level of scale and funding where this is like a commodity we can invest in."

III. TECH's Funding Sources

TECH was initially envisioned by the California legislature as a market development program with a strategy leading towards reducing greenhouse gas emissions. In the four years since it was launched, it has evolved into a market transformation platform through which other programs targeting clean heating are using. The result is high levels of funding that have been "bolted on" to the initial tranche approved in 2018. TECH now encompasses the following funding sources:

(1) TECH's initial funding. $120 million was approved in Senate Bill 1477 in 2018 for market transformation activities for "Technology and Equipment for Clean Heating." This triggered a competitive solicitation in 2020, won by Energy Solutions. The funding came from the revenues of California's cap and trade auction (Stern, 2018). The program launched in early 2021, with incentives launching in December of 2021. Per the enabling law, TECH is being evaluated for the market share of eligible technologies, projected utility bill savings, and cost per metric ton of avoided greenhouse gas emissions (ODCa, 2022).

(2) Self-Generation Incentive Program (SGIP). This long-standing program is predominantly intended to provide incentives for customer-side generation and storage. Because water heaters act as a form of load-shifting energy storage, the CPUC approved a tranche of funding limited to grid-enabled heat pump water heaters. Per the parameters of the program, this part of TECH's funding is being evaluated on the total greenhouse gas reductions achieved by reductions in therms or kilowatt hours, and the peak reduction benefits compared to a non-load shifting heat pump water heater (HPWH) (Verdant, 2023).

(3) 2023 Funding Augment. Responding to the popularity of the first year of TECH, the CPUC approved an additional $50 million of funding in February 2023, again using cap-and-trade auction revenues (CPUCb, 2023).

(4) Greenhouse Gas Reduction Fund. The California Air Resources Board awarded $95 million to TECH in July 2023 through California's Greenhouse Gas Reduction Fund (GGRF). These funds come from the revenues of California's cap and trade auction (CARB, 2025).

(5) High-Efficiency Electric Home Rebate Act (HEEHRA). In 2022, President Joe Biden signed into law the sprawling Inflation Reduction Act. Part of the funding went towards HEEHRA, which is intended to provide rebates for efficient heat pumps. $35 million of these funds were made available for rebates through TECH, and the TECH staff set up an on-line portal to administer the rebates (TECHf).

IV. TECH's Data and evaluation methods

The lead evaluator for TECH is Opinion Dynamics Corporation (ODC), an evaluation consultancy with headquarters in Massachusetts and offices throughout the U.S., including two in California. ODC's evaluation of TECH is managed by staff of the CPUC. ODC is using a developmental evaluation approach, which they have trademarked as "Whole Independent System Evaluation," or WISE, which includes collection and analysis of data that "…allows us to adapt our approaches early in the program design and implementation process and provide insights at key decision points. This approach favors developing relationships with Energy Solutions and its sub-contractors from the start, so as to synchronously infuse evaluation insights into every step of program design and implementation" (ODCb 2022). Figure 2 below illustrates the components of TECH's developmental evaluation. ODC is also evaluating the performance of TECH against the metrics required by the state, and must report the annual performance of the program to the California Air Resources Board, who are the stewards of cap and trade funds.

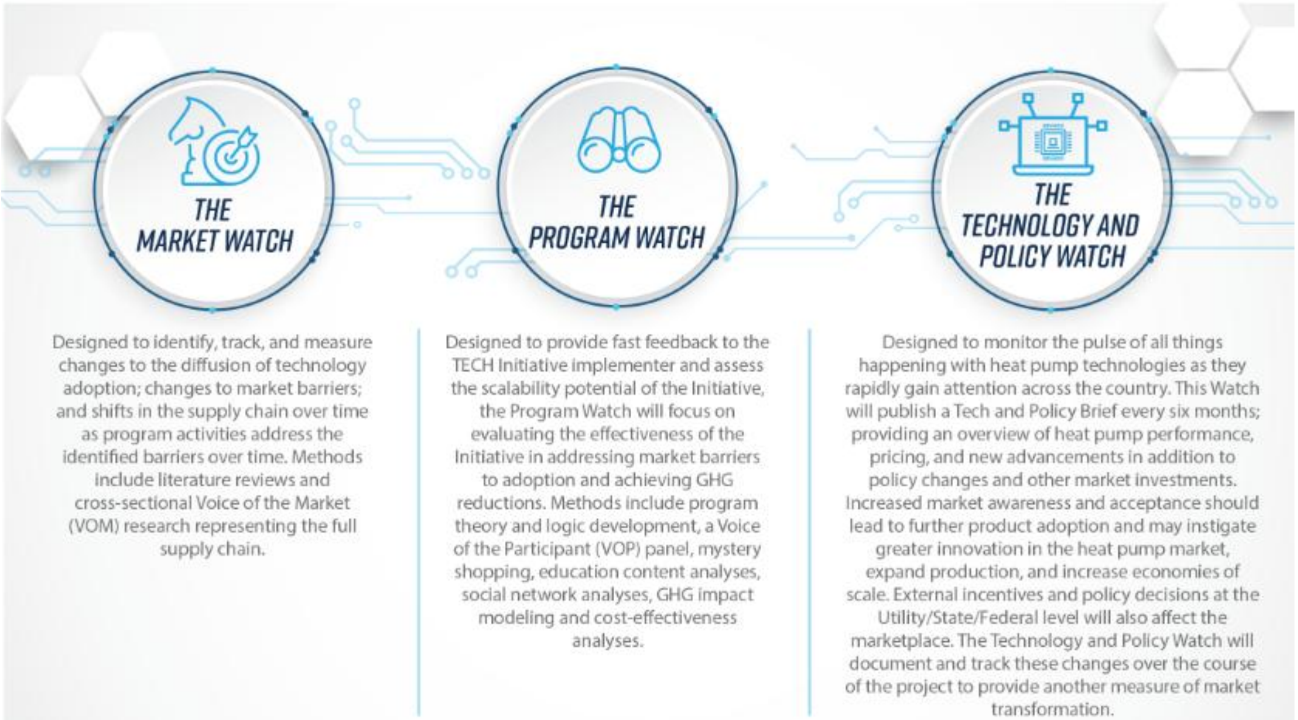

Figure 2. TECH Evaluation Areas (ODCb, 2022).

Developmental Evaluation

The conceptual framework of ODC's evaluation approach for TECH was inspired by the work of Michael Quinn Patton, who is the architect of a method called "Developmental Evaluation" (DE). DE is uniquely suited to "… innovation, radical program re-design, replication, complex issues, and crises" (Better Evaluation 2025). According to Quinn-Patton, "Developmental Evaluation supports innovation development to guide adaptation to emergent and dynamic realities in complex environments. Innovations can take the form of new projects, programs, products, organizational changes, policy reforms, and system interventions. A complex system is characterized by a large number of interacting and interdependent elements in which there is no central control. Patterns of change emerge from rapid, real-time interactions that generate learning, evolution, and development – if one is paying attention and knows how to observe and capture the important and emergent patterns. Complex environments for social interventions and innovations are those in which what to do to solve problems is uncertain and key stakeholders are in conflict about how to proceed" (Quinn-Patton, 2010).

Table 1 below summarizes the key differences between traditional and developmental evaluation approaches.

Differences Between Traditional and Developmental Evaluation Approaches		
	Traditional Evaluation	**Developmental Evaluation**
Purpose	Supports improvement, summative tests, and accountability.	Supports development of innovation and adaptation in dynamic environments.
Roles & relationships	Positioned as an outsider to assure independence and objectivity.	Positioned as an internal team function integrated into the process of gathering and interpreting data, framing issues, surfacing and testing model developments.
Accountability	Focused on external authorities and funders based on explicit and pre-ordinate criteria.	Centered on the innovators' values and commitment to make a difference.
Options	Rigorously options-focused, traditional research and disciplinary standards of quality dominate.	Utilisation focused; options are chosen in service to developmental use.
Measurement	Measure performance and success against pre-determined goals and SMART outcomes.	Develops measures and tracking mechanisms quickly as outcomes emerge; measures can change during the evaluation as the process unfolds.
Evaluation results	Detailed formal reports; validated best practices, generalisable across time and space. Can engender fear of failure.	Rapid, real-time feedback; diverse, user-friendly forms of feedback. Evaluation aims to nurture learning.
Complexity & uncertainty	Evaluator tries to control design implementation and the evaluation process.	Learning to respond to lack of control; staying in touch with what's unfolding and responding accordingly.
Standards	Methodological competence and commitment to rigour, independence; credibility with external authorities and funders; analytical and critical thinking.	Methodological flexibility eclecticism, and adaptability; systems thinking; creative and critical thinking balanced; high tolerance for ambiguity; open and agile; teamwork and people skills; able to facilitate rigorous evidence-based perspectives.

Table 1: Differences between traditional and developmental evaluation approaches. (Better Evaluation).

TECH is uniquely suited to this approach. The state's policies call for a dramatic shift in the way people's homes and water are heated, at a time when many other changes are taking place in the midst of a clean energy transition. Because it is a market transformation effort at a time when the heat pump market is in a nascent stage, there are many stakeholder groups that must adjust to the push for electrification (home-owners, contractors, local governments, energy service providers). TECH is much different from the traditional summative energy efficiency programs that are evaluated primarily for their energy savings and net-to-gross ratios.

Additional complexity has occurred because of the different funding streams of TECH, each with their own funding goals and reporting requirements. Funding streams, and their tendency to become quickly exhausted, have also meant that program activity has stopped and started over the course of TECH's life, making measurement of effectiveness more difficult. While TECH is the largest platform for heat pump incentives in California, there are numerous other entities in California providing incentives and rebates as well: local governments, regional energy service providers, utilities, and others. This adds to the complicated landscape.

V. Methods

To assess the effectiveness of the WISE approach and the overall approach to data collection and management within TECH, the authors reviewed evaluation reports, relevant policy and law, literature regarding developmental evaluation, as well as interviewed the following stakeholders. Interviews were all conducted in January 2025:

- **California Public Utilities Commission**: Sebastian Sarria, lead analyst for TECH on behalf of the State of California
- **Energy Solutions**: Teddy Kisch and Evan Kamei, TECH program managers
- **Opinion Dynamics**: Jennifer Loomis, consultant; Jayden Wilson, director (lead evaluation staff for TECH)
- **Recurve**: Alex Pollard, Director of Strategic Projects (lead for TECH-related work)

All of the interview subjects and the authors of this paper played, or continue to play, formative roles in the development, oversight, management, and evaluation of TECH. Much of this paper reflects their first-hand experience.

VI. Developmental Evaluation in Practice

In practice, the WISE developmental approach has included regular meetings with staff of Energy Solutions, CPUC staff, and when appropriate Energy Solutions' sub-contractors, as well as a consistent flow of independent research.

The approach and philosophy was summarized by the staff of Opinion Dynamics in the aforementioned interview, "Why continue to have the same mistakes throughout the 3 or 4 years instead of getting those learnings and being able to send them back and get them enacted on? Sometimes we write reports, but we've already been talking to ES about things we're finding. So that by the time we write the report with the recommendations, the recommendations have already been instituted.

"When you're coming at the end conducting summative evaluation, you try to learn about the program, but typically what you learn is how the program ended, not how it evolved over time. One of our clear roles, given the spirit of market transformation, is to codifying what's changed and why, so we have that kind of best practices and lessons learned thread. That's hard when you come in at the end to try to go back and reconstruct, like you're reconstructing a baseline. It is very much in these newer pilots, market transformation programs in emerging areas, that this approach is particularly salient for."

The following deliverables can be found on the TECH website at the web page referred to below (TECHg, 2025). In the spirit of Developmental Evaluation principles, these studies are designed to guide TECH's program design, and are not program evaluations. They are simultaneously informing California's energy efficiency programs, which are funded through a different budget. As they are available to the public, they also have the potential to guide the California heat pump market at-large.

- *Water Heater Market Characterization* studies which, periodically, provide "…a strategic understanding of the state's water heater market, including business models, pricing strategies, hiring practices, contractor behaviors, and the current training landscape."
- *Residential Building Decarbonization Technology and Policy* brief. A report that summarizes, with bold graphics, market and policy trends affecting the heat pump market.
- *California Heat Pump Market Characterization and Baseline* study. The study also explores the opportunities and barriers of integrating heat pumps into new construction as well as best practices from mature programs.

- *TECH Baseline Market Assessment* of the residential space- and water-heating retrofit market in California as it relates to heat pumps. It describes the market conditions in California before the TECH Initiative incentives began.
- Consumer surveys which were distributed to single-family homeowners in two groups: one group representing a sample of the general public, and one group who received a TECH-incented heat pump on a biweekly basis. The purpose of these surveys is to understand decision-making and gauge satisfaction among TECH customers with contractor and installation.
- Post-training surveys. ODC published two sets of findings from post-training surveys fielded after contractors completed trainings through TECH. These were conducted with the goal to understand attendee's satisfaction with the training and its impact to their work and business.
- *TECH Incremental Cost Study.* This included an HVAC contractor survey including cost quotes and bid packages, providing a better understanding of the costs of replacing various heating and cooling equipment to get a baseline.
- *TECH Engineering Desk Reviews*. This report summarizes the findings from engineering desk reviews conducted for a sample of TECH Clean California projects. ODC completed 81 reviews for a sample of incentivized HVAC heat pump and heat pump water heater projects.
- Real-time circuit monitors on a subset of participant homes, shared publicly. These are providing real time information regarding energy usage in about 75 different homes.

VI. Results

Based on this review, we have found that the DE approach of used by ODC has led to some significant course corrections within TECH, as well as some innovative evaluation and data collection approaches. These all occurred with enough time for Energy Solutions to quickly implement the suggested improvements. According to ODC staff, "A lot of these little changes we're talking about were just that—little changes. Little things that could be addressed, like adding another data field (in a database). It's just so silly not to have that voice in the beginning so you aren't addressing missing data needs in a summative evaluation." These include:

(1) In 2024, ODC installed about 75 circuit monitors on individual heat pump appliances. The goal of these is to track how heat pumps actually operate in people's homes across California's climate zones. These data will be used to target customers and the regions that will most benefit from heat pumps. The meters can track device-level usage data down to less than one minute. This task was delayed due to concerns of sharing the customer's data publicly. However, once the sample of customers was asked if they would like to participate in having one of these devices, almost all of them agreed to it, even though the customer's address and device's energy use data would be shared with the public.

(2) In 2024, ODC published a water heater market characterization study. This was pivotal especially as getting water heater installers to switch from gas-powered water heaters to heat pump models is critical to the success of TECH. Yet there was not a lot of information regarding who installs water heaters, whether gas or electric. Among the key findings of the study is that more than half of California's water heaters are installed by the resident of the home, not a paid contractor, which is an important market characteristic to know when designing a water heater market transformation program (ODC, 2024)

(3) In 2023, ODC conducted a web usability study for the public marketing website "The Switch is On," which targets consumers. Based on the study, ES and their subcontractor Building Decarbonization

Coalition (BDC) made changes to the website. ODC found that the data from the "Switch is On" was owned by a third party that was contracted to run and manage the site by TECH's subcontractor BDC. This meant that important website-user data was not available to ES or Opinion Dynamics. Due to this finding, BDC took over ownership of the website, and is now collecting the data.

(4) ES reports using the semi-annual "Market Watch" studies (about the heat pump market) as well as the frequent customer satisfaction surveys fielded by ODC. According to Teddy Kisch of ES, "I use that data on a weekly or monthly basis at minimum. We're in a new space—this is about rapid iteration. If we want to figure out a question like, How important is the role of financing in water heating vs. HVAC? Or, how many customers are considering solar? Why are people buying water heaters vs. HVAC? There are so many questions when you want to design something. I review (their reports) in almost every presentation I'm giving or discussion or thought of how we might want to iterate on the program to refresh how customers or the market perceive things."

(5) Soon after TECH's launch, ODC identified that trainings for contractors were difficult to access on TECH's website, according to surveys conducted of the contractors. This information was greatly improved and better organized after ODC's findings were shared. It is now easier to see what trainings are available, and there is a calendar that has all of the available trainings in one place.

(6) Using data of orders taken by contractors, ODC found that contractors were not collecting customers' email addresses, nor were they recording whether or not the home had solar panels. ODC reviewed and made improvements to all of the questions that customers were being asked as part of the program application, while keeping in mind the hazard of burdening the questionnaire with too many items.

These are a few representative examples. A complete library of ODC's output is available on the TECH website (TECHh, 2025).

VII. Lessons Learned and Recommendations

Based on our survey of available data and interviews of key TECH stakeholders, the authors find the following:

(1) Developmental evaluation is especially appropriate for pilots and market transformation programs. Evan Kamei from Energy Solutions explained it, "Developmental evaluation is more like having a tutor than having a teacher—if you're going to take an exam at the end of the year, whatever grade you get you get, but having developmental evaluation makes you feel like you have a tutor where you get an assessment to see where you're at, and get you from a C to an A by the end of the year."

(2) There is a high amount of buy-in and confidence that ODC's approach is beneficial to the program. According to Teddy Kisch of Energy Solutions, "The TECH implementation team is probably the single biggest user of Opinion Dynamics' work to better understand the market and make improvements, and I leverage their work very frequently to guide our implementation efforts. And fundamentally, that's what you'd want out of an evaluation process, rather than a shelved report to check a box. In fact, I recommended this real-time evaluation approach to a few other agencies throughout the U.S. that are scaling up their decarb efforts."

(3) No stakeholder that we interviewed found that there was any perception of conflict of interest between ODC and the TECH implementation team. Parallel to the developmental work, ODC provides independent, third-party evaluation for TECH which is reported to the agencies overseeing the program.

(4) All stakeholders agreed that access to utility meter data is critical when a program's goal is to transform a market. For TECH, the involved agencies, implementer, and evaluator spent years after program launch getting the data platform up and running. The CEC hosts a data repository of customer data. According to Jayden Wilson of ODC, "CEC's data repository has the potential to be the holy grail. It is a great process. We are in the final stages of our first population level consumption analysis. It's the foundational source for so many different types of analyses."

(5) Roles and responsibilities of involved entities need to be clearly conceived of and communicated. Both ODC as well as Recurve are collecting and analyzing program and customer data. However, staff of ODC and the CPUC expressed frustration and confusion about which of these two are playing what role, and there is some concern that ratepayers are funding duplicative efforts. This has persisted since ODC initiated their contract in 2022.

(6) Do not underestimate the willingness of customers to volunteer their usage data for public interest research, especially after receiving a generous incentive for the appliance. With the 75 individual metering devices placed on heat pumps in peoples' homes, most of the program participants who were asked agreed to share their data.

VIII. References

American Council for an Energy Efficiency Economy (ACEEE). (Retrieved January, 2025). *State Scorecard Rank*.

Better Evaluation Knowledge website. (Retrieved in March 2025). *Developmental Evaluation*.

Better Evaluation Knowledge website. (Retrieved in July 2025). Developmental Evaluation – Methods and Approaches

California Air Resources Board (CARB). (2022). *AB32 Climate Change Scoping Plan*.

California Air Resources Board (CARB). (Retrieved July 2025). 2022 GHG Emissions by Main Economic Sector

California Air Resources Board (CARB). (Retrieved March 2025). *Funding Guidelines for Agencies that Administer California Climate Investments.*

California Energy Commission (CEC). (2021). *Clean Energy Almanac*

California Energy Commission (CEC). (2021). *2022 Building Efficiency Standards*.

California Energy Commission (CEC). (2022). *"Final 2021 Integrated Energy Policy Report*."

Legislative Analyst's Office (LAO). (2017) Evaluating California's Pursuit of Zero Net Energy State Buildings.

California Legislative Analyst Office (Cal LAO). (January 7, 2025). *Assessing California's Climate Policies—Residential Electricity Rates in California*.

California Public Utilities Code (1996). *Section 381 (Public Goods Charge), created by Assembly Bill (AB) 1890 (Statutes of 1996)*

California Public Utilities Commission (CPUC). (2016). *California Solar Initiative (CSI)*.

California Public Utilities Commission – EE Strategic Plan. (2008). Energy Efficiency Strategic Plan

California Public Utilities Commission (CPUCa). (2022). Energy Efficiency webpage.

California Public Utilities Commission (CPUCb). (April 7, 2022) *CPUC Provides Initial Incentives and Framework for Electric Heat Pump Water Heaters.*

California Public Utilities Commission (CPUCa) (2023). *Net Energy Metering and Net Billing.*

California Public Utilities Commission (CPUCb). (February 2, 2023). *Decision Adopting New Funding Pursuant to Assembly Bill 179 for the Technology and Equipment for Clean Heating Initiative.*

Lazo, Alejandro. (August 19, 2024). Cal Matters. *California hits milestones toward 100% clean energy — but has a long way to go.*

Newsom, Gavin. (October 20, 2024). Press Release. *Governor Newsom Issues Executive Order Tackling Rising Electric Bills.*

Opinion Dynamics Corporation (ODCa). (November 7, 2022.) *Interim Process Evaluation of the Clean Heating (TECH) Initiative*. Page 1.

Opinion Dynamics Corporation (ODCb). (February 25, 2022.) *Evaluation of Technology and Equipment for Clean Heating (TECH) Initiative.* Pages 2 - 4.

Opinion Dynamics. (March 29, 2024.) *California Water Heater Market Characterization*. Page 9.

Quinn-Patton, Michael. (2010), *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use.* Guilford Press.

Stern, Senator Henry. (2018) California Legislature. *Low-emissions buildings and sources of heat energy*.

Switch is On website (Switch). (Retrieved in March 2025.) *Main Page.*

TECH Clean California website (TECHa). (Retrieved 2025). *About.*

TECH Clean California website (TECHb). (Retrieved in March 2025). *Our Approach*.

TECH Clean California website (TECHc). (Retrieved in March 2025). *Contractor Data*.

TECH Clean California website (TECHd). (Retrieved in March 2025). *Tariffed On-Bill Pilot.*

TECH Clean California website (TECHe). (Retrieved in March 2025). Heat Pump Data.

TECH Clean California website (TECHf). (Retrieved in March 2025). *HEERA Rebate Verification Portal.*

TECH Clean California website (TECHg). (Retrieved in March 2025). Heat pump data evaluation studies.

TECH Clean California website (TECHh). (Retrieved in March 2025). TECH Evaluation Studies.

TECH Clean California website (TECH). (August 2021). *TECH Quarterly Stakeholder Meeting slide deck*.

U.S. Energy Information Agency (US EIA). (2023.) *Highlights for Space Heating in U.S. Home by State, 2020*. (Page 1)

Verdant Associates. (November 18, 2023). Self-Generation Incentive Program. Heat Pump Water Heater Program Evaluation Research Plan.