Opinion Dynamics

Energy Efficiency Residential Pulse Check

FINAL Report

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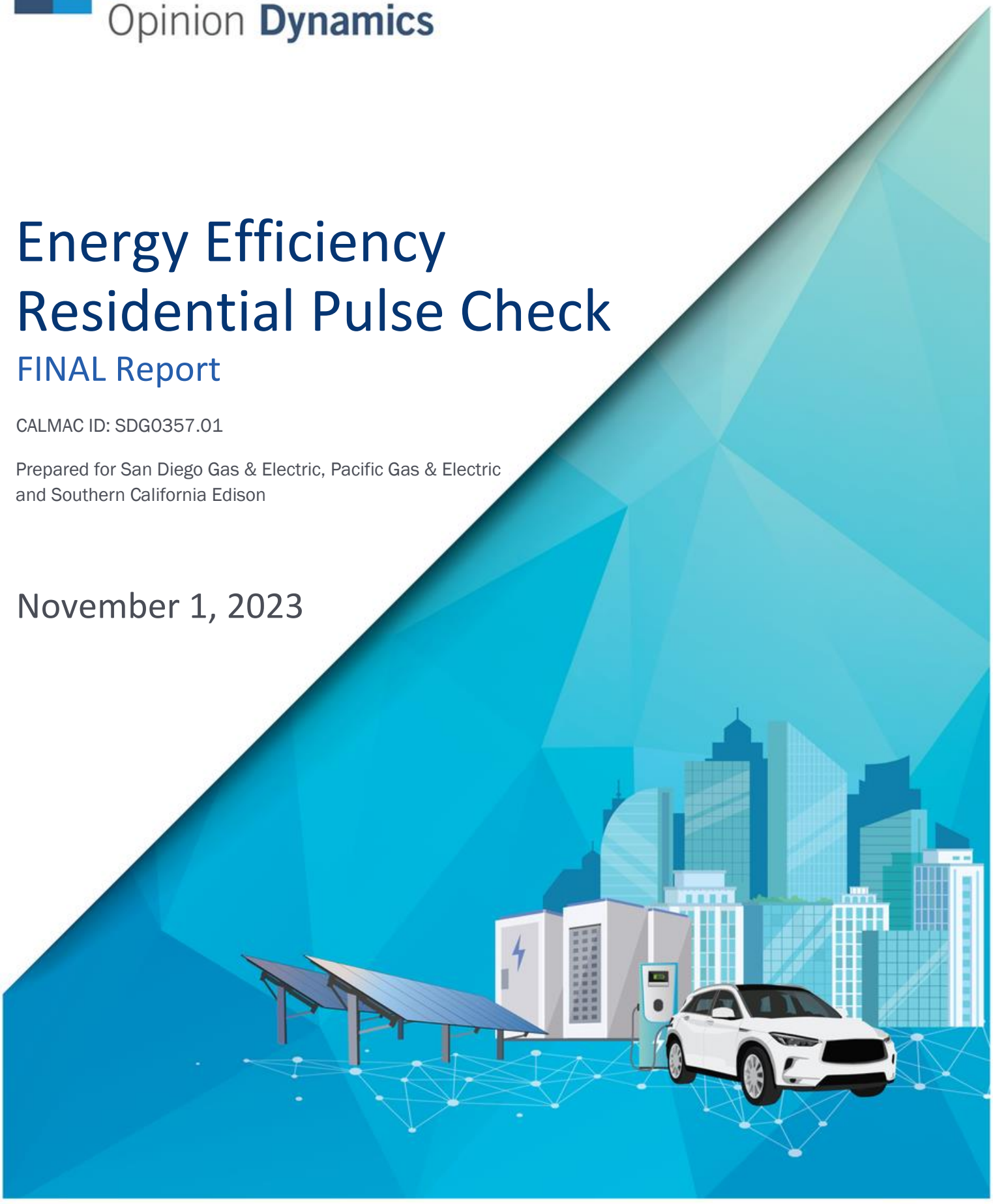

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1. Executive Summary

This study describes the energy efficiency needs and priorities of non-low-income, residential customers in single-family and manufactured and mobile homes within the three California Investor-Owned-Utility (IOU) electric service territories: Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). While the focus is on electricity, gas is not excluded. Further, the research focuses on resource acquisition program opportunities. The purpose of this study was to fill gaps in existing knowledge about wants, needs, and general characteristics of residential customers to assist program planners and third-party (3P) implementers to develop new and more effective residential offerings for customers. Specifically, this study explored the following:

1. Energy needs and priorities of residential customers;
2. Ways current programs are meeting customer needs;
3. Most effective ways to engage with residential customers; and
4. Barriers and opportunities for new programs or service offerings.

1.1 Methods

The study findings are based upon three distinct data collection activities:

- **Literature Review (Landscape Analysis):** Included IOU program annual reports, plans, budget filings, CPUC savings potential estimates, California emerging technology programs, and relevant market studies available as of August 2022.
- **In-Depth Interviews (Landscape Analysis):** Documented perspectives on the market with Program Administrators and Implementation staff as of September 2022.
- **Customer Pulse Check Survey:** Captured perceptions and attitudes directly from customers in May and June 2023.

The literature review and in-depth interviews informed a landscape analysis, which fully or partially answered some research questions. The landscape analysis then informed the development and fielding of a statewide Pulse Check survey with 900 residential customers to fill in knowledge gaps.

1.2 Conclusions and Recommendations

The purpose of this study was to fill gaps in existing knowledge about wants, needs, and general characteristics of residential customers to assist program planners and third-party (3P) implementers to develop new and more effective residential offerings for customers. As such, we encourage program planners and 3P implementers to review the detailed findings in this report during program planning and redesign stages as relevant.

The following sections provide our conclusions and recommendations, given the full breadth of the findings from this study, organized by research objective.

1.2.1 Energy Needs and Priorities

Customers' greatest energy burden is heating or cooling needs in the home, but customers do not prioritize equipment replacement until their existing unit reaches end-of-life. Roughly one-third (36%) of Pulse Check survey respondents said cooling was the greatest source of electricity consumption in their home and 47% said heating was the greatest

source of gas consumption in their home. Staff interviews conducted as part of the landscape analysis confirmed most customers enter existing energy efficiency programs when their equipment fails and they need a replacement. Interviewees said a large motivating factor for customer decision-making related to new equipment purchases is when current equipment reaches its end of useful life, or "breaks." Customers want a replacement "right now" rather than later. This is especially true with furnaces, air conditioners, and water heaters.

- **Recommendation:** Programs should focus on how customers can control and reduce heating and cooling usage (through smart thermostats or behavioral programs) while also providing resources at times when equipment fails and there is an opportunity to install more efficient equipment. Ensure the market is ready with energy-efficient options at the time of customer need. This includes proactively engaging with distributors and retailers to ensure energy-efficient equipment inventory is stocked and available when customers seek it. Additionally, this includes training and education to ensure contractors are bringing up energy-efficient equipment options when called by customers for a replacement.

Most customers monitor their usage by reviewing their energy bill monthly and are at least somewhat concerned with monitoring their usage. Most Pulse Check survey respondents (86%) reported tracking their home's energy usage by looking at their monthly energy bills; however, more than half of respondents (54%) indicated being at least "somewhat interested" in an online utility account connected to an AMI meter to support energy monitoring for their home. All three electric IOUs included in the study offer online utility account information to customers to monitor their energy bills. However, in the Pulse Check survey, SDG&E respondents were significantly more likely than PG&E and SCE respondents to indicate they actually leveraged their online real-time utility account to monitor energy use. PG&E staff, during interviews conducted as part of the landscape analysis, indicated customers are not interested in engaging with the monitoring resources available to them (e.g., asking customers to log in to their accounts to see their energy use was a barrier). PG&E Pulse Check survey respondents were significantly more likely than SDG&E and SCE respondents to indicate that the monitoring tools at their disposal were hard to use.

Residential Customer Methods for Monitoring Home Energy Use

	Overall	Utility		
		SDG&E	PG&E (b)	SCE
n	924	315	309	300
Monthly energy bills	86%	83%	84%	89%
Online real time utility accounts	18%	27%	19%	15%
Other web-based tools provided by utility	14%	19%	14%	13%
Other management or monitoring systems	15%	19%	17%	9%
Other	3%	3%	4%	4%
Don't know	<1%	<1%	<1%	2%

Source: Pulse Check Survey

- **Recommendation:** There is an opportunity for programs to help customers monitor their energy usage on a more frequent basis so they can make changes to reduce usage and costs closer to real-time and experience the "cause and effect" on their monthly electric bill. Each month with their utility bill, remind customers of the availability of their online utility account to support their energy monitoring needs and encourage ongoing engagement. For easier access to the account, provide a direct click-through for digital bill customers to access their account when reviewing/paying their electronic utility bill. Provide a QR code for paper bill customers to have easy access to their online account.
- **Recommendation:** Add messaging regarding changes to monthly energy use directly to customers' energy bills (whether online or paper billing), since that is the most prominent source of energy monitoring information customers are using. Offer tips (akin to those available through home energy reports) directly to the bill advising how to reduce usage and/or energy costs that align with the customer's specific rate (whether time-varying or general service).

When customers need to replace their HVAC or water heating equipment, cost and "ease" are two large factors that determine the type of equipment they purchase. Findings across the landscape analysis and Pulse Check survey confirmed cost was the primary consideration when deciding on equipment to purchase. Literature review findings also suggest that the "hassle factor" or the ease in purchasing, installing, and using a technology is important when making replacement decisions. Because customers do not have a sense of urgency around the accelerated replacement of household appliances/equipment, programs need to "meet them where they are" and capture customer attention when they are in the market for equipment replacement. The Pulse Check survey found the four resources customers most frequently reference when purchasing HVAC and water heating equipment were a general web search (68%), contractors/equipment installers (66%), friends/family (46%), and retail stores such as Home Depot (41%).

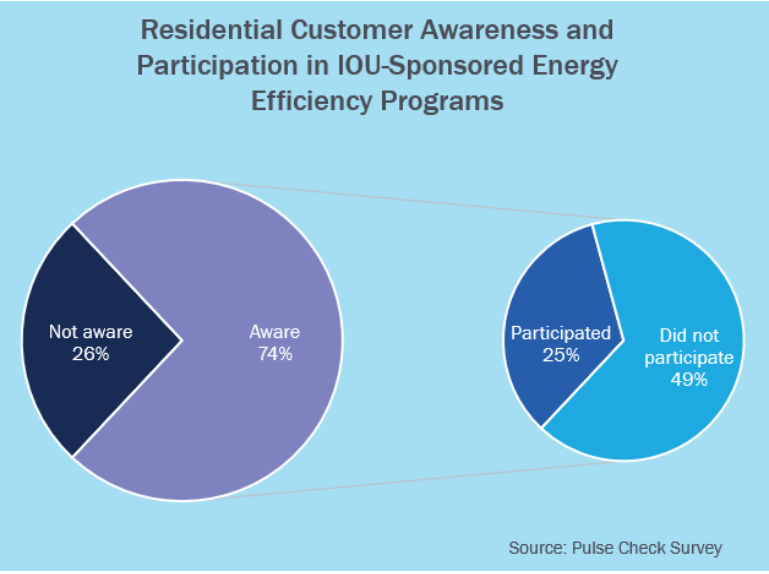
- **Recommendation:** Programs need to address the cost barrier with incentives and/or financing. Research and identify opportunities to bundle multiple funding/incentive sources, incorporating the recent influx of federal and state funding for energy efficiency upgrades (from sources such as the Inflation Reduction Act and Bipartisan Infrastructure Law), to further mitigate upfront cost barriers for customers.
- **Recommendation:** Address the "hassle factor" by providing easily accessible information on equipment options, costs, and benefits at the places where customers are currently researching options and purchasing this type of equipment. In addition to contractors (as previously mentioned), ensure relevant retail stores such as Home Depot and Lowe's have program materials accessible and training to educate retail floor staff to bring up energy-efficient equipment options when asked by customers for advice. Continue to prioritize investments in search engine marketing to ensure energy efficiency program information is easily accessible to customers in the market for new equipment.

While cost and "ease" are of higher importance to decision-making, environmental concerns are important to some, especially those who are currently interested in heat pump technology. Staff interviews conducted as part of the landscape analysis indicated the effects of climate change are noticeable already to customers in California and it is motivating some to reduce energy. The literature review included findings that explored motivations, specifically for installing heat pumps, and found saving energy and reducing carbon emissions were the top motivators.

- **Recommendation:** Include environmental themes in messaging as environmental concerns will likely grow in importance as residents continue to experience the impacts of climate change. Environmental themes may pair best with promotions targeting heat pump awareness/adoption.

1.2.2 Current Program Overlaps with Customer Needs

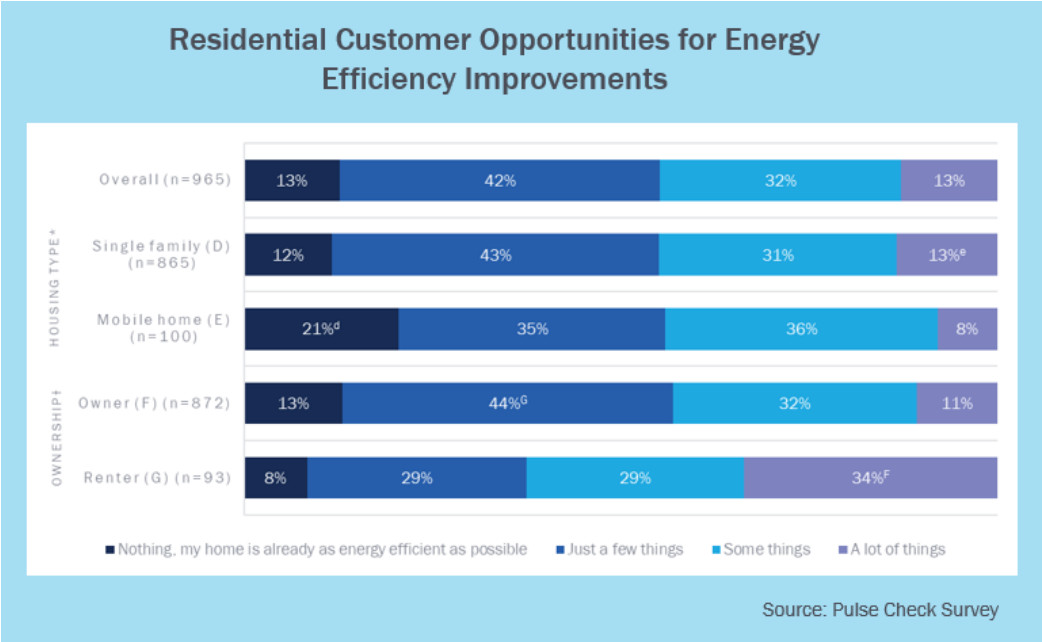
Program awareness is relatively high in the residential market, but participation is low partly because incentives are not high enough for customers to afford equipment or the equipment customers need is not covered by programs.



Three- quarters (74%) of Pulse Check survey respondents were aware of IOU-sponsored energy efficiency programs, but only one-quarter (25%) of those aware had participated in a program in the past two years. The literature review indicated financial constraints are the largest reasons customers cite for not being able to incorporate energy-efficient measures into their homes. Deeper, more comprehensive energy-efficient solutions (such as HVAC upgrades) can be costly for customers. The incremental cost of efficient products and the lack of access to (affordable) capital are both common barriers among residential customers. Of those Pulse Check survey respondents who were aware of energy efficiency programs but had not participated, eight percent said the programs did not meet their needs largely because the equipment they wanted to purchase did not qualify for a rebate or because the rebates were not high enough for them to afford the equipment. According to the landscape analysis, the IOUs' resource acquisition programs are held to cost-effectiveness tests which limit the incentive amounts they can offer and the type of equipment they can address. As such, the programs cannot address all customer needs and opportunities that could save energy, despite some measures being heavily aligned with California's energy transition goals (i.e., electrification). For example, the literature review revealed heat pump technologies are a high-risk measure category because their Total Resource Cost score is close to 1.0, even though heat pumps are a key element of California's energy transition plan.

- **Recommendation:** As ratepayer funded efforts, the programs should continue to strive for cost-effective offerings. Provide as much cost-effective direct assistance as possible and collaborate with other funding resources that can help address customer costs and equipment needs such as financing options (e.g., Go Green Homes).
- **Recommendation:** Advocate for exploration of customer benefits that go beyond energy savings and align with California's broader environmental goals. Emphasize the importance of considering these benefits in energy efficiency program cost-effectiveness frameworks. Some jurisdictions are looking to the Societal Cost Test (rather than Total Resource Cost test) to measure energy efficiency program cost-effectiveness for this reason. For example, New York allows consideration of carbon reduction benefits in its cost-effectiveness calculations for energy efficiency programs (through the Societal Cost Test) to prioritize alignment of energy efficiency advancements with the state's overall electrification goals.

Renters have more challenges with upgrading equipment and participating in programs than other customer segments. The Pulse Check survey revealed renters were less aware of IOU-sponsored programs and were less likely to have participated in a program than homeowners. Less than two-thirds of renters (64%) were aware of programs compared to 75% of homeowners. Similarly, only 14% of renters had participated in a program in the last two years while 26% of homeowners had. Renters typically need landlord approval to make energy-efficient equipment improvements; however, more renters responding to the Pulse Check survey identified having potential for energy efficiency improvements than homeowners (63% compared to 43%), likely because they do not have the decision-making authority to move forward with upgrades and replacements when they deem them necessary. Similarly, renters indicated in the Pulse Check survey they feel they have less control over their energy use than homeowners.



Source: Pulse Check Survey

Access to cooling, more so than energy efficiency, is a motivating factor for renters when choosing a place to live. In the Pulse Check survey, when renters were asked how important the cost of utilities was in their rental decision-making process, renters provided an average score of 6.6 (on a scale of 1, "not at all important", to 10, "very important"). Similarly, when asked how important it was to live in a place with energy-efficient equipment, respondents provided an average score of 6.8, on the same scale. These results suggest these considerations are important to renters but are not necessarily influences on decision-making. When asked to rate how influential given home features were on their decision to rent their current home (on a scale of 1, "not at all influential", to 10, "very influential"), neither the cost of utilities nor the presence of efficient equipment were among the most highly rate. The presence of cooling equipment was the most important home feature renters considered (6.9) followed by the presence of heating equipment (5.9). Because access to cooling may drive renter demand for properties, this could be a value proposition of interest to landlords to encourage engagement in IOU-sponsored programs (specifically, rebates for heat pumps or other efficient cooling equipment).

- **Recommendation:** Programs should make efforts to address the rental segment through landlords. Messaging focused on renter interest in cooling equipment may encourage landlords to invest in energy efficiency and participate in programs. For further engagement among the rental segment, and perhaps encourage accelerated replacement, consider bonus rebates for landlords who own multiple properties and are willing to replace equipment in multiple residences at once.

1.2.3 Effective Engagement

Customers had an equal preference for mail-in and direct-from-contractor incentive delivery models and sought in-person engagement for receiving heating, cooling, and water heating equipment recommendations. The landscape analysis revealed the IOU's existing program portfolio largely focuses on downstream strategies, but two Statewide programs employ a midstream strategy (for plug load and appliances as well as HVAC measures). The Pulse Check survey gauged customers' interest in various program delivery models, including a website where you receive a coupon to redeem at select retail or online stores (instant discount model), a discounted price through an installation contractor (direct-from-contractor or midstream model), and a rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application (mail-in or downstream model). Interest across the three incentive modes was very similar, ranging from 6.4 to 6.8 (on a scale of 1 "not at all interested" to 10 "very interested"). There was no difference in ratings when asked about the incentive delivery in terms of purchasing space heating and cooling equipment versus water heating equipment. Pulse Check survey respondents were also asked to rate (on the same scale) how interested they would be in the different ways their utility could provide them with assistance to address their HVAC and water heating needs the next time they are in the market for a new system. When presented with an IOU-sponsored at-home energy assessment, a phone consultation with an energy advisor (such as a virtual audit), and a website that collects information and recommends equipment options (such as an online audit), Pulse Check survey respondents indicated the greatest interest in the at-home energy assessment (rated 5.8 compared to 4.0 for the phone consult or 5.3 for the online audit). Like the incentive delivery results, respondents' ratings were consistent for both space heating/cooling and water heating end-uses.

Residential Customer Interest in Utility Offers that Provide Incentives on Energy-Efficient Equipment

	n	Instant Discount A website where you receive a coupon to redeem at select retail or online stores		Midstream Incentive A discounted price through an installation contractor		Downstream Incentive A rebate for the installed equipment where reimbursement for the rebate is mailed to you after you apply	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Space Heating and Cooling	834	6.4	3.4	6.6	3.2	6.8	3.2
Water Heating	838	6.4	3.3	6.5	3.3	6.7	3.2

Source: Pulse Check Survey

- **Recommendation:** Continue to offer both mail-in and direct-from-contractor (downstream and midstream) incentive delivery models to cover as much of the residential market opportunity as possible.
- **Recommendation:** Despite the added cost of in-person engagement, continue to offer at-home energy assessments as an effective way to engage and educate customers.

Mobile/manufactured home residents may be apprehensive about getting their ductwork assessed, even at no cost. The Pulse Check survey asked mobile/manufactured homes respondents about their interest in an IOU-sponsored offering where a professional would come to their home at no cost to assess the condition of the ductwork and repair/replace it at a discounted price. Respondents provided an average score of 4.8 on a scale of 1 "not at all interested" to 10 "very interested." Mobile/manufactured homes customers have a perception their ductwork is already in good condition and a lack of trust in programs/utilities providing this service. Approximately 85% of Pulse Check survey mobile/manufactured home respondents indicated their home had duct work. Over half of those with duct work (64%) indicated it was in good condition and there were no concerns. Only 13% indicated their duct work needed some level of repair and a small percentage (4%) indicated it needed to be replaced. According to the landscape analysis, lack of trust and interest are more pronounced barriers among mobile/manufactured home customers. Programs are

currently addressing trust barriers with mobile/manufactured homes customers through a door-to-door canvassing approach. The literature review revealed Californians have the highest level of trust in friends, family, and people at church. This demonstrates the importance of word-of-mouth referrals and actively engaging with community leaders when promoting energy efficiency programs to garner higher participation.

- **Recommendation:** Since word-of-mouth referrals garner trust, especially within designated communities, consider having past participants who successfully had their ducts assessed and replaced serve as ambassadors of a ductwork program for other mobile home residents in their community. Programs in other jurisdictions, such as Minnesota, have capitalized on the trust- and awareness-building that community blitz campaigns provide. Through a community blitz, all homes in a targeted community are approached with program information, typically through a community energy efficiency event. Satisfied program participants from the community (or neighboring communities) can provide testimonials of their experience at the event and answer questions from interested community members.

1.2.4 Barriers and Opportunities

Mobile/manufactured homes were less likely to have a smart thermostat than single-family customers and were less interested in trying one. Overall, 51% of Pulse Check survey respondents had a programmable thermostat and 17% had a manual thermostat (34% already had a Wi-Fi-connected smart thermostat). Mobile/manufactured home customers were statistically less likely to have a smart thermostat than single-family customers (25% compared to 35%); however, mobile/manufactured home customers were statistically more likely than single-family customers to indicate they were "not interested" in trying a smart thermostat (58% compared to 39%). Literature review findings suggest the mobile/manufactured home segment skews older and less "tech savvy." According to the Pulse Check survey, the average age of mobile/manufactured home respondents was 67 years where the average age of single-family respondents was 59 years. The literature review revealed mobile/manufactured home customers tend to resist trying new technology such as smart thermostats. They also tend to interact with cell phones and computers differently than other customer segments. The Pulse Check survey indicated mobile/manufactured home respondents were less likely than single-family respondents to have any smart monitoring/control technologies in their home (including smart plugs, occupancy sensors, smart home energy management systems, or in-home usage display technology). Staff interviews conducted as part of the landscape analysis indicated a direct-to-consumer approach is an effective way to reach mobile/manufactured home residents. Also, according to IOU staff, the opportunity to try an unfamiliar measure, such as a smart thermostat, can be an effective way to engage customers in energy efficiency programs and other ways to save.

Residential Customer Interest in Smart Thermostats by Housing Type

	Overall	Housing Type	
		Single family	Mobile home
n	613	539	74
Very interested	13%	14%	10%
Somewhat interested	27%	29%	14%
Slightly interested	18%	18%	19%
Not interested	41%	39%	58%

Source: Pulse Check Survey

- **Recommendation:** Mobile/manufactured home customer characteristics indicate a need for more hands-on education and instruction in addition to "free/direct install" methods that allow customers to try new technology. If deemed cost-effective, initiate a smart thermostat giveaway targeting mobile/manufactured homes customers paired with installation and education services for how to use the new measure.

Smart monitoring and control technologies are relatively new in the marketplace and not yet highly adopted by customers. No more than one-quarter of Pulse Check survey respondents indicated having any smart monitoring/control technologies. Overall, 24% of survey respondents indicated having smart plugs connected wirelessly to their phone/other display device, 20% had occupancy sensors/dimmers/smart outlets/voice controls connected to smart home devices, and 16% had an online utility account connected to an AMI meter (despite all IOUs offering an online utility account option to customers). Only 8% of respondents indicated having a smart home energy management system and 4% indicated having in-home display technology. The Pulse Check survey also asked respondents who did not own the referenced technologies how interested they were in trying each in the future. Overall, the technologies respondents indicated the highest interest in were an online utility account connected to an AMI meter (54%), a smart home energy management system (48%), and in-home display technology (47%). Interest in these technologies could grow with efforts to increase awareness of the energy-saving benefits associated with them.

- **Recommendation:** Consider efforts to capture existing customer interest in obtaining an online utility account connected to an AMI meter. All of California's IOUs offer this product for customers already. Make efforts to increase awareness and engagement among residential customers but promoting the online utility account available to them through common forms of media customers are consuming frequently: online video streaming services, online social media, and broadcast TV. Provide direct "click through" links and QR codes for easy accessibility for customers.
- **Recommendation:** Consider cost-effective opportunities to increase penetration of smart home energy management systems and in-home display technologies (since these are the smart monitoring/control technologies customers are most readily interested in). Utilities often pair these technologies with behavioral programs to increase opportunities for program benefits and help justify the cost of incentives or giveaways for these types of products. According to the literature review, most of California's energy efficiency potential exists in Behavior, Retro-commissioning and Operational Efficiency (BRO) programs which have historically saved 1%-2% annual savings through real-time feedback engagement with customers.

Penetration of heat pump technologies is low, but barriers are vast, including cost, awareness, interest, and need for additional construction to install the unit. Only 12% of Pulse Check survey respondents used an air source heat pump for space cooling/heating and less than 1% of respondents used a heat pump water heater. Among those who did not already use these technologies, a very large percentage of Pulse Check survey respondents had "never heard of them before" or "only knew of the name" (60% for air source heat pumps and 75% for heat pump water heaters). Overall, lack of interest in heat pump technologies was primarily tied to simply not being in the market for new equipment (55% for air source heat pumps and 51% for heat pump water heaters). Cost was the primary barrier to heat pump adoption (78% of customers cited cost as something that would keep them from considering air source heat pumps in the future and 73% for heat pump water heaters). A notable percentage of Pulse Check survey respondents indicated the need for additional construction to install heat pump technologies as a barrier to them considering these in the future (44% for air source heat pumps and 38% for heat pump water heaters), likely due to cost and "hassle factor" concerns.

Residential Customer Barriers to Selecting Heat Pump Equipment

	Heating/Cooling	Water Heating
n	872	965
Cost of equipment	78%	73%
Additional construction needed to install the unit	44%	38%
Limited data on the effectiveness of new technology	23%	15%
Noise level	21%	13%
Capacity of unit	19%	25%
Fewer contractors trained to install	7%	8%
Energy-efficient equipment less available and may have to wait to get the system installed	7%	7%
Fewer contractors trained to repair	7%	7%
No barriers	7%	9%
Other	2%	4%
Don't know	2%	0%

Source: Pulse Check Survey

- **Recommendation:** Programs encouraging heat pump technology adoption should address the full breadth of barriers discussed in this study. Generate greater awareness and familiarity with heat pump technologies through a statewide educational campaign so that heat pump technologies are top of mind for customers when they are in the market for new equipment. Invest in workforce education and training opportunities to ensure contractors are promoting and readily installing heat pump technologies. Jurisdictions, including Massachusetts, have been successful in employing community-based outreach campaigns to bring together community leaders, residents, and installers to increase awareness and penetration of heat pumps throughout the state.[1]
- **Recommendation:** Identify opportunities to layer incentives and financing for heat pump technologies to lower the upfront cost barrier for customers. Programs such as California's BUILD and TECH may offer added incentives for heat pump installations, especially if there are fuel switching benefits tied to the project.[2] Consider if there are incentives or financing that can be used to supplement the added costs of construction needed with heat pump technology installation, such as the cost of electrical panel upgrades or aesthetic renovations to accommodate the new equipment in the home (covering piping, etc.). Make sure contractors are trained to inform customers of these added incentive/financing resources available to them.

[1] https://www.masscec.com/program/heatsmart-mass

[2] docs.cpuc.ca.gov/PublishedDocs/Published/G000/M421/K107/421107786.PDF

2. Introduction and Overview

Currently, "the residential sector accounts for 17 percent of the state of California's energy consumption. The sector is comprised of more than 14 million single- and multifamily homes that house more than 39 million Californians. California investor-owned utilities (IOUs) account for approximately three-quarters of the electricity supply in the state."[3]

This study describes the EE needs and priorities of non-low-income, residential customers in single-family and manufactured and mobile homes within the three California IOU electric service territories: Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. While the focus is on electricity, gas is not excluded. Finally, the research is limited to resource acquisition program opportunities. Demand response, renewables, and electrification are not considered. This analysis explores the following:

1. Energy needs and priorities of residential customers;
2. Ways current programs are meeting customer needs;
3. Most effective ways to engage with residential customers; and
4. Barriers and opportunities for new programs or service offerings.

This analysis is based upon three data collection activities:

- **Literature Review:** Included IOU program annual reports, plans, budget filings, CPUC savings potential estimates, California's technical reference manual, California emerging technology programs, and relevant market studies
- **In-Depth Interviews:** Documented perspectives on the market with PAs and 3P staff
- **Customer Pulse Check Survey:** Captured perceptions and attitudes directly from customers

Findings from the literature review and interviews were combined into a landscape analysis. The full landscape analysis is included in this report as APPENDIX A. Demographics for the Pulse Check survey respondents are provided in APPENDIX A. The Pulse Check survey instrument is provided in APPENDIX C. A full survey analysis workbook is provided in APPENDIX D.

2.1 Study Purpose

The purpose of this study was to fill gaps in existing knowledge about wants, needs, and general characteristics of non-low-income residential customers (specifically, homeowners of detached single-family and manufactured/mobile home dwellings) and provide 3P program designers a "pulse check" on the residential program landscape.[4]

[3] Impact Evaluation of Home Energy Reports Residential Sector – PY2018, p. 5
[4] Residential Energy Efficiency Programs Pulse Check Research Plan, July 26, 2022

Table 1. Research Objectives and Questions

Overarching Research Objectives	Research Questions
Research Objective 1: Identify energy needs and priorities of residential customer segments and how they vary for different customer segments	a. What are the customers' energy needs and priorities?
	b. What impact, if any, has COVID-19 had on their needs and priorities?
	c. What factors motivate customer decision-making when it comes to new equipment purchases or upgrades?
Research Objective 2: Identify ways in which the overall market of current programs is not meeting customers' needs	a. What program offerings are currently available to residential customers in single-family, mobile, and manufactured homes?
	b. To what extent have these customers been served by current EE programs?
	c. What are the residential customer segments, if any, that are not being served by current residential EE programs?
Research Objective 3: Identify the most effective ways to engage with residential customers in single-family, mobile, and manufactured homes	a. Which distribution channels (retail, midstream, etc.) have been the most successful at reaching residential customers? How does this differ by customer type (e.g., Disadvantaged Community [DAC]/Hard-to-reach [HTR])?
	b. When programs employ multiple communication methods, which communication method has resulted in the highest customer participation for each customer type?[5]
	c. What types of programs/offerings are participants most interested in?
Research Objective 4: Identify barriers and opportunities for new measures or services	a. What challenges do customers face in reducing/monitoring/controlling their energy use and demand?
	b. What behavioral, decision-making, or market barriers do customers living in single-family, mobile, or manufactured homes face? What relationships exist, if any, between these barriers?[6]
	c. Which types of customers are not participating in EE programs and why?
	d. What opportunities exist for new measures that address unmet needs of residential customers (e.g., new services, technologies)?

2.2 Background

The regulatory policies regarding EE, renewables, and carbon reduction have evolved rapidly and become more aggressive in recent years. In 2006, California Assembly Bill (AB) 32 established a comprehensive program to reduce greenhouse gas (GHG) emissions from all statewide sources to 1990 levels by the year 2020. This goal represented a statewide reduction of approximately 30%. In 2015, California State Bill (SB) 350 increased California's renewable electricity procurement goal to 50% by 2030. In addition, SB 350 required the State to double statewide savings in electricity and natural gas end uses by 2030. Then, in 2018, SB 100 set a planning target of 100% zero-carbon electricity resources by 2045. In addition, SB 100 increased the 2030 renewables target from 50% to 60%. On the same day that SB 100 was signed, Executive Order B-55-18 set a new statewide goal to achieve carbon neutrality (zero-net GHG emissions) by 2045 and to maintain net negative emissions thereafter.

This aggressive GHG emission reduction and renewable electricity procurement strategy increases the use of Renewable Portfolio Standard-eligible resources, including solar, wind, biomass, geothermal, and others. This strategy also places enormous pressure on the California PAs to seek innovative technologies and approaches to improve the

[5] Corresponds to the following original research question from the RFP: Which communication methods have resulted in the highest customer participation for each customer type?

[6] Corresponds to the following original research question from the RFP: What behavioral, decision, or market barriers do customers face?

design and cost-effectiveness of their EE, demand response, and resource acquisition (RA) portfolios. These aggressive goals are becoming increasingly difficult to achieve as the number of savings opportunities are reduced. For example, increasingly stringent EE building codes and equipment standards, along with decreasing avoided costs, have made certain measures, such as efficient lighting, no longer available to programs.

Also in 2018, CPUC D.18-01-004 increased the required minimum percentage of 3P programs from 20% of the total budgeted portfolio in 2020 to 60% by the end of 2022.[7] The rationale for the 3P requirements is based on supporting innovation in program design, as well as the potential for cost savings associated with EE programs and portfolios through the competitive solicitation of programs. In addition to 3P-implemented and PA-solicited and -contracted programs available through the California IOUs, Regional Energy Networks (RENs) throughout the state may also offer RA programs to customers who reside within the same IOU territory. CPUC D.12-05-015 originally introduced the concept of RENs, which were "intended to augment or supplement the existing utility energy efficiency portfolio."[8] RENs were first approved in D.12-11-015, which also issued the following guidance criteria for evaluating proposed RENs:

1. Activities that utilities cannot or do not intend to undertake.
2. Pilot activities where there is no current utility program and where there is potential for scalability to a broader geographic reach.
3. Pilot activities in hard-to-reach markets, whether or not there is a current utility program that may overlap.[9]

In 2019, D.19-12-021 authorized the continued operation of existing RENs, invited new REN proposals, and further emphasized that RENs are "designed to fill gaps in the portfolios of all other PAs and to serve hard-to-reach customers."[10] As of July 2022, the RENs throughout the state include: BayREN, SoCalREN, 3CREN, I-REN, and RuralREN; however, BayREN is the only REN currently administering a residential RA program. Further, BayREN's Business Plan 2024–2031 and Portfolio Plan 2024–2031 do not mention any plans for residential RA programs. Community Choice Aggregators (CCAs) can also apply to the CPUC to administer programs. As of July 2022, Marin Clean Energy (MCE) is the only CCA offering an RA program to the residential, single-family market.

2.3 Methods

The research team utilized a mixed methods approach. The study began with a literature review of IOU regulatory filings and program materials. This was combined with in-depth interviews of PA and 3P staff to fulfill a landscape analysis. The findings were used to develop and field a statewide residential survey to fill in knowledge gaps in the landscape analysis.

2.3.1 Literature Review

This literature review included three distinct types of data sources:

1. Existing evaluation reports and market studies
2. Existing and relevant datasets
3. Relevant policy and program implementation plans

[7] CPUC D. 18-01-004 Decision Addressing Third Party Solicitation Process for Energy Efficiency Programs
[8] CPUC D. 19-12-021 Decision Regarding Frameworks for Energy Efficiency Regional Energy Networks and Market Transformation, p.5
[9] Ibid, p.4-5
[10] Ibid, p.2

The nature and value of these three sources and the sources reviewed are described in the table below. Although some categories include information related to equity and market support program plans, this study focused mostly on the RA programs.[11]

Table 2. Literature Review Sources

Literature Category	Category Description	Sources
Evaluation Reports and Market Studies	Recent impact and process evaluation studies of residential programs and recent market studies have data that can help answer research questions for this study.	▪ CA 2021 EE Potential and Goals Study ▪ Recent residential impact evaluation reports from the California Measurement Advisory Council (CALMAC)[12]
Data Sources	Large residential market survey data related to energy efficiency awareness, knowledge, attitudes, adoption, barriers, and motivators.	▪ 2020 survey of ~598 residential customers that informed the 2021 EE Potential and Goals Study ▪ 2020 CPUC COVID-19 Customer Support ME&O General Population Survey Report, a survey of 2,000 residential customers ▪ 2020 survey of 2,660 DAC residential customers in the San Joaquin Valley ▪ 2019 California Residential Appliance Saturation Study (RASS) study ▪ 2022 CA Heat Pump Residential Market Characterization and Baseline Study ▪ Publicly available vendor research
Policy and Program Documents	These documents help provide the energy policy framework guiding EE investments and strategies in addition to the program plans currently in place to capture the market's EE potential.	▪ Senate Bills 350 and 100 ▪ Assembly Bill 32 ▪ CPUC D. 19-12-021 and D. 18-01-004 ▪ 2021 EE Annual Budget Advice Letters ▪ 2024–2031 EE Strategic Business Plans (draft proposals) ▪ 2024–2027 EE Portfolio Plans (draft proposals) ▪ 2021 CA PA Annual Report Narratives ▪ 3P and other residential program implementation plans ▪ California Energy Efficiency Coordinating Committee (CAEECC) Market Support and Equity Working Groups proposed metrics ▪ CA Home Energy Report, most recent evaluations, and PIPs

Note: 3P data sources include SCE Residential Behavioral PIP, SoCalGas 3884 Comprehensive Manufactured Home PIP, SoCalGas 3885 Residential Manufactured Home PIP, PG&E Energy Access SF PIP, MCE SFE PIP and MCE Residential Direct Install PIP

2.3.2 In-Depth Interviews

Opinion Dynamics conducted in-depth interviews with IOU program staff across PG&E, SCE, and SDG&E in early October 2022. In late October 2022, we also conducted interviews with the implementers of the three statewide programs administered by SDG&E. The IOU interviews lasted 60–90 minutes and were recorded with consent from the interviewees and transcribed for reference in analysis. Multiple program staff attended each interview representing all EE resource programs targeting residential, single-family, and manufactured/mobile home customers. The implementer

[11] D. 21-05-031 categorized programs into three categories. Resource Acquisition Programs have "a primary purpose of, and a short-term ability to, deliver cost-effective avoided cost benefits to the electricity and natural gas systems. Short-term is defined as during the approved budget period for the portfolio, which will be discussed further later in this decision. This segment should make up the bulk of savings to achieve TSB goals. Market Support Programs have a primary objective of supporting the long-term success of the energy efficiency market by educating customers, training contractors, building partnerships, or moving beneficial technologies towards greater cost-effectiveness. Equity Programs have a primary purpose of providing energy efficiency to hard-to-reach or underserved customers and disadvantaged communities in advancement of the Commission's Environmental and Social Justice (ESJ) Action Plan."

[12] All residential impact evaluations used in this memo can be found at California Measurement Advisory Council (calmac.org)

interviews lasted approximately 30 minutes. The table below provides an overview of the staff who attended each interview. Findings from these interviews are summarized throughout this report.

Table 3. Interview Participants

	PG&E	SCE	SDG&E	CLEAResult	Synergy
Interviewees	3 staff representing residential EE programs, including the Manager of Residential EE Programs and Partnership Programs; Many programs have had management turnover, but these staff could speak to the Plug Load & Appliance program and Multifamily program	2 staff representing residential EE programs	4 staff representing residential EE programs	2 program managers of statewide EE program Participate in emerging tech forums	1 program manager of a statewide program Participate in emerging tech forums
Programs / Markets	Plug Load & Appliances, Multifamily, EE Program, Pay for Performance; all targeting Single Family and/or mobile/manufactured homes	Plug Load & Appliances, Residential Direct Install, and Comprehensive Manufactured Homes	SW Plug Load and Appliances, SW Residential HVAC, Residential Single Family, Multifamily Program	SW Plug Load and Appliances, SW Residential HVAC	Residential Single Family, Multifamily Program
History with Programs	Mostly new staff, but 1/3 had been involved in program implementation since 2018 and in the field since 2007	Both staff had over 10 years of experience managing residential EE programs	Range of history from 2–6 years	Range from 9–10 years	2 years
Experience with Customer Segments	1/3 had a high level of experience, while 2/3 were new to the field and had a low level of experience with 3 customer segments	2/2 had a high level of experience with 3 customer segments	4/4 had a high level of experience with 3 customer segments	2/2 had a high level of experience (9–14 years) with residential segments across states	2 years

2.3.3 Customer Pulse Check Survey

Opinion Dynamics fielded a statewide customer Pulse Check survey to fill any knowledge gaps identified by the landscape analysis. The survey focused on PG&E, SCE, and SDG&E non-low-income electric customers residing in single-family or mobile/manufactured homes.

PG&E, SCE, and SDG&E provided data extracts of the contact information for their residential electric customers residing in single-family and mobile/manufactured homes; the vast majority of mobile/manufactured homes were within SCE territory. The research team drew a stratified random sample to complete 900 residential Pulse Check surveys (300 per IOU). Assuming a response rate of 7.5%, the team used a sample frame of 12,000 residential customers (4,000 PG&E, 4,000 SCE single-family data, 4,000 SDG&E). To ensure adequate mobile/manufactured home representation, the research team also included all SCE mobile/manufactured home records (2,484) in the sample frame. The final sample included 14,484 customer records. To ensure the survey hit the targeted number of completes per IOU, the research team pulled additional samples, as needed. Overall, 965 residential customers completed the survey, with a response rate of 5.8%. The research team invited customers to participate in the Pulse Check survey via an invitation mailed to their homes. The team followed up with customers who did not respond to the

survey via email (where contact information was available) and postcard. The research team offered customers a $10 gift card for their participation in the Pulse Check survey.

Table 4. Pulse Check Survey Sampling Strategy and Completes

	Initial Sample Frame	Additional Sample Frame	Final Sample Frame	Pulse Check survey Targets	Pulse Check survey Completes
Overall	14,484	4,666	19,150	900	965
Utility					
SDG&E	4,000	N/A	4,000	300	321
PG&E	4,000	4,666	8,666	300	321
SCE	6,484	N/A	6,484	300	323

Weighting

The weighting scheme in our analysis ensures that the findings can be extrapolated to the California population. Our weighting scheme is based upon a thorough analysis of key demographics including:

- A comparison of each group's demographic distribution to the most recent California census data;
- An analysis (proportional and mean significance testing at the 90% confidence level) to understand differences in responses due to demographics;
- A correlation coefficient analysis between all of the demographics to understand the relationship between the demographics and make sure that we were selecting the appropriate weighting variables.

Based on the above analyses and the demographic distribution of the Pulse Check survey data, the research team weighted responses by IOU. The table below presents the demographic distribution of completes compared to actual statewide demographic distributions from the 2021 American Community Survey 5-Year estimates,[13] apart from the percentage of residential electric customers by utility, which was provided by SDG&E.

Table 5. Completed Surveys Compared to Statewide Metrics

	Completed Surveys	Statewide Breakdown	Percent Difference	Weighting Decision
Utility				
SDG&E	33%	10%	23%	The research team weighted overall survey data by IOU.
PG&E	33%	55%	-22%	
SCE	33%	35%	-2%	
Ownership				
Own	90%	69%	-21%	The research team did not weight by ownership because it is difficult to assess the actual distribution of ownership among the target audience (non-low-income residents of single-family or manufactured/mobile homes) given the census distribution represents all residents of CA
Rent	10%	31%	21%	
Age				

[13] https://www.census.gov/data/developers/data-sets/acs-5year.html

	Completed Surveys	Statewide Breakdown	Percent Difference	Weighting Decision
Younger than 65	60%	76%	16%	The research team did not weight by age because most of the survey questions addressed household-level topics, and age is representative of the individual.
65 or older	40%	24%	-16%	
Housing Type				
Single-Family	90%	95%	5%	The research team did not weight by housing type because the representation among completed surveys is similar to the statewide distribution.
Mobile/ Manufactured Home	10%	5%	-5%	

The research team calculated and applied statistical weights based on the population estimates for each IOU. Final weights are presented in the table below.

Table 6. Survey Weighting Values

IOU	Weight
SDG&E	0.30
PG&E	1.65
SCE	1.05

Data Analysis

The research team analyzed every Pulse Check survey question at the overall level for all respondents. Additionally, the research team conducted significance testing by customer segments on almost all survey questions. All survey questions that were tested for statistical significance were tested by IOU and housing type; some questions were tested by income status, IOU-sponsored program participation, ownership, and age. The research team planned to analyze select questions by Disadvantaged Community (DAC) status and Hard-To-Reach (HTR) status; however, there were not a large enough number of respondents in these categories to warrant statistical analysis.

The research team conducted significance testing by beginning with a preliminary test of significance and completing follow-up/post hoc analysis on results that were significant. To test for preliminary significance, the team used chi-squared tests (for nominal and ordinal questions) and one-way analysis of variance (ANOVA) tests (for numeric/string questions). The research team deemed that there was a significant relationship between the segmentation and survey question if the p-value of the preliminary test was less than a 0.10 alpha. Measures of effect size were also calculated (Cramer's V for chi-squared, eta-squared for ANOVA). The research team explored these significant relationships further by conducting post hoc analyses in the form of pairwise z-tests. The pairwise z-tests provided a more granular look at how responses varied by subsegment. The research team tested significance at an alpha of 0.10 and 0.01. Originally, the research team proposed using a Bonferroni adjustment. A Bonferroni adjusts the alpha value to be more conservative (i.e., lower - the lower the alpha, the higher the chance of significance) based on the number of statistical tests conducted. Given the sheer volume of statistical tests done as part of this effort, the research team determined that it would be more appropriate to test at both a 0.10 alpha and 0.01 alpha. Statistical variations in response across customer segments are described in the findings section of this report.

3. Responses to Research Questions

This section presents the key takeaways related to each of the study's research objectives. Based on these findings, we present a conclusive response to each of the study's research questions.

3.1 Energy Needs and Priorities

The table below lists the key findings associated with each research question related to the energy needs and priorities of residential customers. Overall, residential customers are concerned with and monitor their energy usage; although, cost is the biggest motivator for saving energy and deciding factor when making home efficiency upgrades (not necessarily environmental concerns). Residential customers do not often find themselves in the market for new HVAC and water heating equipment unless their existing equipment has failed. COVID's impact on energy use concerns dropped off significantly after the first months of California's shelter-in-place order compared to the onset of the order.

Table 7. Key Takeaways Regarding Customer Energy Needs and Priorities

Research Question	Key Takeaways
What are customers' energy needs and priorities?	**Customers' greatest energy need is reducing their heating and cooling burden. Customers prioritize reducing their utility bills; most customers monitor their usage by reviewing their energy bills monthly and are at least somewhat concerned with monitoring their usage.** ▪ The Pulse Check survey indicates SDG&E and SCE customers perceive cooling as their greatest electricity burden, while PG&E customers perceive heating to be their greatest gas burden. ▪ 77% of Pulse Check survey respondents are at least somewhat knowledgeable about how much energy their home uses; single-family and market rate customers are more knowledgeable about their usage than mobile/manufactured home and moderate-income customers (83% and 78% vs. 72% and 72%, respectively). ▪ 91% of Pulse Check survey respondents feel they have at least some control of their home's energy usage; however, homeowners and those who have recently participated in an IOU-sponsored program feel they have more control than renters and those who have not participated (92% and 95% vs. 83% and 91%, respectively). ▪ 82% of Pulse Check survey respondents monitor their energy usage largely by reviewing their monthly energy bill and 80% are at least somewhat concerned with keeping an eye on their usage. ▪ 83% of Pulse Check survey respondents feel it is at least somewhat important for them to do their part in making California more energy efficient. Customers who participated in an IOU-sponsored program in the past two years feel it is more important for them to do their part in making California more energy efficient and monitor their energy usage more frequently compared to those who have not participated (89% compared to 80%, respectively). ▪ Just under half of Pulse Check survey respondents (45%) feel they could improve some or a lot of elements of their home; renters feel there is more to improve than homeowners (63% vs. 43%, respectively). ▪ Mobile/manufactured homes have a more pronounced and nuanced need for high-performing ductwork and greater space constraints for equipment than single-family homes. Although only 17% of Pulse Check survey respondents in this segment self-reported a need for repair or replacement of their home's ductwork.
What impact, if any, has COVID-19 had on customer needs and priorities?	**COVID-19 did not have lasting impacts on customer energy needs and priorities.** ▪ The landscape analysis indicated customers tried to reduce their energy less frequently a few months into the shelter-in-place order compared to the onset of the order. Customers' level of concern with managing their energy use decreased significantly during the shelter-in-place order compared to the onset of the order, though a majority remain concerned. ▪ According to the landscape analysis, customers who reported financial impacts as a result of COVID-19 thought it more important for their household to do its part in making California more energy efficient (79%), were more willing to want to save energy and reduce their bills during the pandemic (79%) and were willing to change their actions to achieve such reductions (78%).

Research Question	Key Takeaways

What factors motivate customer decision-making when it comes to new equipment purchases or upgrades?	**When customers need to replace their HVAC or water heating equipment, cost and "ease" are two large factors that determine the type of equipment they purchase. While cost and "ease" are of higher importance to decision-making, environmental concerns are important to some, especially those who are currently interested in heat pump technology.**
	▪ The landscape analysis showed single-family and mobile/manufactured home customers share the following motivations for adopting EE equipment:
	  ▪ **Upfront equipment cost**: This is often higher than many people are willing to spend.
	  ▪ **Hassle factor**: Time involved in researching, purchasing, and installing new equipment.
	  ▪ **Concern about energy-saving performance**: Will the equipment really provide a reduced bill?
	  ▪ **Reluctance for accelerated replacement**: Most customers replace equipment when their existing equipment fails.
	▪ The landscape analysis indicated reducing carbon emissions was a top motivator for purchasing and installing energy-efficient technology like a heat pump, the Pulse Check survey found customers' most important decision factor for new HVAC and water heating was installation cost (62% and 59%, respectively). A small percentage (10% for HVAC, 8% for water heating) indicated a system's impact on the environment/greenhouse gas reductions was an important decision factor.

3.2 Current Program Overlaps with Customer Needs

The table below lists the key findings associated with each research question related to how the overall market of current energy efficiency programs aligns with residential customers' needs. Overall, the IOUs offer a wide variety of single-family-focused energy efficiency programs, however, only a quarter of those aware of these programs have participated within the last two years. Younger customers and renters are less likely to participate in energy efficiency programs than other customer groups. Program participation did not statistically vary by housing type. SCE and SCG serve mobile/manufactured homes with targeted programs for this segment.

Table 8. Key Takeaways Regarding Current Program Overlaps with Customer Needs

Research Question	Key Takeaways
What program offerings are currently available to residential customers in single-family and mobile/manufactured homes?	**Statewide, downstream measures include smart thermostats, home appliances, and consumer electronics. Midstream measures most commonly include pool pumps, water heaters, and HVAC (furnaces and heat pumps). No-cost, direct installation measures typically include faucet aerators, low-flow showerheads, and pipe insulation and are accompanied by an audit. A no-cost, direct install program targets mobile/manufactured homes in SCE and SCG's territory.** ▪ The landscape analysis indicated single-family, residential programs cover upgrading appliances, HVAC, and water heating equipment, as well as whole home upgrades. These are delivered as no-cost services, direct-to-customer rebates (downstream), manufacturer buydowns (upstream/midstream), or direct installation. ▪ According to the landscape analysis, SCE and SCG are the only two IOUs with programs targeting mobile and manufactured homes and moderate-income customers, specifically. Most of California's mobile/manufactured homes segment is located within these territories.
To what extent have residential customers been served by current EE programs?	**Only one-quarter of residential customers aware of current programs have participated within the past two years.** ▪ 74% of Pulse Check survey respondents were aware of IOU-sponsored programs, but only 25% participated in one in the past two years.

Research Question	Key Takeaways
What are the residential customer segments, if any, that are not being served by current residential EE programs?	**The rental segment is not being served by current programs.** ▪ According to the Pulse Check survey, EE participation varied by home ownership and age: homeowners were more likely to have participated than renters (26% vs. 14%), and those 65 or older were more likely to have participated than those younger than 65 (30% vs. 23%). ▪ Program participation did not vary statistically by income in the Pulse Check survey. According to the landscape analysis, moderate-income customers face significant financial obstacles to adopting EE. Of those Pulse Check survey respondents who were aware of EE programs but had not participated, 30% do not know why they have not participated, while 18% say it is because they were not eligible due to income or time at residence, and 15% said they have not purchased equipment lately. ▪ 8% said the programs did not meet their needs largely because the equipment they wanted to purchase did not qualify for a rebate or because the rebates were not high enough for them to afford the equipment. ▪ The Pulse Check survey indicated single-family and mobile/manufactured home customers' EE program participation was statistically similar.

3.3 Effective Engagement

The following table lists the key findings associated with each research question related to effective customer engagement. IOU staff indicated one-on-one customer touchpoints (or in-person) are most successful at engaging customers in energy efficiency. This aligns with the Pulse Check survey findings indicating, when given the choice between three audit program options (in-person, online, or phone), residential customers are most interested in receiving recommendations for new HVAC and water heating systems via an at-home (in-person) energy assessment. Respondents' interest in an at-home energy assessment varied significantly by income, however, with market-rate respondents being more interested than moderate-income customers.

Overall, general web searches and contractors/equipment installers followed by friends/family and retail stores are the most popular sources of information for residential customers to seek out when in the market for HVAC and/or water heating equipment. Residential customers show no clear preference across the three standard incentive models for HVAC and water heating programs: point of purchase coupon, discount via a contractor, and downstream rebate.

Table 9. Key Takeaways Regarding Effective Customer Engagement

Research Question	Key Takeaways

Which distribution channels (retail, midstream, etc.) have been the most successful at reaching residential customers? How does this differ by customer type?	**IOUs are focused on downstream strategies which they consider the most effective way to engage customers in energy efficiency. Customers do not show a preference for downstream compared to midstream distribution channels.**
	▪ Staff interviews revealed, PG&E and SCE are largely focused on downstream strategies, which they consider the most effective way to engage customers in EE. SDG&E's local programs also employ downstream strategies, which they have found an effective way to reach lower income customers, rental customers, and those living in mobile/manufactured homes. The two Statewide programs targeting Plug Load and Appliances and HVAC upgrades largely employ a midstream strategy.
	▪ The landscape analysis elicited several program delivery channels that effectively engage residential customers:
	  ▪ **Direct to Consumer Approaches:** According to IOU staff, knocking on customer doors and canvassing neighborhoods has been an effective way to reach mobile/manufactured homeowners, HTR customers, or customers residing in DACs. Auto-enrolling customers in free behavior platforms allows for reaching a large proportion of the customer base.
	  ▪ **Contractors:** IOU staff said contractors can be an effective way to engage customers as they often provide customers with recommendations. When contractors promote EE, it can help increase customer interest in EE programs.
	  ▪ **Opportunity to Try Products:** The opportunity to try an unfamiliar measure, such as an LED bulb or a smart thermostat (or other "gateway measures"), can be an effective way to engage customers in EE programs and other ways to save.

When programs employ multiple communication methods, which communication method has resulted in the highest customer participation for each customer type?	**There were no research findings related to the communication methods that result in the highest customer participation by customer type.** ▪ According to IOU staff interviews, reaching customers "where they are" is effective at generating customer "click-throughs" to a program website via advertising on digital streaming platforms. This refers to marketing to customers through media channels they most often frequent. ▪ According to Pulse Check survey respondents, the four most popular resources for information when looking to buy HVAC or water heating equipment were a general web search (68%), contractors/equipment installers (66%), friends/family (46%), and retail stores (41%). ▪ Pulse Check survey respondents aged 65 years and younger consume media in a statistically different manner than customers 65 years and older: Customers younger than 65 consume digital forms of media more often than those 65 and older (online video streaming, online social media, radio/music streaming, podcast websites/apps); those 65 and older consume tradition forms of media more than those younger than 65 (broadcast TV, print newspapers, print magazines).
What types of programs/offerings are participants most interested in?	**Given the option among three audit program offerings (in-person, online, and phone), customers prefer in-person. Mobile/manufactured homes customers are weary of in-person audits of their ductwork. Customers do not have a preference for downstream versus midstream incentives.** ▪ Regarding audit program offerings, Pulse Check survey respondents were most interested in receiving recommendations for new HVAC and water heating systems via a utility-sponsored at-home energy assessment (in-person) over an online assessment or phone consultation with an energy advisor; respondents' interest in an at-home energy assessment varied significantly by income, with market-rate respondents being more interested than moderate-income customers. ▪ Pulse Check survey respondents expressed similar levels of interest in three tested incentive models for HVAC and water heating upgrades: retail/online store coupon, discounted price through a contractor, and downstream rebate). Single-family respondents were significantly more interested in all the incentive modes than mobile home respondents for HVAC and two of the three incentive types for water heating (e.g., a discounted price through a contractor and a downstream rebate). Market rate respondents were significantly more interested in using a website compared to moderate-income respondents for water heating. ▪ Pulse Check survey mobile/manufactured home respondents with duct work indicated only moderate interest in a program where a building professional would come to their home, at no cost to them, to assess the condition of their home's ductwork and help repair or replace it at a discounted price (rated 4.8 out of 10, where 10 is "very interested"). Common reasons for a lack of interest in this service included that they did not feel they needed their duct work checked (22%), they wanted to have someone else (not a program-related representative) check it for them (17%), they recently had their ductwork checked (13%), or their duct work was relatively new (12%).

3.4 Barriers and Opportunities

The table below lists the key findings associated with each research question related to barriers and opportunities for new measures and services. Despite IOU expectations, nearly all Pulse Check survey respondents indicated monitoring their energy use, but most do so via their monthly energy bill rather than a real-time monitoring tool. More than half of customers who do not already have one (or don't know if they have one) are interested in obtaining an online utility account connected to an AMI meter to monitor energy usage. Only about one-third of Pulse Check survey respondents indicated using a Wi-Fi-connected smart thermostat. In general, there is an opportunity to increase penetration of smart monitoring/control technologies in customer homes.

Pulse Check survey respondents said upfront cost is the most important factor they consider when needing to purchase new HVAC and water heating equipment, and specifically regarding heat pump technologies, lack of awareness, interest, and need for new equipment are the most prominent barriers to adoption (after cost). Heat pump technology penetration among Pulse Check survey respondents was low, especially for water heating end-uses.

Table 10. Key Takeaways Regarding Barriers and Opportunities

Research Question	Key Takeaways

What challenges do customers face in reducing/ monitoring/ controlling their energy use and demand?	**Customers are generally unaware of their access to utility online accounts to monitor their energy use.**
	▪ 95% of Pulse Check survey respondents monitor their households' energy usage; 86% do so by reviewing their monthly energy bill, one-third do so using an online utility account or an online tool provided by their utility.
	  ▪ SDG&E respondents were significantly more likely than PG&E and SCE respondents to indicate they leveraged their online real-time utility account. Market rate respondents were significantly more likely than moderate income respondents to indicate they used online real time utility accounts.
	▪ While PAs and implementers indicated during interviews that customers had challenges monitoring their energy use (such as logging in to an online utility account), but 65% of Pulse Check survey respondents indicated it was at least "somewhat easy" for them to monitor their homes' energy usage.
	  ▪ Those Pulse Check survey respondents who said monitoring their energy usage was less than "very easy," most frequently reported that they forgot to/did not think to monitor their home energy use (43%), did not have enough time to do so (25%), and/or did not understand their monthly energy bill (25%).
	  ▪ PG&E respondents were significantly more likely than SDG&E and SCE respondents to indicate that the monitoring tools at their disposal were hard to use. In interviews, PG&E indicated customers are not interested in engaging with the monitoring resources available to them (e.g., PG&E has found that asking customers to log in to their account to see their energy use is a barrier).
	▪ 91% of Pulse Check survey respondents indicated they had at least "some" control over their household energy usage, with 54% indicating they had "quite a bit" or "a great deal." Homeowners were statistically more likely than renters to indicate they had "quite a bit" of control.
	▪ Most Pulse Check survey respondents (76%) reported that it was "somewhat easy" (51%) or "very easy" (25%) to control the amount of energy their household used.
	▪ In terms of challenges related to reducing or controlling energy use, Pulse Check survey respondents most frequently cited concerns about household comfort (40%), themselves or a member of their household working from home (31%), and their home energy use already being low and not being able to reduce it any further (23%).
	  ▪ Market rate Pulse Check survey respondents were significantly more likely than moderate income respondents to indicate they did not have the infrastructure or metering equipment needed to keep them on track (21% vs. 12%), had a household member who worked from home (38% vs. 25%), or felt it was inconvenient (19% vs. 12%). Moderate income respondents were more likely than market rate respondents to indicate there was a household member that required medical equipment (10% vs. 4%).

Research Question	Key Takeaways
What behavioral, decision, or market barriers do customers living in single-family or mobile/ manufactured homes face? What relationships exist, if any, between these barriers?	**Cost, "hassle factor", and lack of interest (before equipment breaks) are the greatest barriers facing all customers. Apathy is a greater barrier to mobile/manufactured home customers, who believe their home is "already as energy efficient as possible" more often than single-family customers.** ▪ Pulse Check survey respondents said upfront cost is the most important factor they consider when needing to purchase new HVAC and water heating equipment. According to the landscape analysis, the cost of the upgrades is an even more pronounced barrier among the mobile and manufactured home segment than other segments. ▪ 13% of Pulse Check survey respondents indicated their home was "already as energy efficient as possible." Mobile/manufactured home respondents were significantly more likely than single-family respondents to provide this response (21% compared to 12%, respectively). ▪ Only 12% of Pulse Check survey respondents used an air source heat pump for space cooling/heating and less than 1% of respondents used a heat pump water heater. Among those who did not already use these technologies, a large percentage had "never heard of them before" or "only knew of the name" (60% for air source heat pumps and 75% for heat pump water heaters). Overall, 45% indicated they were "very interested" (19%) or "somewhat interested" (27%) in learning more about air source heat pumps next time they are in the market for new space heating or cooling and 49% of respondents indicated they were "somewhat interested" (32%) or very interested" (17%) in learning more about heat pump technology for water heating. Customers residing in mobile/manufactured homes were generally less interested in heat pump technologies for both HVAC and water heating than single-family customers. ▪ Regarding heat pump technologies, the landscape analysis stated cost and lack of need to upgrade current equipment are barriers to adoption. These are barriers similar to any EE equipment upgrades. However, customers also lack of awareness of heat pump technology. Specifically, interest, perceived need for additional construction, lack of performance information, and a preference for gas equipment are unique barriers to heat pump adoption.
Which types of customers are not participating in EE programs and why?	**Renters and customers younger than 65 years participate in energy efficiency programs less than homeowners and customers aged 65 and older. Renters face unique split incentive challenges that make participation more difficult. Customers aged 65 years and younger consume different media from those 65 years and older and may not be as readily targeted with messages for participation as older customers.** ▪ According to the landscape analysis, the types of customers not participating in EE programs are often renters, HTR, members of a DAC, or low-to- moderate income (LMI) customers. ▪ The Pulse Check survey revealed that 74% of respondents are aware that their utility offered rebates and incentives for customers to save energy. Homeowners were significantly more likely to indicate they were aware than renters (75% vs. 64%). ▪ Only 25% of aware respondents indicated in the Pulse Check survey they participated in a program in the past two years. Homeowners were significantly more likely than renters to indicate they had participated in that time frame (26% vs. 14%). Additionally, respondents 65 or older were significantly more likely than those younger than 65 to have participated (30% vs. 23%). ▪ These participants (as indicated in the Pulse Check survey) reported a significantly higher 2022 income before taxes on average than non-participants ($201,274 vs. $162,768); however, this difference existed solely within the market rate bracket. ▪ The Pulse Check survey asked respondents who were aware of programs but indicated they did not participate why they had not done so. Overall, a large portion of respondents indicated not being able to pinpoint a particular reason for their non-participation (30%). Among popular responses were that they were not eligible due to their income/time at residence/etc. (18%) or had not purchased equipment eligible for a program recently (15%). ▪ According to the landscape analysis, renters typically need landlord approval to make EE equipment improvements; however, renters responding to the Pulse Check survey identified having more potential for energy efficiency improvements than homeowners, likely because they do not have the decision-making authority to move forward with upgrades and replacements when they deem them necessary.

Research Question	Key Takeaways
What opportunities exist for new measures that address the unmet needs of residential customers (e.g., new services, technologies)?	**Very few customers have smart monitoring technologies in their homes. Customers are most interested in trying smart home energy management systems and in-home energy display technologies. There is an opportunity to increase penetration of smart thermostats among mobile/manufactured home customers, but the segment is weary of this technology.** ▪ 98% of Pulse Check survey respondents have a thermostat, 51% have a programmable thermostat, 34% have a Wi-Fi connected smart thermostat, and 17% have a manual thermostat. Mobile/ manufactured homes were statistically less likely to have a smart thermostat than single-family customers and were less interested in trying one. ▪ Less than one-quarter of Pulse Check survey respondents have smart monitoring/control technologies in their homes. Most commonly, Pulse Check survey respondents indicated having smart plugs connected wirelessly to their phone or another display device (24%), occupancy sensors/dimmers/smart outlets/voice controls connected to smart home devices (20%), or an online utility account connected to an AMI meter (16%). Only 8% of respondents indicated having a smart home energy management system and 4% indicated having in-home display technology. Single-family respondents were significantly more likely than mobile home respondents to have any of these advanced technologies. ▪ Of these technologies, Pulse Check survey respondents indicated the highest interest in obtaining an online utility account connected to an AMI meter (54%), a smart home energy management system (48%), and in-home display technology (47%). Single-family and market-rate respondents were more likely to indicate higher levels of interest than mobile home and moderate-income respondents.

4. Findings

This section details the combined results from the landscape analysis and survey. Findings are summarized by the study research objectives. Detailed findings from the landscape analysis are provided in APPENDIX A.

4.1 Research Objective 1: Residential Customer Energy Needs and Priorities and Variance by Customer Segment

The first research objective aims to understand how customers think about energy in terms of their needs and priorities, assess how COVID-19 affected customers' needs and priorities (if at all), and explore what factors motivate customer decision-making when replacing/upgrading equipment.

4.1.1 Customers' Energy Needs and Priorities

Both the landscape analysis and Pulse Check survey aimed to explore customers' energy needs and priorities as well as the differences by key customer segmentations like housing type, home ownership, income, utility, and IOU-sponsored program participation history.

There are several recent market research and evaluation studies that touch upon customer energy needs and priorities, the impact of COVID-19, the factors that motivate customers, and the variation across customer segments.

1. The California EE Market Adoption Characteristics Study surveyed 598 single-family non-low-income residential customers across the four IOU service territories in 2021.[14] The survey captures customer characteristics, attitudes, and behaviors to inform technology adoption decision-making for EE technologies, fuel substitution technologies, and demand response (DR) program participation. Findings supported the latest Potential and Goals update.
2. The California COVID-19 Customer Support ME&O General Population Study surveyed 2,000 Californians living in single family and multifamily dwellings.[15] The sample included low-income and non-low-income customers. The study was conducted in May 2020, a few months into the "shelter-in-place" order. The survey explored how the COVID-19 pandemic policies impacted Californians and how effective recent Energy Upgrade California (EUC) marketing campaign efforts were during the pandemic.
3. PG&E's 2024–2031 EE Portfolio and Business Plan Exhibit 2, describes a recent internal study of residential customer energy needs. In 2021, PG&E commissioned a customer insights study to learn about customer perceptions and needs regarding EE and energy management. The study was conducted using interviews and focus groups with residential customers. The purpose was to inform PG&E's strategies and tactics to create a more customer-centric approach for its 2024–2027 portfolio plan.
4. PY2020 HVAC Fuel Substitution Impact Evaluation explored motivations for installing heat pumps. Saving energy and reducing carbon emissions were the top motivators reported among participants in the program.[16]

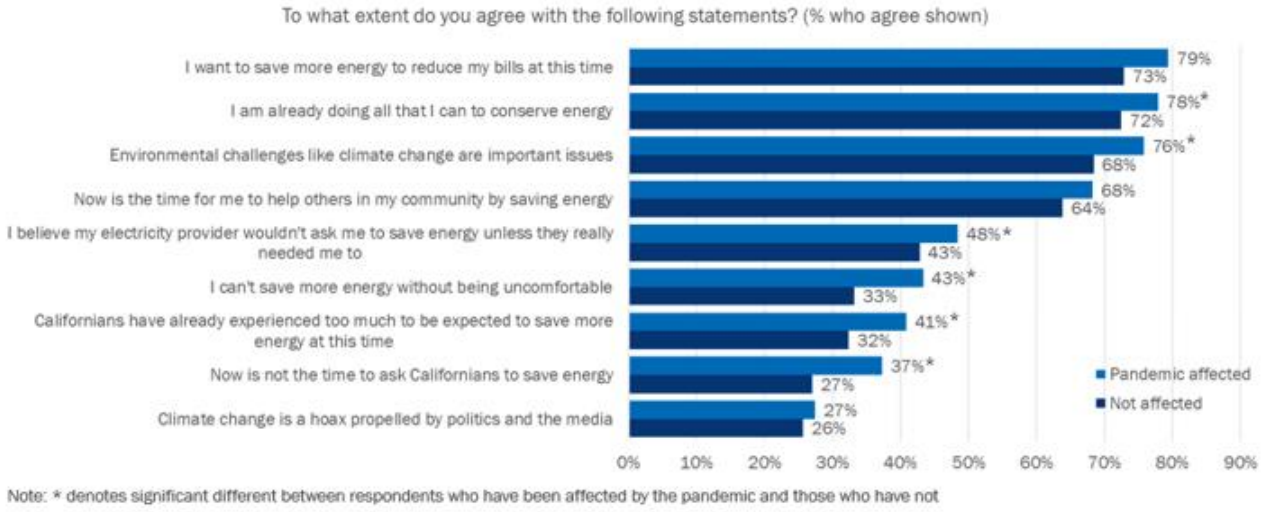
PG&E's Business Plans include qualitative findings from focus groups and in-depth interviews to learn about customer perceptions and needs regarding EE and energy management. Some of the key themes include:

[14] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021
[15] COVID-19 Customer Support Campaign Gen Pop Survey Report
[16] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

- **Concern for Climate Change**: Most customers are broadly concerned about climate change and the threat it poses to the planet.
- **Personal Ownership**: Of those concerned about climate change, the majority also acknowledge at least some ownership and responsibility to do something about it.
- **Approach to EE**: While some customers may be willing and able to invest extra time and/or money in pursuit of EE, most want solutions that are low-cost, low-hassle, and not an inconvenience to them.
- **Passive Engagement**: Though many customers are concerned with climate change, most will not proactively upgrade their equipment; instead, opting to wait until their equipment stops working.
- **Tools for Self-Sufficient Energy Management**: A growing number of customers want tools that will help them manage their energy independently (e.g., customizable tools, smart appliances, real-time tracking).
- **Independence**: There is a sizable contingent of customers who want to retain choice (how to manage their energy and choice of fuel type) and do not want to be constrained by PG&E or the government.
- **Trust:** Customers have a lack of trust in market actors, a lack of trust in the information provided to customers, and a desire to work with partners they can trust.

The COVID-19 Customer Support ME&O General Population Survey, as shown below, indicated most residential customers (single and multifamily) have a strong desire to reduce their energy bills, though most believe they are already doing all they can to conserve energy.

Figure 1. Customer Perspectives



Source: COVID-19 Customer Support ME&) General Population Survey
Survey Question: To what extent do you agree with the following statements? (Single response permitted)

The program administrators and implementers interviewed as part of our landscape analysis agreed that customers have a wide range of energy needs and priorities depending on income, accessibility, and interest. Depending on the available capital customers have available for energy upgrades, household income can largely determine whether customers can replace appliances upon failure or if they need to keep repairing them.

Program staff reiterated that customer energy efficiency needs and priorities are different for each customer but that a common focus is on reducing their utility bill. IOU staff expect to see customers focus more on both reducing their utility bill and contributing to environmental improvements as customers become more educated about energy efficiency and its relationship to California's environmental goals to reduce GHG emissions.

Results of the Pulse Check survey mirrored some of the aforementioned themes and identified additional insights:

- **Knowledge of Energy Usage:** The majority of customers (77%) are at least somewhat knowledgeable about how much energy their home uses; however, single-family and market rate customers are more knowledgeable about their usage than mobile/manufactured home and moderate-income customers (83% and 78% vs. 72% and 72%, respectively).
- **Sense of Control Over Energy Usage:** Most customers (91%) feel they have at least some control of their home's energy usage; however, homeowners and those who have participated in an IOU-sponsored program recently feel they have more control than renters and those who have not participated (92% and 95% vs. 83% and 91%, respectively).
- **Monitoring Energy Usage:** Most customers (82%) monitor their energy usage and are at least somewhat concerned (80%) with keeping an eye on their usage.
- **Community Stewardship:** Most customers (83%) feel it is at least somewhat important for them to do their part in making California more energy efficient, but only half feel it is very or extremely important. Customers who participated in an IOU-sponsored program in the past two years feel it is more important for them to do their part in making California more energy efficient and monitor their energy usage more frequently compared to those who have not participated (89% compared to 80%, respectively).
- **Opportunities for Energy-Efficient Improvements:** Just under half of customers feel they could improve some or a lot of elements of their home; renters feel there is more to improve than homeowners (63% vs. 43%, respectively).

Greatest Energy Consuming Equipment

The Pulse Check survey further explored customer energy needs and priorities. The Pulse Check survey asked respondents to consider which items in their home used the most electricity over the course of a year. The table below presents the overall results and significant differences in response option distribution. Overall, respondents most frequently indicated that cooling equipment (36%), refrigerators/freezers (20%), and laundry equipment (12%) used the most electricity in their home. Only 7% of respondents indicated their heating equipment used the most electricity; however, only 18% of respondents reported having an electric heating system. Results varied by utility and housing type. Notably, SDG&E respondents were significantly more likely than PG&E respondents to indicate their cooling system used the most electricity, and SCE respondents were significantly more likely than both SDG&E and PG&E customers to indicate cooling as their greatest electric burden. This likely has to do with the differing climates of southern and northern California. Additionally, single family respondents were significantly more likely than mobile/manufactured home respondents to indicate their pool or electric vehicle used the most electricity.

Table 11. Item with Highest Electricity Consumption

	Overall	Utility*			Housing Type†	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)
n	965	321	321	323	865	100
Space cooling	36%	34%b	26%	50%A B	33%	56%D
Refrigerator/Freezer	20%	20%	20%	19%	20%	19%
Laundry equipment	12%	13%c	15%C	7%	13%	9%
Lighting	7%	6%	7%	7%	7%	6%
Space heating	7%	3%	9%A C	3%	7%e	3%
Electric vehicle	6%	9%C	7%c	4%	7%E	<1%
Pool	5%	8%b	4%	6%	5%E	0%
Cooking equipment	4%	4%c	5%C	1%	4%	2%
Water heating	<1%	<1%	0%	0%	<1%	0%
Other	4%	2%	5%a c	2%	3%	5%
Don't know	<1%	1%	<1%	1%	1%e	0%

Note: a/b/c/d/e indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de; A/B/C/D/E indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.21 (df=20)

ǂ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.19 (df=10)

Pulse Check Survey Question: Of the following items in your home, which one uses the most electricity over the course of a year? (Single response permitted)

The Pulse Check survey asked respondents to consider which items in their home used the most gas over the course of a year. The table below presents the overall results and significant differences in response option distribution. Respondents most frequently indicated that their space heating (47%) and water heating (24%) equipment used the most gas in their home over the course of a year. This is to be expected given 70% of respondents indicated having gas space heating and 76% gas water heating. Results varied by utility and housing type. Notably, PG&E respondents were significantly more likely to indicate that space heating used the most gas in their home. Again, this aligns with the differences in northern and southern California's climate. Additionally, SDG&E and PG&E respondents were significantly more likely than SCE respondents to indicate they used no gas fuel in their home.

Table 12. Item with Highest Gas Consumption

	Overall	Utility*		
		SDG&E (a)	PG&E (b)	SCE (c)
n	965	321	321	323
Space heating	47%	36%	51%[A]	44%
Water heating	24 %	26%	22%	28%
Cooking equipment	13%	18%[b c]	13%	12%
Laundry equipment	8%	12%[B]	5%	12%[B]
Other	<1%	<1%	<1%	0%
Don't know	1%	1%	<1%	1%
None of the above; I do not use gas to fuel anything in my home	7%	7%[c]	10%[C]	3%

Note: a/b/c/d/e indicates significant differences at a 90% confidence level and 0.10 alpha between the following test: abc; A/B/C/ indicates significant differences at a 90% confidence level and 0.01 alpha between the following test: ABC

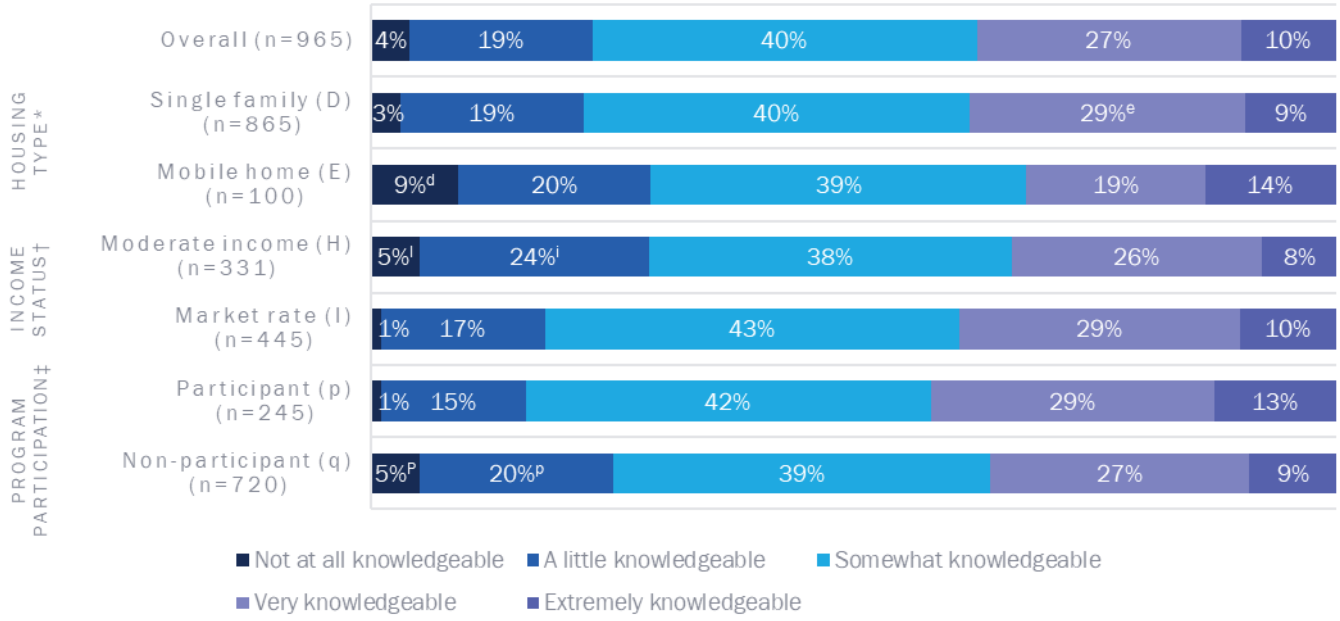
* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.14 (df=12)

Pulse Check Survey Question: Of the items in your home that are fueled by gas, which one uses the most gas over the course of a year? (Single response permitted)

Energy Use Knowledge and Concern

The Pulse Check survey asked respondents how knowledgeable they were about how much energy was used in their home on a regular basis. The figure below presents the overall response distribution, as well as distributions by relevant customer segments. Overall, 77% of respondents indicated they were at least "somewhat knowledgeable," with 37% reporting they were "very knowledgeable" or "extremely knowledgeable." Results were similar across utility but varied by housing type, income, and IOU-sponsored program participation. Specifically, results suggest single family respondents are more knowledgeable about their household energy use than mobile home respondents as they were statistically more likely to indicate they were "very knowledgeable" and significantly less likely to say they were "not at all knowledgeable." Moderate income and non-participant respondents were significantly more likely to indicate they were "not at all knowledgeable" or "a little knowledgeable" than market rate respondents and participants, respectively.

Figure 2. Knowledge of Home Energy Usage



Note: d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: de, hi, pq; D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: DE, HI, PQ

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.08 (df=8)

† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=4)

‡ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.14 (df=4)

Pulse Check Survey Question: How knowledgeable would you say you are about how much energy is being used in your home on a regular basis? (Single response permitted)

The Pulse Check survey asked respondents how often they looked at the amount of energy their home was using by keeping track of their monthly bill or using a monitoring device or app. Approximately 82% of respondents indicated they monitored their energy usage "sometimes" (38%) or "most of the time" (44%). Results were similar across utility, housing type, and income subsegments but varied based on IOU-sponsored program participation. Specifically, participants were significantly more likely than non-participants to indicate they monitored their energy usage "Most of the time" (51% vs. 41%)[17] and significantly less likely to indicate they "rarely" monitored it (8% vs. 15%).[18]

The Pulse Check survey asked respondents how concerned they were with "keeping an eye on" their energy usage on a typical day. Overall, 80% of respondents indicated they were at least "somewhat concerned," with 41% indicating they were "very concerned" (30%) or "extremely concerned" (11%). Results were similar across the utility, housing type, income, and IOU-sponsored program participation subsegments.

The Pulse Check survey asked respondents how important they felt it was for them to do their part in making California more energy efficient. Overall, 83% of respondents indicated it was at least "somewhat important," with 53% indicating it was "very important" (37%) or "extremely important" (16%). Results were similar across utility, housing type, and income subsegments, but varied by IOU-sponsored program participation. Participants were significantly more likely

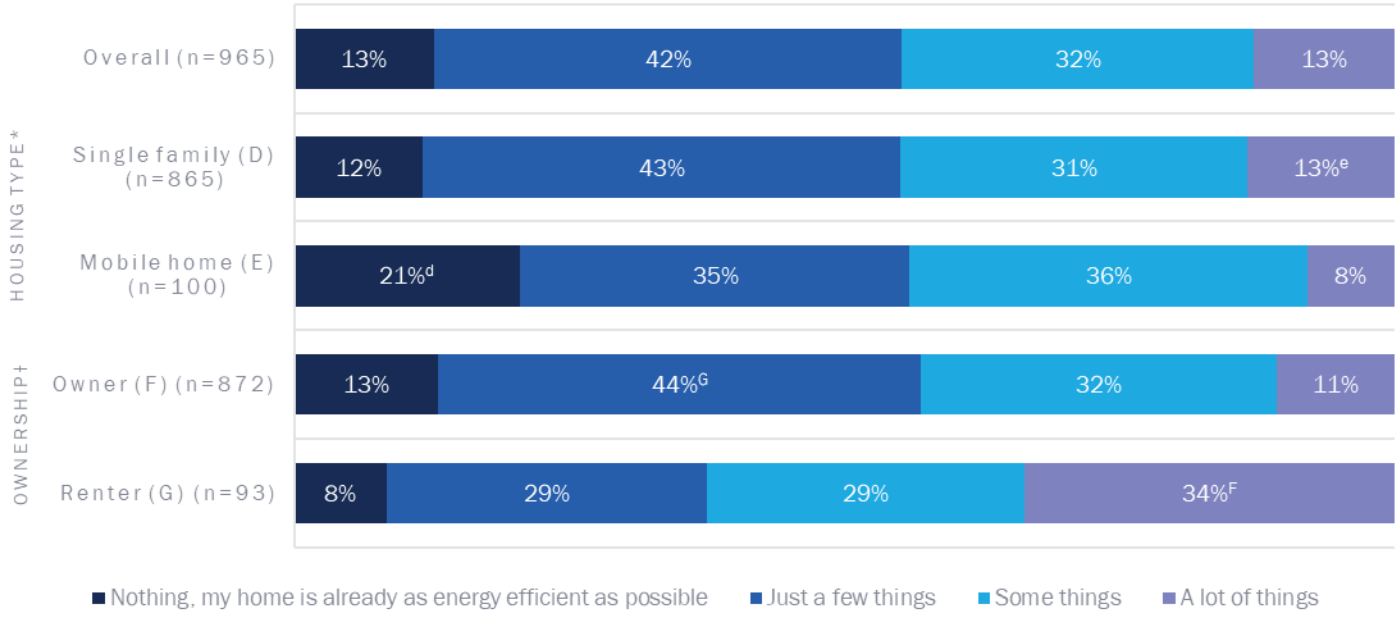
[17] Difference significant at conservative alpha value of 0.01
[18] Difference significant at conservative alpha value of 0.01

than non-participants to indicate they felt it was "extremely important" (26% vs. 12%)[19] and less likely to indicate it was "not at all important" (5% vs. 8%[20]) or "a little important" (7% vs. 12%).[21]

The Pulse Check survey asked respondents how the cost of their energy bill compared to their other overall expenses. About 50% of respondents indicated their energy bill was the greatest burden, 34% said it was moderate, and 16% said it was minimal. Results were similar across utility, housing type, income, and IOU-sponsored program participation subsegments.

The Pulse Check survey asked respondents to consider how much more energy-efficient they or their landlord could make their home if they tried. The figure below presents the overall response distribution, as well as distributions by relevant subsegments. Approximately 45% of all respondents indicated they could improve "some things" or "a lot of things." Approximately 43% indicated they could improve "just a few things," and 13% indicated their home was "already as energy efficient as possible". Results were similar across utility, income, and IOU-sponsored program participation subsegments, but varied by housing type and home ownership. Specifically, mobile home respondents were significantly more likely than single family respondents to indicate their home was "already as energy efficient as possible" and less likely to indicate there was "A lot of things" that could be improved. Regarding ownership, renters were significantly more likely than owners to indicate they could improve "a lot of things" and less likely to indicate they could improve "just a few things."

Figure 3. Opportunities for Energy Efficiency Improvements in Home



Note: d/e/f/g indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: de, fg; D/E/F/G indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: DE, FG

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=3)

† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.20 (df=3)

Pulse Check Survey Question: How much more energy efficient could you make your home if you tried? (Single response permitted)

[19] Difference significant at conservative alpha value of 0.01

[20] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

[21] Difference significant at conservative alpha value of 0.01

Renter Needs and Priorities

The Pulse Check survey asked renters an additional battery of questions to explore these customers' unique needs and priorities. Given that the total number of renters within each subsegment (utility, income, dwelling type, etc.) was small (n = 88), the study team presents the overall renter results only.

Firstly, renters were asked about the influence of specific home features on their decision to rent their current residence on a scale of 1, "not at all influential," to 10, "very influential." The table below presents the mean score given for each feature. None of the features averaged above 7.0, suggesting no features were critical to respondents' decision to rent their home; however, the presence of cooling equipment, presence of heating equipment, and presence of a thermostat that controls heating/cooling were rated most influential on average.

Table 13. Influence of Home Features on Rental Decision

Home Feature	n*	Mean Score	Standard Deviation
The presence of cooling equipment	64	6.9	3.6
The presence of heating equipment	88	5.9	3.7
The heating and cooling systems are controlled by a thermostat	80	5.4	3.8
The presence of an energy-efficient system for cooling your home	7	4.6	3.6
The estimated cost of utilities	88	4.5	3.2
The type of fuels used in the home	88	3.9	3.2
The presence of an energy-efficient system for heating your home	9	2.8	2.2
The presence of charging stations or technology for an electric vehicle on premise	78	1.7	1.8

*n counts for this question are variable as some features were only asked about if the respondent indicated their home having that feature, additionally respondents who indicated "Don't know" were excluded from this analysis.

Pulse Check Survey Question: When you decided to rent your current home, how much of a factor were the following items? (1-10 scale) (Single response permitted)

When asked how important the cost of utilities like electric, gas, and water was in their rental decision-making process on a scale of 1, "not at all important," to 10, "very important," respondents provided an average score of 6.6 (Standard deviation, SD=2.8). Similarly, when asked how important it was to live in a place with energy- efficient equipment, respondents provided an average score of 6.8 (SD=2.6). These results suggest these considerations are important to renters but are not necessarily influences on decision-making. Lastly, when asked how likely they would be to request an energy-efficient model from their landlord the next time something needed to be repaired or replace on scale of 1, "not at all likely," to 10, "very likely," respondents provided an average score of 6.7 (SD=3.2).

Mobile/Manufactured Home Needs and Priorities

The CPUC PY2020 HVAC Fuel Substitution Impact Evaluation, along with the PAs and IOU staff interviewed for the landscape analysis, noted that the needs of the mobile and manufactured customers differ slightly in a few ways.

- In terms of equipment needs, mobile/manufactured homes have a **more pronounced and nuanced need for high performing ductwork**. The ductwork in these homes is often underneath the home, if present at all, and tends to need major improvement. Coincidentally, ductwork tends to be the most cost-effective measure for this customer segment.
- Further, this customer segment tends to have **more space constraints**, or structural barriers, to doing upgrades. For example, heat pump water heaters (HPWHs) are taller than other models and will not fit in water heater closet spaces typically found in mobile and manufactured homes.

- A unique complexity to the mobile and manufactured home market is that these homes may be individually or master-metered homes. Currently, this segment often is **master metered making it a challenge** to administer programs to these customers and comply with data collection requirements.
- The homes in this customer segment, alongside older single-family homes, may need **upgrades largely from a health and safety perspective** before addressing other EE upgrades (e.g., repairing or replacing ductwork instead of installing an HPWH).
- Customers in this segment tend to be **older and not very tech savvy.** For example, these customers tend to resist trying new technology such as smart thermostats. They also tend to interact with cell phones and computers differently than other customer segments. Many mobile and manufactured home parks are 55+ communities.[22] According to the Consumer Financial Protection Bureau, the majority of these residents (84%) are between 60 and 74 years old and the remainder are 75 or older.[23]
- Customers in this segment are largely focused on recovering from the pandemic and dealing with the **economic impact of inflation**. These customers need bill relief regardless of the source of relief. A portion of that bill relief can come from EE upgrades, but the first cost can be a barrier.

In line with the landscape analysis, the Pulse Check Pulse Check survey found that customers residing in mobile and manufactured homes were older and lower income, averaging around 67 years old. The Pulse Check survey explored mobile/manufactured home customers' unique needs related to ductwork. Approximately 85% of customers (n = 94) indicated their mobile/manufactured home had duct work, most of whom indicated it was underneath the floor (in the crawl space). Over half of those with duct work (64%) indicated it was in good condition and there were no concerns. Only 13% indicated it needed some level of repair and a small percentage (4%) indicated it needed to be replaced. Notably, 19% did not know the condition of their duct work. When asked about their interest in an IOU-sponsored offering where a professional came to their home at no cost to assess the condition of the ductwork and repair/replace it at a discounted price, respondents provided an average score of 4.8 on a scale of 1 "Not at all interested" to 10 "Very interested" (SD=3.7).

4.1.2 Impact of COVID-19 on Customer Needs and Priorities

The landscape analysis sought to understand how customers' needs and priorities around energy may have changed in response to COVID-19 and the associated shelter-in-place orders. Given the fair amount of data that already exists on this topic and the need to trim the Pulse Check survey to a reasonable length, the Pulse Check survey did not capture further data on this topic.

The landscape analysis revealed that the COVID-19 pandemic continues to impact how PAs design and implement EE programs, as well as how California residents generally think about energy upgrades. The statewide shelter-in-place order that went into effect on March 19, 2020, temporarily halted direct install and other face-to-face programs and also re-aligned residents' priorities. Simultaneously, it increased residential customer engagement in online and virtual platforms.

The COVID-19 Customer Support ME&O General Population study reported that customers had experienced multiple COVID-19 impacts just a few months into the shelter-in-place order.

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[22] There are 363,389 mobile home spaces in California. Of the 180 resident-owned communities, 112 are 55+. https://mhphoa.com/ca/mhp/statistics.

[23] https://www.consumerfinance.gov/consumer-tools/educator-tools/resources-for-older-adults/data-spotlight-profiles-of-older-adults-living-in-mobile-homes/.

- Approximately one-third of residential households moved to tele-work from home, reduced weekly working hours, and/or experienced a loss in finances.
- Respondents reported trying to reduce their energy less frequently a few months into the shelter-in-place order.
- Respondents' level of concern with managing their energy use decreased significantly during the shelter-in-place order, though a majority were still concerned.
- Renters reported they increasingly face barriers related to perceived control of their energy use and home comfort during shelter-in-place.
- Pandemic-affected customers reported they had more opportunities to make their homes more energy efficient.
- Customers who were affected by the pandemic indicated a greater likelihood to make home efficiency upgrades.
- Renter's likelihood of making home efficiency upgrades decreased considerably during the shelter-in-place order. Respondents were asked why they were unlikely to change their actions to save energy. The most common reason provided was that energy bills were not high enough and they did not want to be uncomfortable in their homes.

The California EE Market Adoption Characteristics Study explored the impact of COVID-19 on residential single family non-low-income customers in 2021. For 62% of customers, COVID-19 had a negative impact on their daily life but roughly the same percentage claimed their financial situation did not change. Further, at the time, the majority (62%) of customers were still very or somewhat comfortable with a contractor working inside their home during the pandemic.

As stated in SDG&E's 2021 Annual Energy Program and Portfolio Budget Advice Letter (ABAL), "the pandemic has led to an unprecedented reduction in the ability of energy efficiency implementers and contractors to deliver certain types of energy savings projects in their homes. In addition, the pandemic and resulting economic impact has resulted in a decline in customer demand for many of the program administrators' equipment rebate programs, causing uncertainty for the administrators and their third-party implementers about energy savings forecasts."[24] Further, SCG's ABAL mentioned that "the COVID-19 pandemic has impacted the economy, customers willingness and ability to invest in energy efficiency, and how energy efficiency programs are implemented, among other impacts. This pandemic is ongoing and may have a long-term effect on the EE market that is not yet known. SoCalGas would like to lead a study on the effect of the COVID-19 pandemic."[25]

The impact evaluation of the PY2020 Residential HVAC Measures noted that installations in 2020 were approximately one-third lower than the prior two years.[26] Further, changes in customer habits at home during the pandemic impacted smart thermostat use, such as optimizing set points. Optimizing set points was more difficult when occupants were home all the time. This increased occupancy time reduced opportunities for setbacks that help achieve savings. Direct installation programs came to a halt in March 2020 and only picked up steam again in the latter half of the year.

SCE's 2024–2031 EE Portfolio and Business Plan described how energy usage among residential customers changed with COVID-19 and how those changes may continue in the near future.

> "Prior to Covid-19, electricity usage in the Residential sector had been slowly transitioning from historically high demand periods to a flattened demand curve throughout the day. This trend accelerated when Covid-19 hit, forcing a significant portion of the population to alter its work, schooling, and social behaviors. Because more people were in their homes during this period, consumption increased in this sector, as expected. As the pandemic moderates however, there is an expectation that

[24] SDG&E ABAL 2021, p. 3
[25] SCG 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 105
[26] Impact Evaluation of Residential HVAC Measures Residential Sector PY2020, DNV April 2022

> a gradual shift back to the Commercial sector may occur, but based on industry trends, this new work/study-from home model may resume indefinitely – permanently altering the usage profiles of the past. This observation is important to note in light of the Potential and Goals study on opportunities for fuel substitution. As the work-from-home population grows, demand for electricity during daytime hours may continue to increase. For instance, on a cool winter day when demand for heating increases to serve more people at home, the requirement for increased EE is compounded if gas heaters are swapped for electric heat pumps. This type of trade-off between increased electricity usage that results from fuel substitution factors heavily in how SCE composes its portfolio to balance requirements for GHG reduction while minimizing impact to the grid with incremental load."[27]

During the shelter-in-place period more residents stayed at home and therefore used more energy. This, in turn, motivated some residential customers to make changes to save energy and participate in energy efficiency programs.[28] COVID-19 also shifted marketing and communication methods. For example, PG&E's Energy Access Single Family implementation plan mentioned how "the pandemic has significantly shifted outreach from in-person to digital.[29] SDG&E's 2024–2031 EE Portfolio and Business Plan referenced a need to maintain health and safety for program staff and customer interactions while minimizing project interruptions. Activities and services were converted to online platforms where appropriate. "For example, on-site inspections/ verifications were converted to virtual verification processes."[30]

SCE's 2024–2031 EE Portfolio and Business Plan described a strategy to implement should an event similar to COVID-19 occur in the next cycle. "In 2020, the COVID-19 pandemic impacted industries focused on customer-oriented energy program. If a major unplanned event occurs during the four-year portfolio period, SCE will communicate with implementers to determine the situation and likelihood of meeting contractual obligations, establish a mitigation plan unique to the circumstances faced, leverage pay-for-performance contracts to ensure customers are protected, and assess SCE's ability to meet the four-year goals. Next, SCE will leverage the experience gained through the COVID-19 pandemic to establish a mitigation plan specific to new circumstances, potentially including different delivery models, incentive approaches, technologies, or other appropriate strategies."[31]

While all PAs' 2024–2031 EE Portfolio and Business Plans mention COVID-19 to some degree, they do not specifically state how their program plans address COVID-19 concerns for the residential market. Instead, most PAs discuss how they will approach the commercial market differently due to COVID-19.

4.1.3 Factors that Motivate Customer Decision-Making

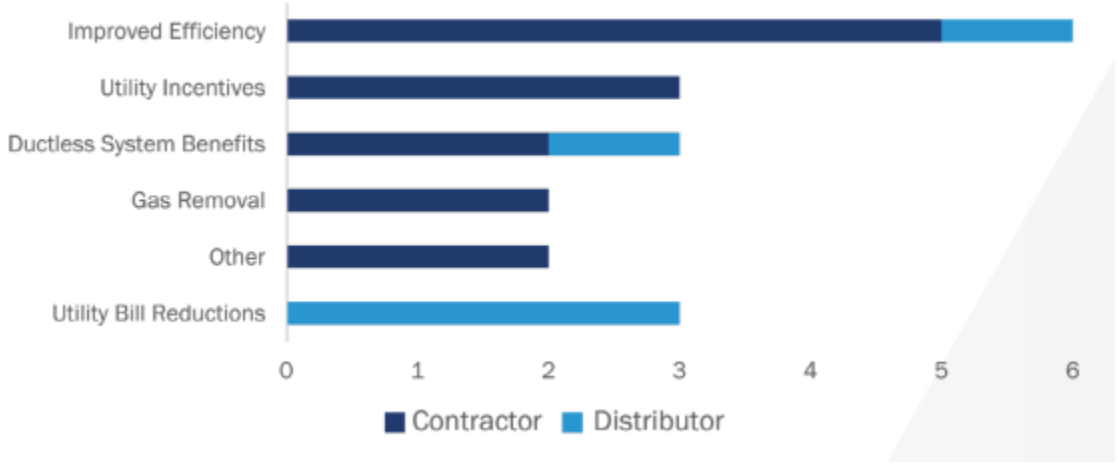
Heat Pump Adoption Motivations

The landscape analysis and Pulse Check survey sought to understand what motivates customer decision-making when replacing/upgrading equipment. There are multiple factors that motivate customers' decision-making when it comes to EE upgrades, specifically heat pumps. As part of the California Heat Pump Residential Market Characterization and Baseline Study, contractors and distributors noted that customers are motivated to adopt heat pump technologies such

[27] SCE 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 132
[28] Ibid, p. 11
[29] PG&E Energy Access Implementation Plan, p. 11
[30] SDG&E 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 217
[31] SCE 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 28

as heating and cooling units, clothes dryers, and water heaters for several reasons. These included improved efficiency, availability of incentives, desire to control temperature in individual rooms, and reduced utility bill costs.[32]

Figure 4. Trade Ally Perceived Customer Motivations



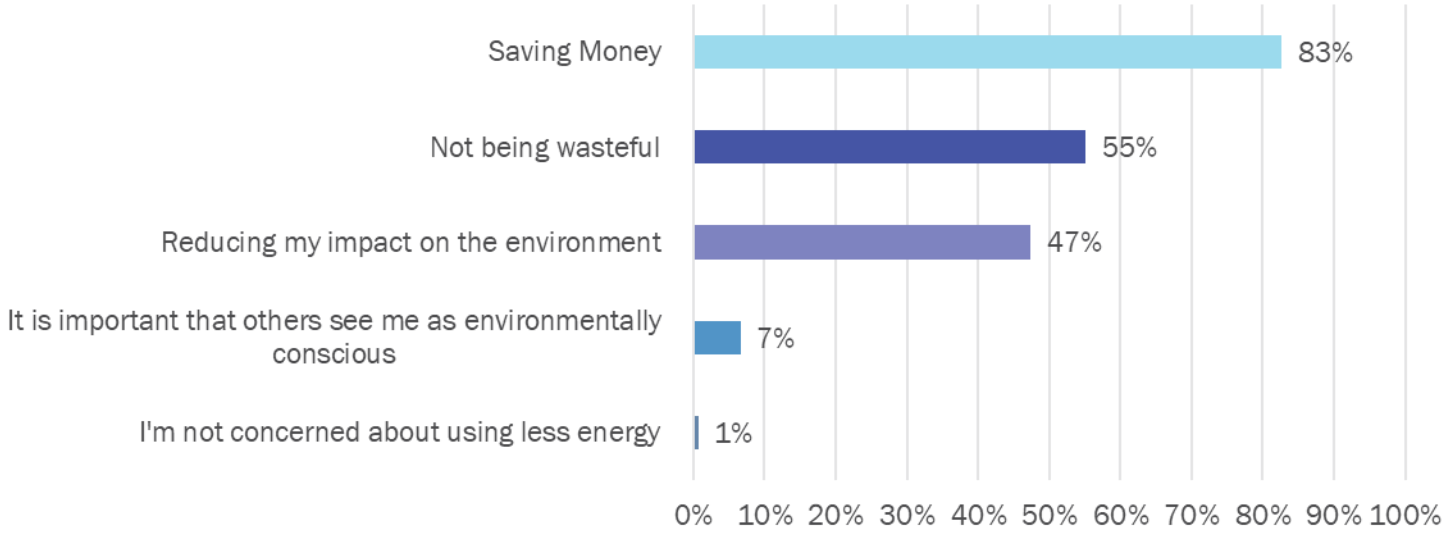
Source: California Heat Pump Residential Market Characterization and Baseline Study
n=14; *Interview Question: What motivates customers to adopt heat pump technologies?*

Similarly, the Pulse Check survey found saving energy was a top motivator among customers when deciding to purchase household appliances or electronics. The Pulse Check survey asked respondents how often the amount of energy used by a product (such as electronics or household appliances) influenced their decision of what to buy. Most respondents (84%) indicated that the amount of energy used by a product influenced their purchasing decisions "sometimes" (37%) or "most of the time" (47%). Only 5% of respondents indicated efficiency never influenced their purchase decisions. Results were similar across utility, housing type, and income subsegments, but varied by IOU-sponsored program participation. Compared to non-participants, respondents who had participated in an IOU-sponsored program within the past two years were significantly more likely to indicate the amount of energy used by appliances or household electronics influenced their purchasing decisions "most of the time" (54% vs. 45%).[33]

The Pulse Check survey asked respondents what motivated them to save energy. The figure below presents the percentage of all respondents who indicated each response option. Across all respondents, the most selected motivations to use less energy were saving money (83%), not being wasteful (55%), and reducing their impact on the environment (47%). Results were similar across utility, housing type, and income subsegments.

[32] California Heat Pump Residential Market Characterization and Baseline Study, Opinion Dynamics, May 13, 2022, p 66
[33] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

Figure 5. Motivations for Saving Energy



Pulse Check Survey Question: Which of the following reasons motivate you to try to use less energy? (Multiple responses permitted); n=965

The CPUC PY2020 HVAC Fuel Substitution Impact Evaluation explored motivations for installing heat pumps and found saving energy and reducing carbon emissions were the top motivators.[34]

> "A majority (61%) of those with central heat pumps reported the desire to save energy and reduce carbon emission[s] for motivating their installations while the majority of those with ductless heat pumps (69%) reported safety and comfort as their motivation for installing their system. These motivations explain the load building and lower savings estimated at the meter for the latter group. [Contractor] recommendations, saving money, equipment failure, and better use of renewable energy round out the other top motivations for installing the heat pumps. The majority of both groups (54% and 59% for those with central and ductless heat pumps, respectively) reported no barriers or challenges in connection with their heat pump installation. But for those that did experience barriers, installation and cost posed challenges."

[34] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

Table 14. Participant Motivations and Barriers to Installation

Characteristics	PY 2020 Central Heat Pump Participants (n=171)	PY 2020 Ductless Heat Pump Participants (n=394)
Motivations		
Save energy/reduce carbon emissions	*61%	47%
Improve safety and comfort	*43%	69%
Based on recommendation	*37%	33%
Save money	*34%	32%
Equipment Failure	*31%	16%
Better use of renewable energy	*30%	15%
Based on reputation of heat pumps	21%	20%
Adding air conditioning	*13%	44%
No other options	*2%	14%
Barriers		
No barriers or challenges	*54%	59%
Installation Barriers	*23%	16%
Cost Barriers	*21%	18%
Availability of equipment	*3%	4%
Knowledge Barrier	*6%	5%
Qualified contractors	5%	4%

** Statistically significantly different from ductless installation responses, at least at the 90% confidence level*

Source: CPUC PY2020 HVAC Fuel Substitution Impact Evaluation

Survey Question: What motivated you to install a central/ductless heat pump? (Multiple responses permitted)

While the CPUC PY2020 HVAC Fuel Substitution Impact Evaluation indicated reducing carbon emissions was a top motivator for purchasing and installing energy-efficient technology like a heat pump, the Pulse Check Pulse Check survey found customers' top motivation for using less energy was saving money (83%); in addition, roughly half of respondents selected "not being wasteful" (55%) and "reducing their impact on the environment" (47%). This supports what PAs and implementers shared during in-depth interviews as part of the landscape analysis. PA and 3P staff emphasized that convincing customers they will save money from installing energy-efficient equipment is an extremely important aspect of motivating them to participate in EE programs and save energy. Interviewees also shared that this was especially true of SDG&E customers who were facing unique economic conditions in San Diego, as well as high rates of inflation at the time.

The California EE Market Adoption Characteristics Study[35] indicated single-family residential respondents perceive ecological impacts (environmental issues and repercussions) as highly important considerations in their decision-making about replacing or upgrading technology in their homes.[36] Respondents also rated the lifetime costs of technologies as very important, followed by the hassle factor, non-consumption performance, and social signaling as moderately important. Survey respondents rated the upfront costs of a technology as a somewhat important aspect of making a purchase decision, but the least important among all customer value factors. The single-family residential clusters, based on the California EE Market Adoption Characteristics Study, are defined in Table 16.

[35] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages 33-34.

[36] High-touch technologies include refrigerators, clothes dryers, and smart thermostats while low-touch technologies include furnaces, central air conditioners, water heaters, and insulation.

Table 15. Single-Family Residential Customer Value Factor Mean Scores by Cluster and Technology Type

Technology Type/Cluster	Lifetime Costs	Upfront Costs	Hassle Factor	Non-Consumption Performance	Eco Impacts[a]	Social Signaling[a]
Overall (n=598)	3.6	2.7	3.2	3.2	4.1	3.1
High Touch Technologies (n=598)	3.6	2.6	3.2	3.0	N/A	N/A
Average Californians (n=299)	3.6	2.7	3.2	3.0	N/A	N/A
Eager Adopters (n=120)	3.9	2.0	3.2	3.2	N/A	N/A
Likely Laggards (n=114)	3.1	2.3	3.1	2.9	N/A	N/A
Economically Strained Environmentalists (n=66)	3.6	3.2	3.3	3.0	N/A	N/A
Low Touch Technologies (n=598)	3.7	2.8	3.2	3.2	N/A	N/A
Average Californians (n=299)	3.7	2.9	3.2	3.4	N/A	N/A
Eager Adopters (n=120)	4.1	2.3	3.3	3.2	N/A	N/A
Likely Laggards (n=114)	3.2	2.5	3.0	2.8	N/A	N/A
Economically Strained Environmentalists (n=66)	3.9	3.6	3.4	3.2	N/A	N/A
Fuel Substitution (n=513)	3.4	2.8	3.2	3.3	3.4	N/A
Average Californians (n=248)	3.4	2.9	3.2	3.2	3.4	N/A
Eager Adopters (n=105)	3.4	2.4	3.1	3.5	3.9	N/A
Likely Laggards (n=107)	3.0	2.9	3.4	2.9	2.4	N/A
Economically Strained Environmentalists (n=53)	3.9	2.3	3.5	3.6	3.9	N/A
Demand Response with Smart Thermostat (n=314) [b]	N/A	N/A	3.0	N/A	N/A	N/A
Average Californians (n=152)	N/A	N/A	3.1	N/A	N/A	N/A
Eager Adopters (n=79)	N/A	N/A	2.5	N/A	N/A	N/A
Likely Laggards (n=51)	N/A	N/A	3.0	N/A	N/A	N/A
Economically Strained Environmentalists (n=32)	N/A	N/A	3.1	N/A	N/A	N/A
COVID-19 Adjustment Factor (n=598)	1.2	1.7	2.6	N/A	N/A	N/A
Average Californians (n=299)	1.2	1.7	2.7	N/A	N/A	N/A

Technology Type/Cluster	Lifetime Costs	Upfront Costs	Hassle Factor	Non-Consumption Performance	Eco Impacts[a]	Social Signaling[a]
Eager Adopters (n=120)	1.1	1.4	2.6	N/A	N/A	N/A
Likely Laggards (n=114)	1.2	1.5	2.8	N/A	N/A	N/A
Economically Strained Environmentalists (n=66)	1.2	2.0	2.4	N/A	N/A	N/A

Source: California EE Market Adoption Characteristics Study

Notes: Non-low-income residential customers whose 2019 household income was greater than 200 percent of the federal poverty guidelines. Mean value factor scores on a 5-point scale where 1 means not at all important and 5 means extremely important in decision-making. Counts of less than 67 have less than 90/10 confidence/precision.

[a] The eco impacts and social signaling value factors are not technology-specific, except for the eco impacts value factor for fuel substitution.

[b] The only value factor for DR participation is the hassle factor since participating in a DR program does not involve any other factors.

Table 16. Single-Family Residential Cluster Definitions [a]

Segment Name	Attitudinal and Behavioral Characteristics
Average Californians	Attitudes and values are average and normally distributed (does not strongly skew in either direction on most items).
Eager Adopters	Believes strongly in environmental issues, wants to save energy, and has the financial means for energy upgrades.
Likely Laggards	Not very concerned with environmental issues, saving energy, or social signaling but has financial means for energy upgrades.
Economically Strained Environmentalists	Extremely concerned with environmental issues but efficiency upgrades can be out of financial reach, so desire to save energy is both altruistic and pragmatic; social signaling is important.

[a] Non-low-income residential customers whose 2019 household income was greater than 200 percent of the federal poverty guidelines.

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

According to the California EE Market Adoption Characteristics Study,[37] single-family residential respondents perceive the eco impacts (environmental issues and repercussions) as highly important considerations in their decision-making about replacing or upgrading technology in their homes.

> "There are few significant differences on each value factor between clusters or between the high-touch, low-touch, and fuel substitution technologies, but a few are discussed below:
>
> - **Lifetime Costs.** The Likely Laggards cluster reported that lifetime costs of technology are of lower importance compared to the other clusters, especially the Eager Adopters who rated lifetime costs as very important. Additionally, the clusters rated the lifetime costs of the fuel substitution technologies as less important than the high- and low-touch technology lifetime costs.
> - **Upfront Costs.** The Economically Strained Environmentalists cluster rated upfront costs of technology as much more important than the other clusters. At the technology-level, all clusters rated the upfront cost of installing high efficiency

[37] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages 32-33.

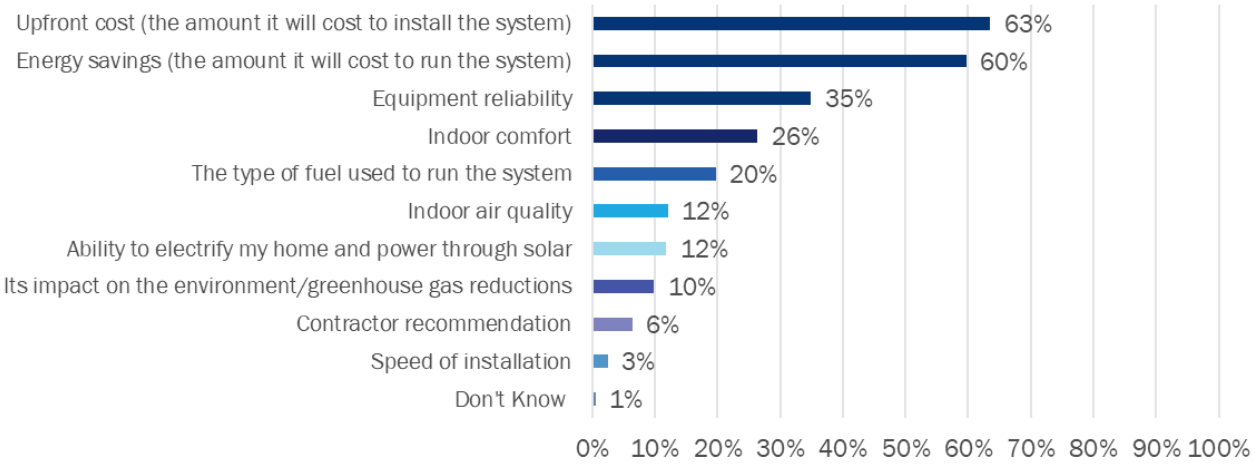
insulation as more important compared to most other technologies (not shown in table).

- **Hassle Factor.** The Economically Strained Environmentalists cluster rated the hassle factor of purchasing and installing technology more important compared to the other residential clusters. Customers across all clusters, who reported not having a smart thermostat rated the hassle factor of participating in a DR program as more important compared to those who reported having a smart thermostat (not shown in table).
- **Non-Consumption Performance.** The Likely Laggards cluster reported that the non-consumption performance of technologies was of lower importance compared to the other clusters. Additionally, all clusters rated the non-consumption performance of the refrigerator and central air conditioning technologies as more important than for the other high- and low-touch technologies (not shown in table).
- **Eco Impacts.** The eco impacts value factor was not technology specific (unlike the value factors above) except for the fuel substitution technologies. There was significant variation in the reported importance of eco impacts among the customer clusters: Eager Adopters and Economically Strained Environmentalists perceived eco impacts as substantially more important than Average Californians and Likely Laggards.
- **Social Signaling.** The social signaling value factor was not technology specific. There is some variation in the reported importance of social signaling across the clusters; the Eager Adopters and Economically Strained Environmentalists rated it as more important than the other customer clusters."

In the Pulse Check Pulse Check survey, homeowner respondents were asked what would be most important to them if they needed to purchase a new space heating or cooling system. The figure below presents the percentage of all respondents who indicated each response option. Among all respondents, the most important factors when purchasing a new space heating or cooling system for their home were upfront cost to install the system (62%), operational costs and energy savings of the system (62%), and equipment reliability (36%). Results were similar across subsegments, apart from housing type. Specifically, single family respondents were significantly more likely than mobile/manufactured home respondents to select the ability to electrify their home and power through solar as an important consideration when purchasing space heating or cooling (13% vs. 7%).[38]

[38] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

Figure 6. Important Factors when Purchasing New Space Heating/Cooling Equipment

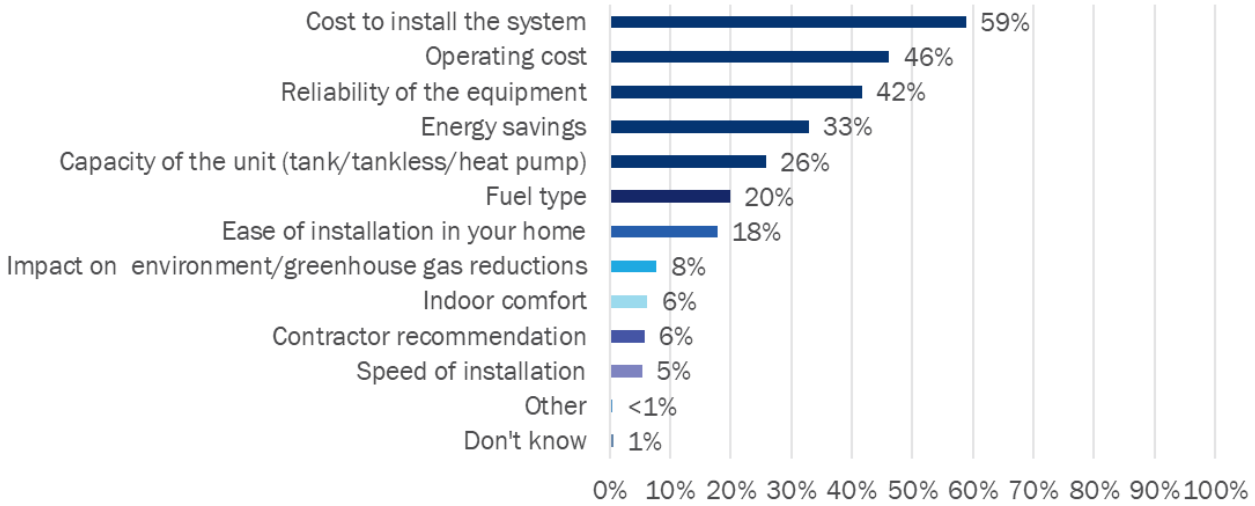


Pulse Check Survey Question: What would be MOST important to you if you needed to purchase a new space heating or space cooling system for your home? (Multiple responses permitted); n=872

Heat Pump Water Heater Adoption Motivations

The Pulse Check survey asked homeowners what would be most important to them if they needed to purchase a new water heating system for their home. The figure below presents the percentage of all respondents who indicated each response option. Across respondents, the most important factors to purchasing a new water heating system included the cost of installation (59%), operational cost (46%), and energy savings (33%). Results were similar across subsegments, apart from housing type. Single family respondents were significantly more likely than mobile home respondents to select the reliability of the equipment (43% vs. 28%)[39] and the capacity of the unit (27% vs. 17%)[40] as an important factor.

Figure 7. Important Factors when Purchasing New Water Heating Equipment



Pulse Check Survey Question: What would be MOST important to you if you needed to purchase a new water heater for your home? (Multiple responses permitted); n=872

[39] Difference significant at conservative alpha value of 0.01
[40] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

4.2 Research Objective 2: Current Program Gaps in Meeting Customer Needs

The second research objective aims to identify ways in which the overall market of current programs is not meeting customer needs by exploring which program offerings are currently available to customers, to what extent customers have been served by the existing programs, and which customer segments (if any) are not being served by the current programs.

4.2.1 Available Program Offerings

To address this objective, we started by looking at current EE programs offered in California. Residential customers have multiple options for participation in EE programs. The IOUs offer these programs directly or through 3P providers. Programs cover upgrading appliances, HVAC, and water heating equipment, as well as whole home upgrades. These are delivered as no-cost services, direct to customer rebates (downstream), manufacturer buydowns (upstream/midstream) or direct-installation.

The table below provides a summarized list of residential EE programs for existing homes offered in 2021 by PAs. EE programs across the IOUs offered several different incentives, rebates, and/or services to customers. Some programs included direct installation of low- to no-cost equipment such as low-flow showerheads, faucet aerators, pipe sleeves, lighting, and weatherization. Other programs offered rebates for the purchase and/or installation of higher-cost equipment such as HPWHs, smart thermostats, furnaces, and space heaters.

Table 17. Residential EE Programs for Existing Homes Offered in 2021[a]

PA	Program	Target	Budget	First Year Net GWh	Type
SDG&E	SDGE3204 SW-CALS – Plug Load and Appliances – POS Rebates	Residential All Types	$1,518,172	1.02	EE; Midstream rebates at point of sale for pool pumps, gas water heaters, electric heat pump water heaters
SDG&E	SDGE_SW_HVAC_Up - SW Upstream HVAC Program	Residential All Types	$2,232,092	1.21	EE; Upstream and midstream incentives for HVAC measures
SDG&E	SDGE4002 - Multi Family Program	Multifamily; Manufactured Homes	$5,345,438	1.30	EE; Direct install measures, complimentary ASHRAE Level 1 audits, incentives for advanced energy efficiency, solar PV installations, and battery storage
SCG	SCG3702 Residential – Residential Energy Efficiency Program	Single-Family	$11,655,724	0.90	EE; Gas measure rebate program for gas appliances
SCG	SCG3706 Residential – Residential HVAC	Single-Family	$500,000	0.0	EE; Incentives to distributors for EE furnaces
SCG	SCG3810 Residential – Smart Home Optimization Program	Single-Family	$828,707	0.0	EE; Installation of energy management technologies such as smart thermostats, cloud optimization protocols, water heater controllers, thermostatic control valves
SCG	SCG3829 Residential – Marketplace	Residential, All Types	$1,417,500	0.0	EE; Website with incentives for home appliances and consumer electronics
SCG	SCG3831 Residential – EE Kits	Residential in DACs and HTR customers	$150,000	0.0	EE; Kits include low-flow showerheads, faucet aerators

PA	Program	Target	Budget	First Year Net GWh	Type
SCG	SCG3832 Residential – Pasadena Home Upgrade	Residential in Pasadena	$447,300	0.0	EE; Home survey and weatherization services; no-cost direct install
SCG	SCG3833 Residential – Burbank Home Upgrade	Residential in Burbank	$374,525	0.0	EE; Electric, water, and gas measures at no cost; whole house approach
SCG	SCG3836 Residential – LADWP HVAC	Residential, All Types	$1,329,300	0.0	EE; No-cost installation of smart thermostats
SCG	SCG 3861 Residential – Community Language Efficiency Outreach – Direct Install (C–EO - DI)	Residential in Limited English and HTR communities	$1,166,123	0.22	EE; Direct install aerators, showerheads, tub-spout diverters, Nest® thermostats,[b] pipe sleeves, water heaters Shifting to an equity program
SCG	SCG3883 Residential – Residential Advanced Clean Energy Program	Single-Family	$0	0.0	EE; Direct install audit with electric, gas and water savings (i.e., aerators, furnaces, water heaters)
SCG	SCG3884 Residential – Comprehensive Manufactured Home Program	Manufactured & Mobile Homes	$0	0.0	EE; Direct install in-home energy and water efficiency survey and weatherization services, specific measures vary depending on audit results (i.e., insulation, ductwork, water heater) Shifting to an equity program
SCG	SCG 3885 Residential – Residential Manufactured Home Program	Manufactured & Mobile Homes	$0	0.0	EE; Direct install measures and incentives for EE measures vary depending on results of comprehensive modeling; Includes SCG3884 and more EE (i.e., lighting, whole house fan, windows) Shifting to an equity program
SCE	SCE-13SW-001B Plug Load and Appliances	Residential, All Types	$3,877,122	14.48	EE; Eco Financing as a payment method for a wide range of product categories; leverages instant point-of-sale rebates on heat pump water heaters from TECH/SGIP
SCE	Residential Direct Install	Residential HTR and LMI customers, Customers in DACs	$3,010,900	4.46	EE; Direct install weatherization and water savings provided and installed at no cost
PG&E [c]	Residential Energy Efficiency Program (PGE21002)	Residential, All Types	$954,279	0.26	EE; Incentives for smart thermostats and electric heat pump water heaters
PG&E [c]	Residential Pay for Performance (AKA Comfortable Home Rebate)	Residential, All Types	$3,472,922	3.41	EE & Behavior; Whole home upgrade rebates and home energy use analysis and reports, used NMEC approach
BayREN	Single-Family Home+	Single-Family, moderate income	$9,176,525	3.26	EE; bundles measures for electrification of water and space heat, cooking, and clothes drying. This program is filed under the “equity” program category.

[a] Opinion Dynamics conducted the landscape analysis in 2022. We reviewed each PA’s 2021 Annual Report Narratives and Budget Filing Detail Reports to identify the resource acquisition programs offered to residential single-family customers. To the extent possible, we focused on programs considered resource acquisition programs as defined in the most recent 2024–2031 PA EE Portfolio and Business Plans.

[b] Nest is a registered trademark of Google LLC, Limited Liability Company, Delaware

[c] Closed in 2021

Based on the information contained in the table above, it appears that the single-family market is being served by the current residential EE programs. Two PAs with overlapping service areas, SCE and SCG, are serving manufactured and mobile homes specifically through a 3P program implementer. The SCG program is considered an equity program rather than an RA program. According to the program implementer (Enervee), over 90% of the purchases made through the SCE Plug Load and Appliances program have been financed, cutting down the upfront cost barrier for customers.

Given these existing programs, new programs will need to identify customer segments or subsegments not currently participating in existing programs. Once identified, customer adoption in these differentiated segments may require more innovative methods for marketing and outreach rather than expanding the technologies offered.

4.2.2 Extent of Program Service Among Residential Customers

The landscape analysis and Pulse Check survey explored what percentage of customers were aware of and participating in IOU-sponsored programs, and whether awareness and participation varied across key customer segments. According to the Potential and Goals study, 75% of residential single-family customers are aware of IOU-sponsored rebate programs, but only 28% have participated in one. The Pulse Check survey results align with these findings. Approximately 74% of respondents were aware of IOU-sponsored programs, but only 25% participated in one in the past two years. Program awareness and participation did not vary statistically by IOU, housing type, or income, but did vary by homeownership. Homeowners were more likely than renters to be aware (75% vs. 64%) and have participated in an IOU-sponsored program (26% vs. 14%)[41] in that time frame.

4.2.3 Customer Segments Not Being Served by Current Residential Programs

The landscape analysis and Pulse Check survey explored which customer segments are not being served by the current residential program portfolio. Based on the PAs' 2024–2031 Portfolio and Business Plans, the types of customers not participating in EE programs are often renters, HTR, members of a DAC, or low-to- moderate income (LMI) customers.[42] For these customers, the following barriers make it challenging to participate in EE programs.

- Hard-to-Reach: Commission staff developed specific criteria to classify residential customers as HTR. These are customers who do not have easy access to program information or generally do not participate in energy efficiency programs due to
  - language proficiency,
  - income,
  - housing type,
  - geographic barrier (outside an identified metropolitan statistical area), or
  - home ownership (split incentives).[43]

[41] Difference significant at conservative alpha value of 0.01

[42] Opinion Dynamics' Pulse Check survey attempted to segment respondents by HTR and DAC status, but not enough respondents from these segments responded to the survey to merit statistical comparisons.

[43] SDG&E EE 3P Solicitation Advice Letter for Statewide Upstream and Midstream HVAC, November 2020, p. 8

The Commission later clarified the HTR customer definition in Resolution G-3497.[44] This resolution clarifies that if a "customer does not meet the geographic criterion (i.e., they are not located in one of the identified metropolitan statistical areas), they must meet a total of three criteria to be considered hard-to-reach; and if a customer meets the geographic criterion, they must meet one other criterion to be considered hard-to-reach."

- **Disadvantaged Community Customers**: "Disadvantaged Communities are in the most environmentally burdened California census tracts, as determined by the top 25 percent of high scores when using CalEPA's CalEnviroScreen tool. [45] These communities experience high unemployment, lower incomes, suffer a disproportionate impact from one or more environmental hazards, and are likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities."[46]
- **Low- to Moderate-Income**: These customers may not qualify for statewide ESA programs and services (due to source of income for example) but have significant financial barriers to adopting EE.[47] The income limits vary by county. Low-income customers have an annual household income of less than 50% of the HUD area median income. Moderate-income customers have an annual household income between 50% and 80% of the HUD area median income.

  For example, according to the 2022 HUD guidelines, a four-person household with an annual income of $65,050 or less in San Diego County is considered low-income. In Fresno County, the same household with an annual income of $38,950 or less is considered low-income.[48]

  According to the National Conference of State Legislatures, LMI customers are a desirable population for assistance because they face a greater "energy burden" than other demographics. This group uses approximately 7.2% of their income for energy needs. This is over twice the amount used by median income households (3.5%).[49] Barriers for this group include,

  - Large upfront capital requirements.
  - Reduced access to desirable financing.
  - Customers' low credit scores.
  - Lack of homeownership.
  - Inability to access tax incentives.
  - Residence in multifamily housing.
  - Residence in inefficient manufactured housing.
  - Lack of roof access.

  Further, a 2021 study of residential customers living in the San Joaquin Valley, one of CA's largest DACs, included a survey of 2,660 residential customers living in the region.[50] The study explored the customers' awareness of EE programs and self-reported recall of participation in any EE program. The table below presents San Joaquin Valley

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[44] D.18-05-041 Page 43
[45] https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40
[46] Source: SDG&E EE 3P Solicitation Advice Letter for Statewide Upstream and Midstream HVAC, November 2020, p. 8
[47] Currently the California statewide ESA income limit for a family of 4 is $69,375. This limit is effective July 1, 2022, to May 30, 2023, https://www.cpuc.ca.gov/consumer-support/financial-assistance-savings-and-discounts/energy-savings-assistance
[48] HUD FY-2022 Income Limits Documentation System, https://www.huduser.gov/portal/datasets/il/il2022/select_Geography.odn
[49] https://www.aceee.org/press/2016/04/report-energy-burden-low-income
[50] Opinion Dynamics, SJV DAC Data Gathering Plan Findings Report, August 2021.

customers' awareness of and participation in EE programs overall and by key customer segments. Overall, half of the customers (51%) were aware of EE programs but only 15% participated. Homeowners were more likely than renters to be aware of and have participated in EE programs. Among non-low-income customers living in this DAC, 60% were aware of EE programs but only 18%–19% participated.

Table 18. San Joaquin Valley Program Awareness and Participation

	n	Aware of SJV Proceeding	Aware of EE Programs	Participated in any EE Program
Overall	2,660	16%	51%	15%
Natural Gas Access				
No Natural Gas (a)	1,391	16%	53%	14%
Natural Gas (b)	1,269	16%	51%	15%
Community Size				
Small, No Natural Gas (c)	458	20%[d]	56%[e]	13%
Medium/Large, No Natural Gas (d)	933	16%	53%	14%
Small, Natural Gas (e)	229	20%[f]	48%	11%
Medium/Large, Natural Gas (f)	1,040	16%	51%	15%[e]
Home Ownership				
Owner, No Natural Gas (g)	1,082	14%	55%[h]	16%[h]
Renter, No Natural Gas (h)	309	21%[gi]	46%	10%
Owner, Natural Gas (i)	815	17%[gi]	55%[j]	19%[gi]
Renter, Natural Gas (j)	454	14%	44%	9%
CARE Eligible				
CARE Eligible, No Natural Gas (k)	571	19%[l]	47%	11%
CARE Ineligible, No Natural Gas (l)	560	15%	60%[k]	19%[k]
CARE Eligible, Natural Gas (m)	582	17%	43%	11%
CARE Ineligible, Natural Gas (n)	469	14%	60%[m]	18%[m]

a/b/c/d/e/f/g/h/i/j/k/l/m/n Indicates significant differences at a 90% confidence level between the following tests: ab,cd,ce,df,ef,gh,gi,hj,ij,kl,km,ln,mn

Source: SJV DAC Data Gathering Plan Findings Report, Opinion Dynamics, 2021.
Survey Questions: Q78, Q79, Q80.

Results from Pulse Check web-survey align with the landscape analysis. As previously mentioned, awareness of IOU-sponsored programs did not vary by housing type or income but did vary by ownership; homeowners were more likely to be aware of these programs than renters. Participation varied by both ownership and age; homeowners were more likely to have participated than renters (26% vs. 14%),[51] and those 65 or older were more likely to have participated than those younger than 65 (30% vs. 23%).

4.3 Research Objective 3: Effective Ways to Engage with Residential Customers

The third research objective aims to determine the most effective ways to engage customers in IOU-sponsored programs. Program engagement includes increasing customer awareness and knowledge of a program, potentially getting existing customers to participate in multiple programs, and attracting new participants. This objective also aimed to explore what types of programs/offerings are of most interest to customers.

[51] Difference significant at conservative alpha value of 0.01

4.3.1 Distribution Channels Successfully Reaching Customers (By Segment)

The landscape analysis and Pulse Check survey explored how IOUs should reach out to customers and whether the best outreach approaches varied across customer segments.

Effective Engagement Strategies

Interviews with IOU staff as part of the landscape analysis elicited several ways to effectively engage with residential customers:

- **Direct to Consumer Approaches:** According to IOU staff, a mix of digital and online marketing is an effective way to reach a large audience with information and resources. Auto-enrolling customers in free behavior platforms allows reaching a large proportion of the customer base.
    - Interviewees indicated a direct-to-consumer approach is an effective way to reach mobile and manufactured homeowners, HTR customers, or customers residing in DACs. In particular, knocking on customer doors and canvassing neighborhoods has been effective. However, this approach is challenging to deploy and may not meet program cost-effectiveness requirements. Similarly, the Pulse Check survey indicated respondents are most interested in learning about energy-efficient technologies, such as HVAC and water heating systems, through services that involve a building professional coming to their home to assess their space heating and cooling needs and recommend options for improvements.[52] According to IOU staff, however, this "face-to-face" approach can be adversely affected by external events such natural disasters and pandemics.
- **Contractors:** IOU staff said contractors can be an effective way to engage customers as they often provide customers with recommendations. When contractors promote EE, it can help increase customer interest in EE programs.
- **Opportunity to Try Products:** The opportunity to try an unfamiliar measure, such as an LED bulb or a smart thermostat, can be an effective way to engage customers in EE programs and other ways to save. Customers tend to like it when they get something in hand, but those strategies do not always yield the most savings.
- **Reaching customers "where they are":** generating "click-through" to a program website via advertising on digital streaming platforms such as podcasts, music streaming, or other social media can be effective engagement channels.

Preferred Resources During Purchasing Process

Overall, the Pulse Check survey found the four resources customers most frequently reference when purchasing HVAC and water heating equipment were a general web search, contractors/equipment installers, friends/family, and retail stores.

The Pulse Check survey asked homeowners to rank their top three options for where they would go for information on what to purchase if they were in the market for a new space heating or cooling system. The table below presents the percentage of respondents who selected each option in their top 3, and the percentage that selected each as their first,

[52] Pulse Check survey respondents were asked to rate their interest on a scale of 1 "Not at all interested" to 10 "Very interested" on the different ways their utility could provide them guidance on space cooling/heating or water heating needs and provide recommendations on energy-efficient equipment next time they are in the market for a new system. The average response was 5.8 across both technology types.

second, and third choice. The choices respondents selected most often were a general web search (68%) and contractor/equipment installer that they had experience with (66%), followed closely by friends and family (46%) and retail stores like Home Depot (41%).

Table 19. Where Respondents Would Go for Information about New Space Heating/Cooling System (Ranked)

	In Top Three	First Choice	Second Choice	Third Choice
General web search	68%	35%	18%	15%
Contractors or equipment installers that you have had experience with	66%	32%	18%	15%
Friends and family	46%	10%	19%	17%
Retail stores like Home Depot	41%	9%	16%	16%
Your electric utility company website	22%	5%	7%	10%
Online stores	17%	3%	7%	7%
Equipment manufacturers	21%	3%	8%	10%
Your gas utility company website	12%	1%	5%	6%
Other utility company website	4%	0%	1%	2%
Other	4%	2%	1%	1%

Pulse Check Survey Question: If you were in the market for a new space heating and cooling (HVAC) system, where would you go for information on what to purchase? (Rank top three); n=872

The choices respondents selected as their top three varied by utility, income, and IOU-sponsored program participation. The table below presents the percentage of respondents who indicated each option as being in their top three overall and by relevant subsegments. Notably, SCE respondents were significantly more likely than SDG&E and PG&E respondents to select their electric utility company's website and more likely than SDG&E respondents to select their gas utility company's website. Also interestingly, participants were significantly more likely than non-participants to select their electric utility company's website. Non-participants were more likely than participants to select friends and family or retail stores.

Table 20. Where Respondents Would Go for Information about New Space Heating/Cooling System (Overall and by Segments)

	Overall	Utility			Income		Program Participation	
		SDG&E (a)	PG&E (b)	SCE (c)	Moderate Income (h)	Market Rate (i)	Participant (p)	Non-participant (q)
n	872	277	280	315	293	401	232	640
General web search	68%	68%	71%[c]	64%	63%	74%[H]	75%[Q]	66%
Contractors or equipment installers that you have had experience with	66%	65%	68%	63%	70%	65%	62%	67%
Friends and family	46%	49%[c]	50%[C]	38%	47%	43%	39%	48%[p]
Retail stores like Home Depot	41%	51%[b]	38%	43%	43%	41%	31%	45%[P]
Your electric utility company website	22%	14%	20%	27%[ab]	20%	24%	30%[Q]	19%
Equipment manufacturers	21%	22%	20%	22%	22%	19%	23%	21%
Online stores	17%	17%	15%	18%	19%	15%	19%	16%
Your gas utility company website	12%	8%	11%	15%[a]	10%	14%	14%	12%
Other utility company website	4%	4%	3%	6%[b]	5%	3%	4%	4%
Other	4%	3%	4%	4%	2%	3%	4%	4%

Note: Chi-squared tests revealed a significant relationship between this question and the listed subsegments; however, measures of effect size were not calculated

Pulse Check Survey Question: If you were in the market for a new space heating and cooling (HVAC) system, where would you go for information on what to purchase? (Rank top three)

The Pulse Check survey asked homeowner respondents to rank their top three options for where they would go for information on what to purchase if they were in the market for a new water heating system. The table below presents the percentage of respondents who selected each option in their top 3, and the percentage that selected each as their first, second, and third choice. Overall, the choices respondents selected as being in their top three most often were a contractor/equipment installer that they had experience with (63%) and general web search (63%), followed closely by retail stores like Home Depot (51%) and friends and family (42%).

Table 21. Where Respondents Would Go for Information about New Water Heating System (Ranked)

	Overall mentions	First choice	Second choice	Third choice
Contractors or equipment installers that you have had experience with	63%	33%	18%	12%
General web searches	63%	28%	19%	16%
Retail stores like Home Depot	51%	15%	18%	17%
Friends and family	42%	9%	16%	17%
Your gas utility company website	21%	5%	7%	9%
Equipment manufacturers	21%	3%	9%	9%
Online stores	18%	2%	6%	10%
Your electric utility company website	13%	2%	5%	6%
Other utility company website	4%	<1%	2%	2%
Other	3%	2%	1%	1%

Pulse Check Survey Question: If you were in the market for a new water heating system, where would you go for information on what to purchase? (Rank top three); n=872

The choices respondents selected as their top three varied by utility, housing type, income, and IOU-sponsored program participation. The table below presents the percentage of respondents who indicated each option as being in their top three overall and by relevant subsegments. SCE respondents were significantly more likely than SDG&E and PG&E respondents to select their gas utility company's website and more likely to select their electric utility company's website than PG&E respondents. Additionally, participants were significantly more likely than non-participants to select their gas utility company's website.

Table 22. Where Respondents Would Go for Information about New Water Heating System (Overall and by Segments)

	Overall	Utility			Housing Type		Income		Program Participation	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate Income (h)	Market Rate (i)	Participant (p)	Non-participant (q)
n	872	277	280	315	775	97	293	401	232	640
Contractors or equipment installers that you have had experience with	63%	61%	66%[c]	60%	64%	61%	63%	64%	62%	64%
General web searches	63%	66%[c]	69%[C]	54%	65%[E]	50%	61%	68%[h]	69%[q]	61%
Retail stores like Home Depot	51%	57%[b]	45%	58%[B]	50%	60%[d]	59%[I]	46%	39%	55%[P]
Friends and family	42%	44%	45%[C]	36%	43%[e]	32%	44%	39%	35%	44%[p]
Your gas utility company website	21%	13%	18%	29%[AB]	21%	26%	20%	22%	26%[q]	20%
Equipment manufacturers	21%	23%	21%	20%	22%	18%	18%	23%	24%	20%
Online stores	18%	19%	16%	19%	17%	24%[d]	19%	16%	20%	17%
Your electric utility company website	13%	11%	11%	17%[b]	13%	19%[d]	10%	15%[h]	15%	13%
Other utility company website	4%	3%	3%	6%[b]	4%	7%	4%	4%	5%	4%
Other	3%	4%	4%	2%	4%	2%	2%	4%[h]	4%	3%

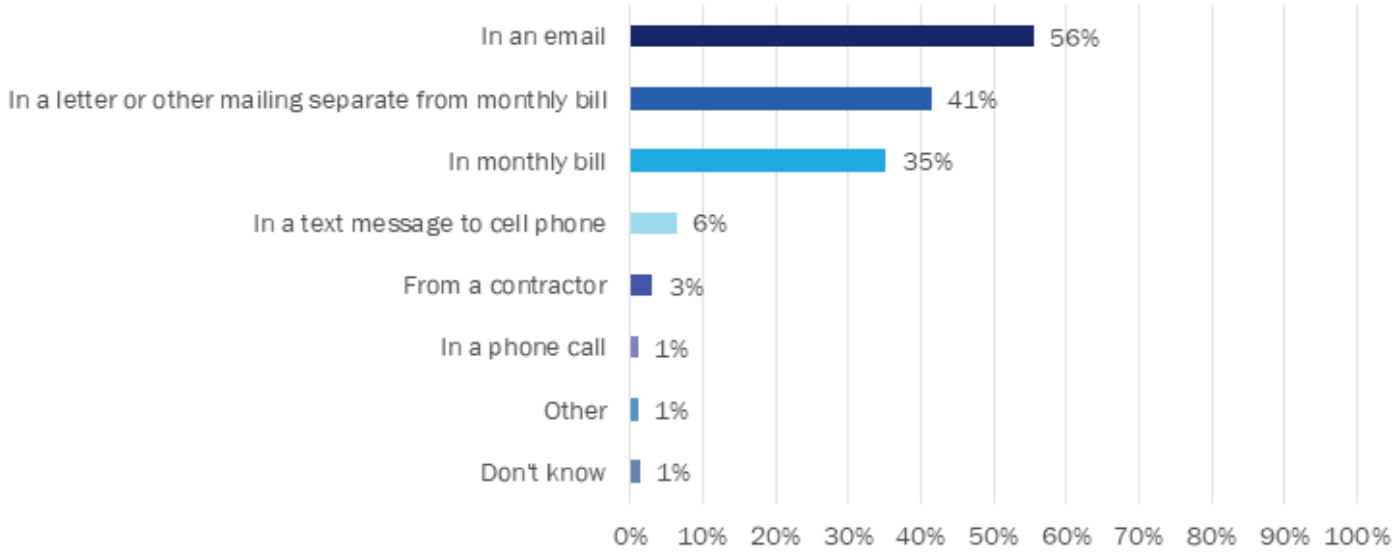
Note: Chi-squared tests revealed a significant relationship between this question and the listed subsegments; however, measures of effect size were not calculated

Pulse Check Survey Question: If you were in the market for a new water heating system, where would you go for information on what to purchase? (Rank top three)

Customer's Preferred Outreach Modes

The Pulse Check survey asked respondents if they were to receive information about saving energy in their home, how they would like to receive it. The figure below presents the percentage of all respondents who indicated each response option. The three most popular outreach channels for receiving information about saving energy at home were in an email (56%), in a letter separate from a monthly bill (41%), and as a bill insert (35%). Results were similar across utility and housing type but varied by income status and age. Specifically, moderate income respondents were significantly more likely than market rate respondents to indicate they would like to receive the information in their monthly bill (39% vs. 33%[53]). Regarding age, respondents under 65 were significantly more likely than those 65 and older to select in an email (61% vs. 50%)[54] and in a phone call (2% vs. <1%).[55] Inversely, those 65 and older were significantly more likely than those under 65 to select a letter or other mailing separate from their monthly bill (52% vs. 35%)[56] and from a contractor (4% vs. 2%).[57]

Figure 8. Outreach Mode Preferences



Pulse Check Survey Question: If you were to receive information about saving energy in your home, how would you like to receive it? (Multiple responses permitted); n=96

Interest in Programs to Assess HVAC and Water Heating Needs

The Pulse Check survey asked respondents to rate how interested they would be in the different ways their utility could provide them with assistance to address their heating/cooling needs the next time they are in the market for a new space heating or cooling system. Respondents rated their interest on a scale of 1 "not at all interested" to 10 "very interested." The table below provides mean interest scores overall and by subsegments. Overall, respondents were most interested in receiving that information via an IOU-sponsored at-home energy assessment (Mean=5.8, SD=3.5), followed by a website (Mean=5.3, SD=3.4). Respondents were least interested in a phone consultation (Mean=4.0, SD=3.4). Respondents' interest in an IOU-sponsored at-home energy assessment varied significantly by income, with

[53] Difference significant at alpha of 0.10, not at conservative alpha of 0.01
[54] Difference significant at conservative alpha value of 0.01
[55] Difference significant at alpha of 0.10, not at conservative alpha of 0.01
[56] Difference significant at conservative alpha value of 0.01
[57] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

market rate respondents being more interested than moderate income. Interest in a website that collects information and provides recommendations varied by housing type, with single family respondents being more interested than mobile/manufactured home respondents.

Table 23. Interest In Utility Offerings that Provide Education/Recommendations on Energy Efficient Heating and Cooling

	n	IOU-sponsored at-home energy assessment		Phone consultation with an energy advisor		Website that collects information and recommends options	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Overall	845	5.8	3.5	4.0	3.2	5.3	3.4
Utility*							
SDG&E (a)	267	5.6	3.5	3.7	3.0	4.9	3.3
PG&E (b)	276	6.0	3.5	4.1	3.2	5.5[c]	3.3
SCE (c)	302	5.6	3.5	3.8	3.2	5.0	3.5
Housing Type†							
Single family (d)	751	5.9	3.5	4.0	3.2	5.3[e]	3.3
Mobile home (e)	94	5.5	3.5	3.6	3.4	4.7	3.7
Income‡							
Moderate income (h)	284	5.6	3.4	4.0	3.1	5.3	3.3
Market rate (i)	396	6.5[H]	3.4	4.2	3.2	5.6	3.4
Program Participation§							
Participant (p)	225	6.2[q]	3.5	3.9	3.2	5.7[q]	3.4
Non-participant (q)	620	5.7	3.5	4.0	3.2	5.1	3.4

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq
A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ
* ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website that collects information and recommend options (effect size 0.006, df=2)

† ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website that collects information and recommend options (effect size 0.003, df=1)
‡ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in IOU-sponsored at-home energy assessments (effect size 0.017, df=1)
§ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in IOU-sponsored at-home energy assessments (effect size 0.003, df=1) and a website that collects information and recommends options (effect size 0.004, df=1)
Pulse Check Survey Question: If you were in the market for a new space heating or cooling system, how interested would you be in each source? (Scale 1-10) (Single response permitted)

The Pulse Check survey asked respondents to rate how interested they would be in different ways their utility could provide them guidance on water heating needs and provide recommendations on energy-efficient equipment next time they are in the market for a new water heating system. Respondents rated their interest on a scale of 1 "not at all interested" to 10 "very interested." The table below provides mean interest scores overall and by subsegments. Overall respondents were most interested in an at-home energy assessment (Mean=5.8, SD=3.6), followed by a website (Mean=5.4, SD=3.4). Respondents were least interested in a phone consultation (Mean=4.0, SD=3.2). Respondents' interest in an IOU-sponsored at-home energy assessment was similar across all subsegments except for income status, where market rate respondents were significantly more interested in an at-home energy assessment than moderate income respondents. Respondents' interest in a phone consultation did not vary by any subsegments. Participants were significantly more interested in utilizing a website to learn about water heating options compared to non-participants.

Table 24. Interest in Utility Offerings that Provide Education/Recommendations on Energy-Efficient Water Heating

	n	IOU-sponsored at-home energy assessment		Phone consultation with an energy advisor		Website that collects information and recommends options	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Overall	839	5.8	3.6	4.0	3.2	5.4	3.4
Utility*							
SDG&E (a)	261	5.6	3.5	3.9	3.1	5.0	3.5
PG&E (b)	274	6.0[c]	3.5	4.1	3.2	5.6[c]	3.3
SCE (c)	304	5.6	3.6	3.9	3.2	5.1	3.5
Housing Type†							
Single family (d)	747	5.9	3.5	4.1	3.2	5.4	3.4
Mobile home (e)	92	5.6	3.6	3.6	3.3	4.9	3.6
Income‡							
Moderate income (h)	279	5.8	3.4	4.1	3.1	5.6	3.3
Market rate (i)	396	6.3[h]	3.5	4.2	3.2	5.6	3.4
Program Participation§							
Participant (p)	224	6.0	3.5	4.1	3.2	5.7[q]	3.4
Non-participant (q)	615	5.8	3.6	4.0	3.2	5.3	3.4

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq
A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ
* ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website that collects information and recommends options (effect size 0.006, df=2); significant results of pairwise testing shown regardless of insignificant ANOVA
† ANOVAs with eta-squared revealed no significant relationships between this subsegment and interest in all educational utility offerings on energy efficient water heating
‡ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in an IOU-sponsored at-home energy assessment (effect size 0.005, df=1)
§ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website that collects information and recommends options (effect size 0.003, df=1)
Pulse Check Survey Question: If you were in the market for a new water heating system, how interested would you be in each source? (Scale 1-10) (Single response permitted)

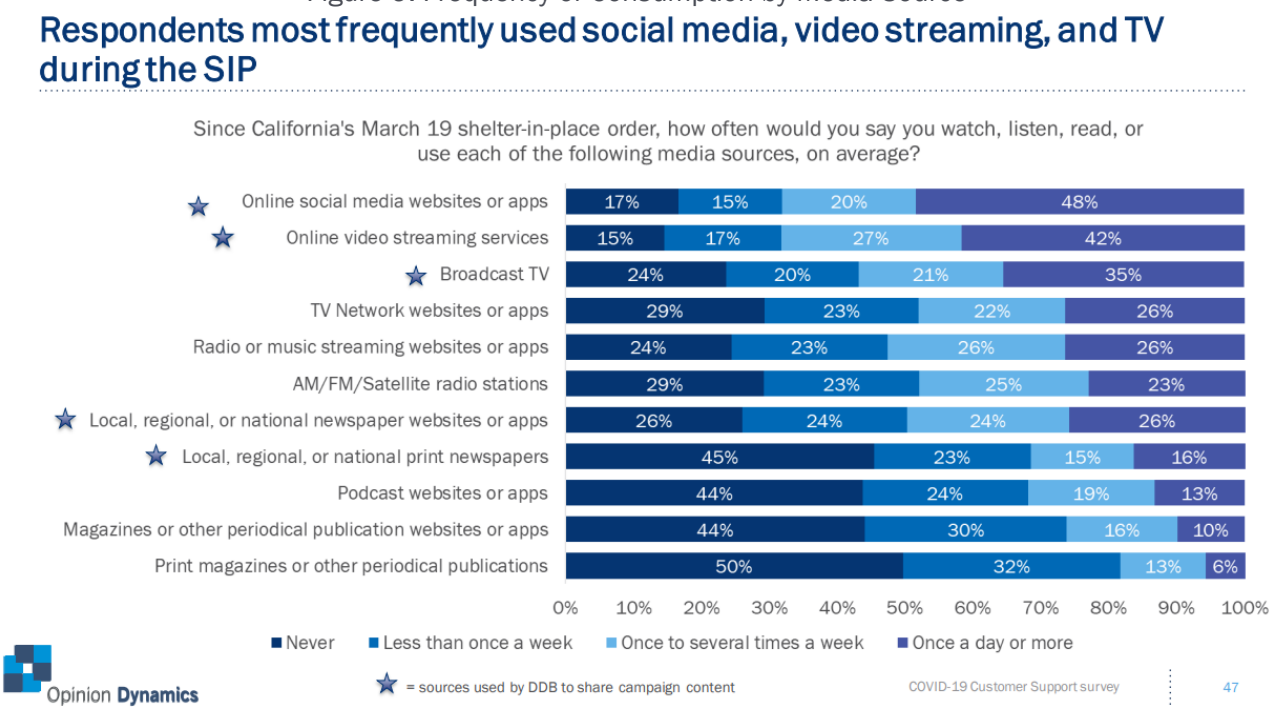
4.3.2 Communication Methods Resulting in Highest Customer Participation (by Segment)

Media Consumption Behavior

The landscape analysis and Pulse Check Pulse Check survey explored what types of media customers consume the most often and, therefore, could result in the highest customer engagement. The figure below depicts customers' how frequently customers consumer different types of media during California's shelter-in-place (SIP) order (March 19, 2020) according to the COVID-19 Customer Support Survey. The media sources residents most frequently watched, listened to, or were social media, video streaming, and broadcast TV.[58]

[58] COVID-19 Customer Support Presentation, slide 47

Figure 9. Frequency of Consumption by Media Source



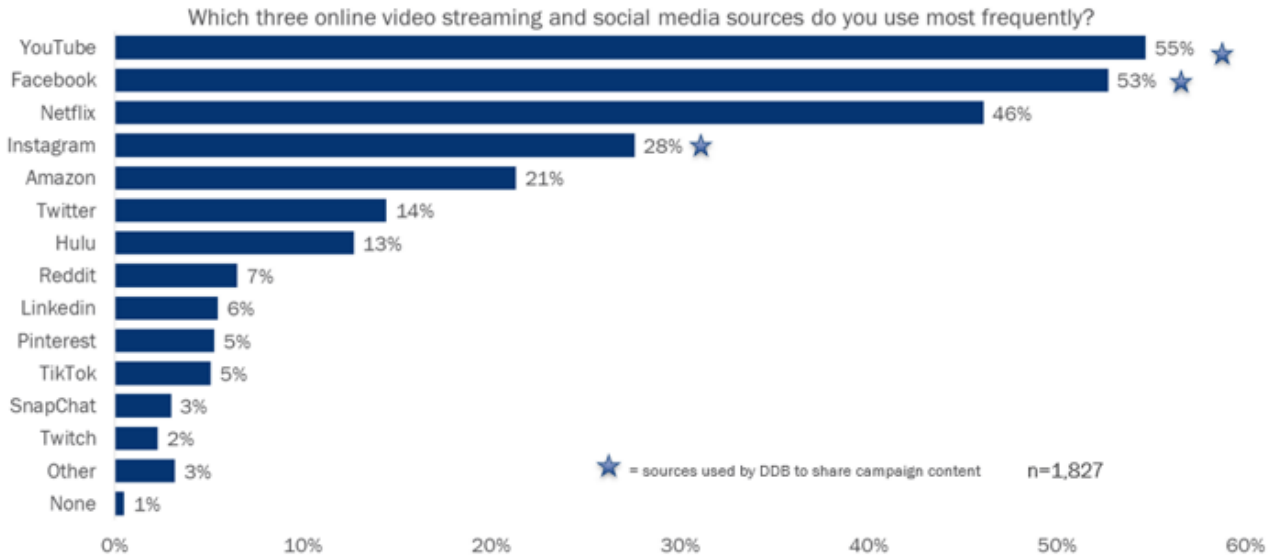
Source: COVID-19 Customer Support Campaign General Population Survey Report

Survey Question: Since California's March 19 shelter-in-place order, how often would you say you watch, listen, read, or use each of the following media sources, on average? (Single response permitted)

Further, knowing where customers spend their time online can help programs focus their digital marketing. The COVID-19 ME&O Survey showed that customers most frequently visited YouTube®, Facebook® and Netflix® for online video streaming and social media sources.[59]

[59] All product or company names that may be mentioned in this publication are tradenames, trademarks, or registered trademarks of their respective owners.

Figure 10. Online Video Streaming and Social Media Sources



Source: COVID-19 Customer Support Campaign General Population Survey Report
Survey Question: Which three online video streaming and social media sources do you use most frequently? (Multiple responses permitted)

The results from analyzing Energy Upgrade California's Flex Alert campaign also showed that most people see or hear about energy upgrades from the internet or social media and interact with these methods of communication at least once a day.[60]

Results on media consumption from the Pulse Check survey align with findings from the landscape analysis. The Pulse Check survey asked respondents how often they watched/listened/read/used various types of media. The table below presents the percentage of respondents that indicated each response option for each type of media. The survey found the three types of media customers consume most frequently ("once a day or more") are online video streaming services (42%), online social media (37%), and broadcast TV (35%). Further, the media that respondents indicated consuming the most frequently, as defined by the percentage who consume it at least "once to several times a month" were online video streaming services (79%), online social media websites and apps (64%), broadcast TV (62%), radio/music streaming websites or apps (60%), and AM/FM/satellite radio stations (59%). Over half of respondents indicated never reading print newspapers (56%), magazine websites/apps (50%), and print magazines (53%).

[60] Ibid, slide 17

Table 25. Frequency of Media Consumption

	Once a day or more	Once to several times a week	Once to several times a month	Less than once a month	Never	Don't know
Online video streaming services	42%	24%	13%	8%	11%	2%
Online social media websites or apps	37%	16%	11%	12%	22%	2%
Broadcast TV	35%	14%	13%	12%	24%	2%
Radio or music streaming websites or apps	30%	18%	13%	11%	26%	3%
AM/FM/Satellite radio stations	28%	19%	12%	13%	27%	2%
Newspaper websites or apps	27%	16%	14%	14%	27%	2%
TV Network websites or apps	23%	17%	13%	15%	31%	2%
Email newsletters	15%	16%	22%	19%	25%	3%
Podcast websites or apps	13%	12%	14%	20%	39%	2%
Print newspapers	11%	8%	9%	15%	56%	2%
Magazine websites or apps	6%	9%	13%	20%	50%	2%
Print magazines	3%	6%	13%	23%	53%	2%

Pulse Check Survey Question: How often would you say you watch, listen, read, or use each of the following media sources, on average? *(Single response permitted)*; n=965

The table below presents the percentage of respondents that indicated they consumed the media at least "once to several times a month" by utility, housing type, income, and age. Presenting the data this way allows for better visibility into overall trends and patterns. There were some differences in how frequently customers consumed select types of media across customer segments:

- **Differences in Media Consumption by Housing Type:** Customers who reside in single-family residences consume the following types of media more than those who reside in mobile/manufactured homes: online video streaming services, radio/music streaming websites or apps, AM/FM/satellite radio stations, newspaper websites/apps, email newsletters, podcast websites/apps, print newspapers, and magazine websites/apps. Inversely, mobile home customers seem to consume broadcast TV more often than single family customers.
- **Differences in Media Consumption by Age:** Customers younger than 65 consume digital forms of media more often than those 65 and older (online video streaming, online social media, radio/music streaming, podcast websites/apps); those 65 and older consume tradition forms of media more than those younger than 65 (broadcast TV, print newspapers, print magazines).

Table 26. Frequency of Media Consumption at least Once to Several Times a Month (Overall and Across Subsegments)

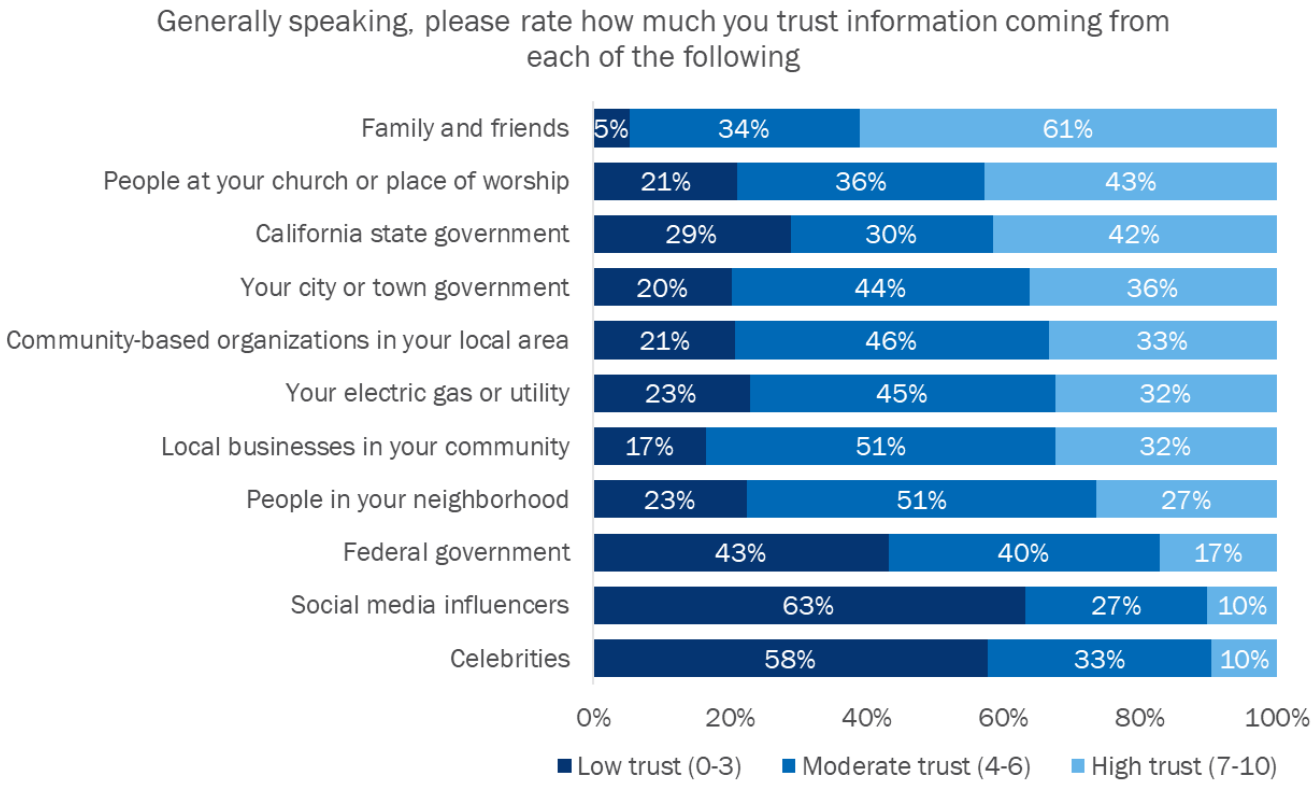
	Overall	Utility			Housing Type		Income		Age	
		SDG&E	PG&E	SCE	Single family	Mobile home	Moderate Income	Market Rate	Under 65	65+
n	965	321	321	323	865	100	331	445	482	320
Online video streaming services	79%	84%	80%	77%	80%	73%	77%	85%	87%	68%
Online social media websites or apps	64%	70%	65%	59%	64%	63%	58%	68%	75%	49%
Broadcast TV	62%	57%	61%	65%	61%	68%	67%	59%	52%	77%
Radio or music streaming websites or apps	60%	71%	64%	52%	62%	44%	58%	65%	72%	47%
AM/FM/Satellite radio stations	59%	60%	58%	59%	60%	48%	57%	60%	61%	55%
Newspaper websites or apps	57%	56%	62%	50%	58%	46%	56%	61%	57%	57%
TV Network websites or apps	53%	52%	54%	51%	53%	54%	57%	52%	49%	49%
Email newsletters	53%	57%	55%	49%	54%	47%	52%	56%	54%	56%
Podcast websites or apps	39%	45%	41%	33%	40%	26%	38%	41%	46%	26%
Print newspapers	28%	22%	30%	27%	29%	19%	29%	28%	18%	40%
Magazine websites or apps	28%	23%	32%	22%	28%	21%	25%	31%	28%	27%
Print magazines	22%	18%	22%	24%	23%	21%	25%	22%	19%	28%

Pulse Check Survey Question: How often would you say you watch, listen, read, or use each of the following media sources, on average? (Single response permitted)

Trust in Information Sources

According to the COVID-19 Customer Support Campaign General Population Survey, Californians trust friends, family, and people at church significantly more than celebrities and social media influencers. This demonstrates the importance of word-of-mouth referrals and actively engaging with community leaders when promoting EE programs to garner higher participation. The figure below shows the extent to which respondents trust different sources of information.

Figure 11. Ranking of Trust Among Information Sources



Source: COVID-19 Customer Support Campaign General Population Survey Report
Survey Question: Generally speaking, please rate how much you trust information coming from each of the following? (Single response permitted)
Note: Question asked on a 0–10 scale. Responses were binned into low, moderate, and high trust.

4.3.3 Programs/Offerings of Interest to Customers

Space heating & Cooling and Water heating incentive Delivery models

The landscape analysis revealed that current space heating/cooling and water heating program incentives are offered to customers in downstream and midstream models. In downstream models, customers can access coupons directly through websites to redeem at select retail or online stores, or purchase equipment directly and then complete an application for reimbursement. In midstream models, customers receive a discounted price on equipment through a contractor. PG&E and SCE are largely focused on downstream strategies, which they consider the most effective way to engage customers in EE. SDG&E's local programs also employ downstream strategies, which they have found an effective way to reach lower income customers, rental customers, and those living in mobile/manufactured homes. The downside is that downstream programs are much more costly to run and therefore, harder to gain participation in large volumes.

The two Statewide programs targeting Plug Load and Appliances and HVAC upgrades largely employ a midstream strategy. The strength of the midstream approach is that there are cost-efficiencies, volume benefits, program operational efficiencies, simplicity for the customer to participate, and consistent branding statewide. The weakness of the midstream approach is that it has some significant data collection and management challenges[61], and can lose

[61] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

some personalization, particularly a connection between the utility and the customer and possibly the opportunity to educate the customer. This may, or may not, be important as part of a positioning strategy.

The Pulse Check survey gauged customers' interest in various program delivery models for space heating and cooling needs versus water heating needs. The Pulse Check survey asked respondents to rate how interested they would be in different types of incentive delivery models the next time they are in the market for a new heating or cooling system. Respondents rated their interest on a scale of 1 "not at all interested" to 10 "very interested." The table below provides mean interest scores overall and by subsegments. Interest across the three incentive modes was very similar, ranging from 6.4 to 6.8. Single family respondents were significantly more interested in all the incentive modes than mobile home respondents.

Table 27. Interest in Incentive Delivery Models for Energy Efficient Space Heating and Cooling

	n	A website where you receive a coupon to redeem at select retail or online stores		A discounted price through an installation contractor		A rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Overall	834	6.4	3.4	6.6	3.2	6.8	3.2
Utility*							
SDG&E (a)	264	6.6	3.5	6.7	3.4	6.7	3.4
PG&E (b)	268	6.4	3.4	6.7	3.2	7.0[c]	3.2
SCE (c)	302	6.2	3.3	6.4	3.3	6.5	3.3
Housing Type†							
Single family (d)	743	6.4[e]	3.4	6.7[e]	3.2	6.9[e]	3.2
Mobile home (e)	91	5.7	3.4	6.0	3.2	6.1	3.3
Income‡							
Moderate income (h)	278	6.0	3.5	6.4	3.2	6.8	3.2
Market rate (i)	391	6.7[H]	3.3	7.1[H]	3.2	7.1	3.1
Program Participation§							
Participant (p)	223	6.6	3.3	7.0[q]	3.2	7.5[Q]	2.9
Non-participant (q)	611	6.3	3.4	6.4	3.2	6.5	3.3

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq
A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ

* ANOVAs with eta-squared revealed no significant relationships between this subsegment and interest in different incentive types; significant results of pairwise testing shown regardless of insignificant ANOVA

† ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website where you receive a coupon to redeem at select retail or online stores (effect size 0.005, df=1), a discounted price through an installation contractor (effect size 0.004, df=1), and a rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application (effect size 0.006, df=1)

‡ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website where you receive a coupon to redeem at select retail or online stores (effect size 0.011, df=1) and a discounted price through an installation contractor (effect size 0.013, df=1)

§ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a discounted price through an installation contractor (effect size 0.005, df=1) and a rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application (effect size 0.018, df=1)

Pulse Check Survey Question: If you were in the market for a new space heating or cooling system, how interested would you be in the following ways to receive discounts on the pricing? (Scale 0-10) (Single response permitted)

The Pulse Check survey asked respondents to rate how interested they would be in different types of IOU-sponsored incentives next time they were in the market for a new water heating system. Respondents rated their interest on a scale of 1 "not at all interested" to 10 "very interested." The table below provides mean interest scores overall and by subsegments. Interest across the three incentive modes was similar, ranging from 6.4 to 6.7. Respondents who participated in an IOU-sponsored program recently were significantly more interested in all the incentive modes

compared to non-participants. Single-family respondents were significantly more interested in two of the incentive modes than mobile home respondents (i.e., a discounted price through an installation contractor and a rebate for installed equipment after submitting an application). Market rate respondents were significantly more interested in using a website compared to moderate income respondents.

Table 28. Interest in Utility Offers that Provide Incentives on Energy-Efficient Water Heating Systems

	n	A website where you receive a coupon to redeem at select retail or online stores		A discounted price through an installation contractor		A rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Overall	838	6.4	3.3	6.5	3.3	6.7	3.2
Utility*							
SDG&E (a)	262	6.5	3.4	6.8	3.3	6.7	3.3
PG&E (b)	273	6.4	3.3	6.7[c]	3.2	6.9[c]	3.1
SCE (c)	303	6.3	3.3	6.2	3.3	6.5	3.3
Housing Type†							
Single family (d)	747	6.4	3.3	6.6[e]	3.3	6.9[E]	3.2
Mobile home (e)	91	5.9	3.4	5.9	3.3	5.8	3.3
Income‡							
Moderate income (h)	277	6.2	3.4	6.5	3.2	6.8	3.1
Market rate (i)	393	6.7[h]	3.3	6.9	3.2	7.0	3.2
Program Participation§							
Participant (p)	223	6.7[q]	3.2	6.9[q]	3.2	7.4[Q]	2.9
Non-participant (q)	615	6.3	3.4	6.4	3.3	6.5	3.3

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq
A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ
* ANOVAs with eta-squared revealed no significant relationships between this subsegment and interest in all incentive modes; significant results of pairwise testing shown regardless of insignificant ANOVA
† ANOVAs with eta-squared revealed no significant relationships between this subsegment and interest in a discounted price through an installation contractor (effect size 0.004, df=1) and a rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application (effect size 0.011, df=1)
‡ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website where you receive a coupon to redeem at select retail or online stores (effect size 0.006, df=1)
§ ANOVAs with eta-squared revealed a significant relationship between this subsegment and interest in a website where you receive a coupon to redeem at select retail or online stores (effect size 0.003, df=1), a discounted price through an installation contractor (effect size 0.006, df-1), and a rebate for the installed equipment where reimbursement for the rebate is mailed to you after you submit an application (effect size 0.015, df=1)
Pulse Check Survey Question: If you were in the market for a new water heating system, how interested would you be in the following ways to receive discounts on the pricing? (Scale 0-10) (Single response permitted)

Duct Work Program need and Interest

Given that the landscape analysis revealed that mobile home customers have unique needs related to duct work and this measure is mainly only cost-effective for program to offer to the mobile home sector, the Pulse Check survey asked mobile home respondents an additional battery of questions regarding potential duct work in their home. Given that the number of mobile home respondents (n=100) in each subsegment (utility, income, ownership status, etc.) was small, only overall results from the segment are discussed.

Of mobile home respondents, 85% indicated their heating/cooling system had duct work. Of these respondents, 80% indicated their ductwork was located underneath the floor (in the crawl space), 20% in the attic or across the ceiling,

and 9% in the interior walls (walls between rooms). No respondents indicated their duct work was in the exterior walls (walls that are perimeter of house) or outside of the house. Thinking about the quality of their duct work, 64% of respondents indicated their duct work was in good condition and they were not experiencing any concerns, 13% indicated it was in good or fair condition but needed some level of repairs, 4% indicated it was in poor condition and needed to be replaced, and 19% did not know the condition of their duct work.

The Pulse Check survey asked mobile home respondents with duct work how interested they would be in a service where a building professional came to their home, at no cost to them, to assess the condition of the duct work and help repair or replace it at a discounted price on a scale of 1 "not at all interested" to 10 "very interested." The mean score was 4.8 (SD=3.7, suggesting high variability in interest). Respondents who provided a score lower than 5 were asked why they provided that response. Approximately 15% of respondents could not pinpoint a particular reason, and 20% provided miscellaneous reasons that were too different to be categorized. Common responses included that they did not feel they needed their duct work checked (22%), they wanted to have someone else (not a program-related representative) check it for them (17%), they recently had their ductwork checked (13%), or their duct work was relatively new (12%).

4.4 Research Objective 4: Barriers and Opportunities for New Measures or Services

The fourth research objective aims to explore what challenges customers face in monitoring/controlling their energy usage, what barriers exist regarding purchasing energy-efficient equipment, what types of customers are not participating in IOU-sponsored programs, and what opportunities for new measures exist.

4.4.1 Challenges Customers Face in Reducing, Monitoring, and Controlling Energy Use and Demand

The landscape analysis and Pulse Check survey explored what challenges customers experience in monitoring and controlling their usage.

The PA/Implementer Perspective

In interviews, PAs and implementers reported similar views on challenges customers face when reducing, monitoring, and controlling their energy use. According to interviewees, these were common issues across regions and segments:

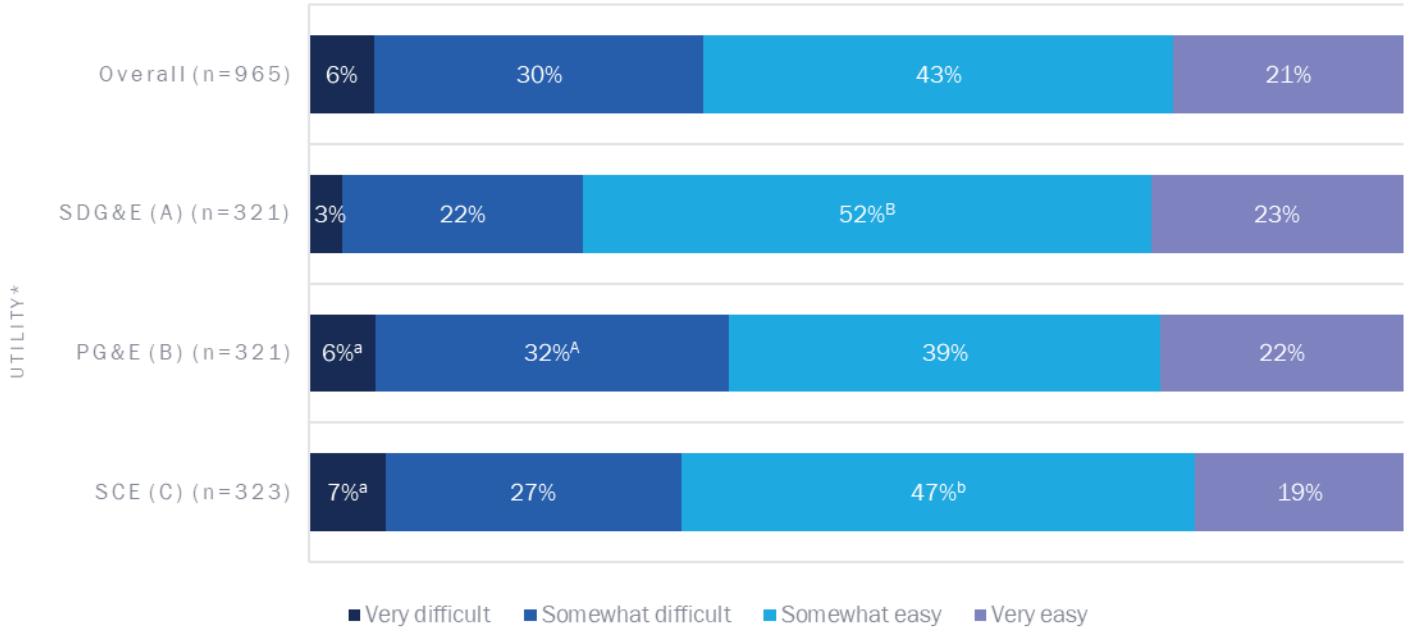
- Challenges reported were largely around monitoring and controlling energy use (rather than reduction).
  - Customers don't know how and when they use energy.
    - Most customers do not have the equipment necessary to monitor energy use in real time.
    - Customers are not interested in engaging with the monitoring resources available to them. For example, PG&E has found that asking customers to log-in to their online account to see their energy use is a barrier.
  - Customers' schedules and equipment in the home impact their ability to control use.
    - Customers may not control their schedules.
    - Customers may conduct high energy use activities, such as doing laundry, on set days, and may be unwilling or unable to change their habits.

- Customers may lack the equipment needed to control their energy use (e.g., if a customer does not have a smart thermostat, they cannot set it to pre-cool their home).

Monitoring Energy Usage

While PAs and implementers raised challenges during interviews regarding customers monitoring their energy use, the majority of Pulse Check survey respondents (65%) indicated it was at least somewhat easy for them to **monitor** their homes' energy usage. The Pulse Check survey asked respondents how easy or difficult it was for them to monitor their homes' energy usage. The figure below presents the response distribution overall and by subsegments. Most respondents (65%) reported that it was "somewhat easy" (43%) or "very easy" (21%) to monitor their usage; approximately 35% of respondents reported that it was "somewhat difficult" (29%) or "very difficult" (6%). Results were similar across housing type, income, and IOU-sponsored program participation subsegments, but varied by utility. Both SDG&E and SCE respondents were significantly more likely than PG&E respondents to indicate it was "somewhat easy" to monitor their homes' energy usage. Inversely, PG&E respondents were significantly more likely than SDG&E respondents to indicate it was "somewhat difficult" or "very difficult." SCE respondents were also more likely than SDG&E respondents to indicate it was "very difficult."

Figure 12. Ease or Difficulty of Monitoring Home Energy Use



Note: a/b/c indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc;
A/B/C indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.08 (df=6)

Pulse Check Survey Question: How easy or difficult is it for you to monitor your home energy use? (Single response permitted)

Overall, only 5% of respondents indicated they never monitored their household's energy usage. The Pulse Check survey asked the remaining 95% of respondents how they went about tracking their usage. The table below presents results overall and by subsegments. Most respondents reported tracking their home's energy usage by looking at their monthly energy bills (86%) and/or online utility account or web-based tool provided by their utility (18% and 14%, respectively). Results varied by utility, housing type, income, and IOU-sponsored program participation. Regarding differences by utility, SDG&E respondents were significantly more likely than PG&E and SCE respondents to indicate they leveraged their online real time utility account. Across income segments, market rate respondents were significantly more likely

than moderate income respondents to indicate they used online real time utility accounts. Lastly, participants were significantly more likely than non-participants to indicate they monitored their usage via online real time utility accounts and other web-based tools provided by their utility.

Table 29 Ways Respondents Monitor Their Home Energy Usage

	Overall	Utility			Housing Type		Income Status		Program Participation	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate Income (h)	Market Rate (i)	Participant (p)	Non-participant (q)
n	924	315	309	300	833	91	316	429	238	686
Monthly energy bills	86%	83%	84%	89%[a b]	86%	86%	87%	86%	84%	87%
Online real time utility accounts	18%	27%[b c]	19%	15%	19%	13%	16%	21%[h]	28%[Q]	15%
Other web-based tools provided by utility	14%	19%[c]	14%	13%	14%	15%	14%	16%	21%[Q]	12%
Other management or monitoring systems	15%	19%[C]	17%[C]	9%	15%[E]	8%	11%	18%[H]	24%[Q]	11%
Other	3%	3%	4%	4%	3%	7%	4%	3%	4%	3%
Don't know	<1%	<1%	<1%	2%[a b]	<1%	2%	<1%	<1%	<1%	1%

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq; A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ

Note: Chi-squared tests revealed a significant relationship between this question and the listed subsegments; however, measures of effect size were not calculated

Pulse Check Survey Question: How are you tracking your home's energy usage? (Multiple responses permitted)

Results from the Pulse Check survey indicated that, contrary to what PAs and implementers mentioned during their interviews, most customers do track their households' energy usage (95%) primarily by reviewing their monthly energy bill and make changes as a direct response to tracking their homes' energy usage (79%); approximately 21% of respondents reported they did not make any changes as a direct response to tracking their home's energy usage. Results were similar across utility, housing type, income, and IOU-sponsored program participation subsegments.

The Pulse Check survey asked those who reported making changes in direct response to monitoring their home's energy usage what changes they made. The table below presents results overall and by subsegments. Most reported turning off or reducing usage of appliances and equipment (46%). Others reported adhering to their time-of-use (TOU) rate (23%) and turning off lights when possible (24%). Results were similar across income subsegments, but varied by utility, housing type, and IOU-sponsored program participation. Notably, SDG&E and PG&E respondents were significantly more likely than SCE respondents to indicate they started adhering to their TOU rate after monitoring their energy usage. Interestingly, participants were significantly more likely than non-participants to indicate they made tangible upgrades to their homes' small appliances, major appliances, and building envelope; inversely, non-participants were more likely than participants to indicate they turned off/reduced their usage of appliances/equipment and turned off lights whenever possible.

Table 30. Changes Made as a Direct Response to Monitoring Energy Usage

	Overall	Utility			Housing Type		Program Participation	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Participant (p)	Non-participant (q)
n	741	259	237	245	666	75	191	550
Turning off or reducing usage of appliances and equipment	46%	49%	45%	47%	46%	45%	38%	49%P
Turned off lights when possible	24%	26%	23%	24%	24%	23%	19%	25%p
Adhering to TOU rate	23%	27%C	28%C	15%	25%E	11%	25%	23%
Upgraded smaller appliances (lightbulbs, smart timers, smaller kitchen appliances, etc.)	20%	19%	19%	22%	20%	26%	26%q	18%
Upgraded major equipment or appliances (washer, dryer, HVAC, thermostat, water heating)	17%	19%	17%	16%	17%	13%	21%q	15%
Added solar	15%	17%	13%	18%	15%	14%	19%	14%
Upgraded envelope	9%	5%	9%a	11%a	9%	12%	17%Q	7%
Don't know	5%	3%	5%	7%a	4%	14%d	2%	6%P
Bought EV	1%	1%	0%	2%b	1%e	0%	1%	1%
Other	1%	<1%	<1%	1%	1%e	0%	1%	<1%

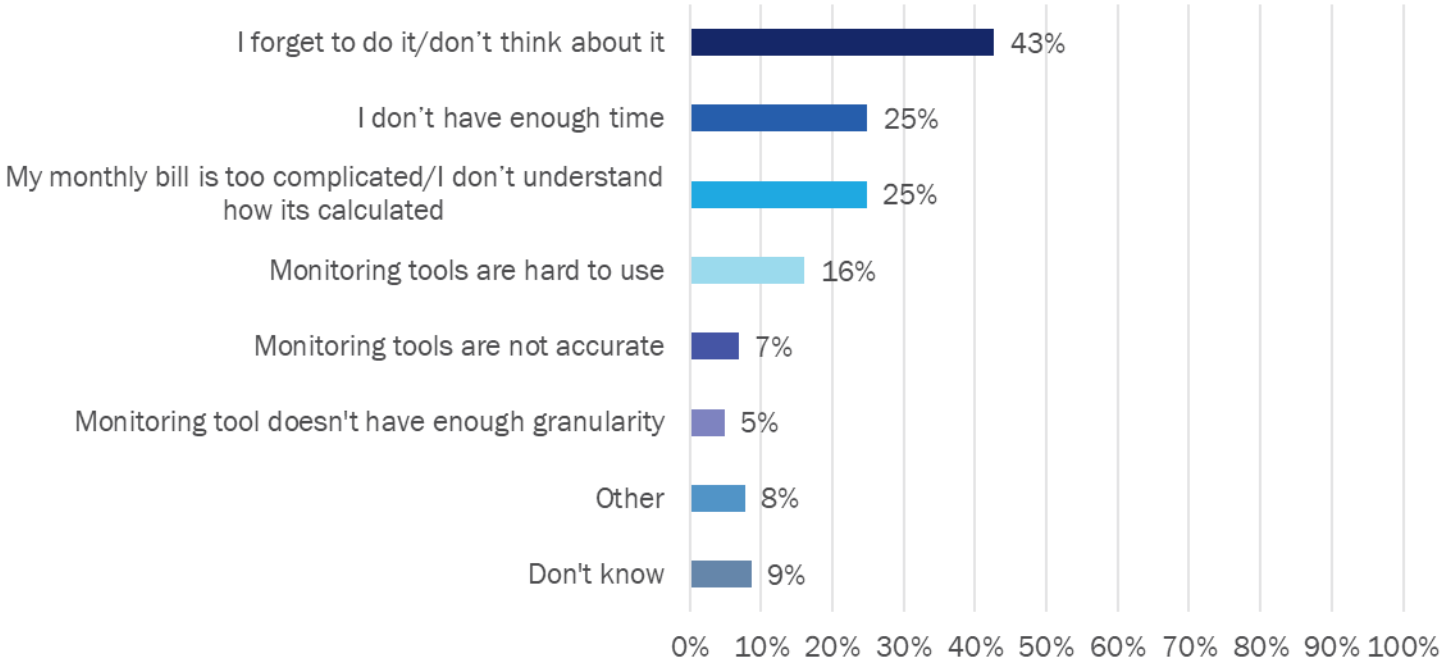
Note: a/b/c/d/e/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, pq; A/B/C/D/E/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, PQ
Note: Chi-squared tests revealed a significant relationship between this question and the listed subsegments; however, measures of effect size were not calculated

Pulse Check Survey Question: What changes have you made in response to monitoring your home's energy usage?

The Pulse Check survey asked respondents who indicated monitoring their home's energy usage was less than "very easy" what challenges they faced in doing so. The figure below presents the percentage of all respondents who indicated each response option. Respondents most frequently reported that they forgot to/did not think to monitor their home energy use (43%), did not have enough time to do so (25%), and/or did not understand their monthly energy bill (25%); only 16% indicated that monitoring tools were hard to use. Results varied by utility, housing type, income status, and IOU-sponsored program participation. Most notably, PG&E respondents were significantly more likely than SDG&E and SCE respondents to indicate that the monitoring tools at their disposal were hard to use (20% vs. 14% vs. 11%),[62] and significantly more likely than SCE respondents to indicate the monitoring tools lacked data granularity (6% vs. 3%).[63]

[62] Difference between SDG&E and PG&E significant at alpha of 0.10, difference between PG&E and SCE significant at alpha of 0.01
[63] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

Figure 13. Challenges Monitoring Home Energy Use

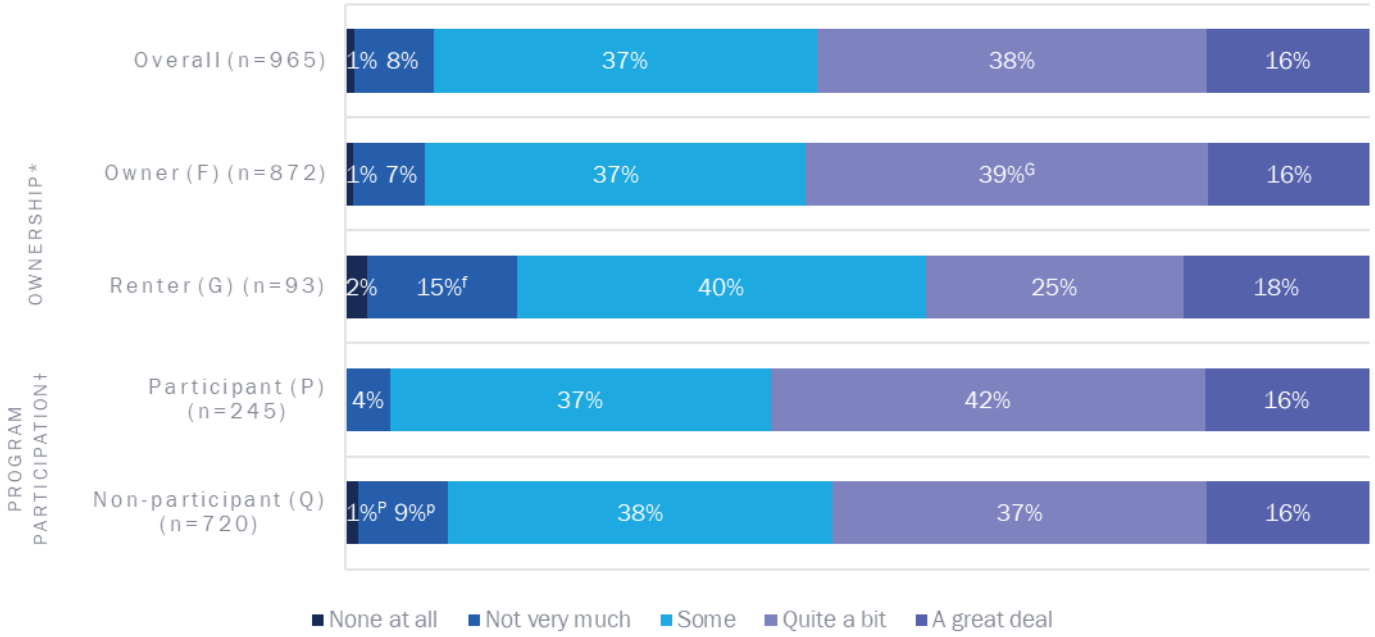


Pulse Check Survey Question: What are some of the challenges to monitoring your home's energy use? (Multiple responses permitted); n=758

Controlling/Reducing Energy Usage

The Pulse Check survey asked respondents how much **control** they felt they had over how much energy their household used. The figure below presents the overall response distribution, as well as distributions by relevant subsegments. Overall, 91% of respondents indicated they had at least "some" control over their household energy usage, with 54% indicating they had "quite a bit" or "a great deal." Results were similar across utility, housing type, and income subsegments- but varied by ownership and IOU-sponsored program participation. Specifically, homeowners were statistically more likely than renters to indicate they had "quite a bit" of control and less likely to indicate they had "not very much" control. Non-participants were statistically more likely than participants to indicate they had "none at all" or "not very much" control.

Figure 14. Sense of Control Over Energy Usage



Note: f/g//p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: fg, pq; F/G/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: FG, PQ

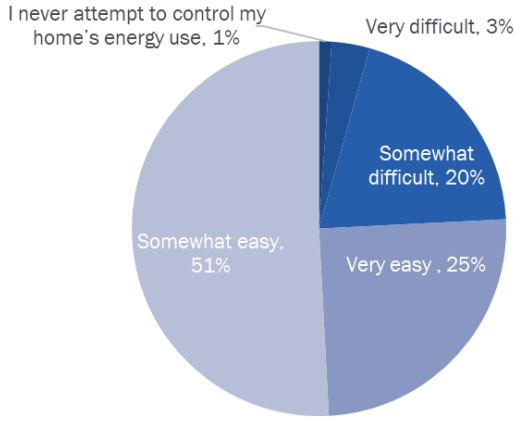
* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.10 (df=4)

ǂ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=4)

Pulse Check Survey Question: How much control do you feel you have over how much energy your household uses? (Single response permitted)

The Pulse Check survey asked respondents how easy or difficult it was for them to control the amount of energy their household used. The figure below presents the overall response distribution. Most respondents (76%) reported that it was "somewhat easy" (51%) or "very easy" (25%) to control the amount of energy their household used. Approximately 23% of respondents indicated that it was "somewhat difficult" (20%) or "very difficult" (3%). Only 1% indicated they never attempted to control their household energy usage. Results were similar across utility, housing type, income, IOU-sponsored program participation, and home ownership subsegments.

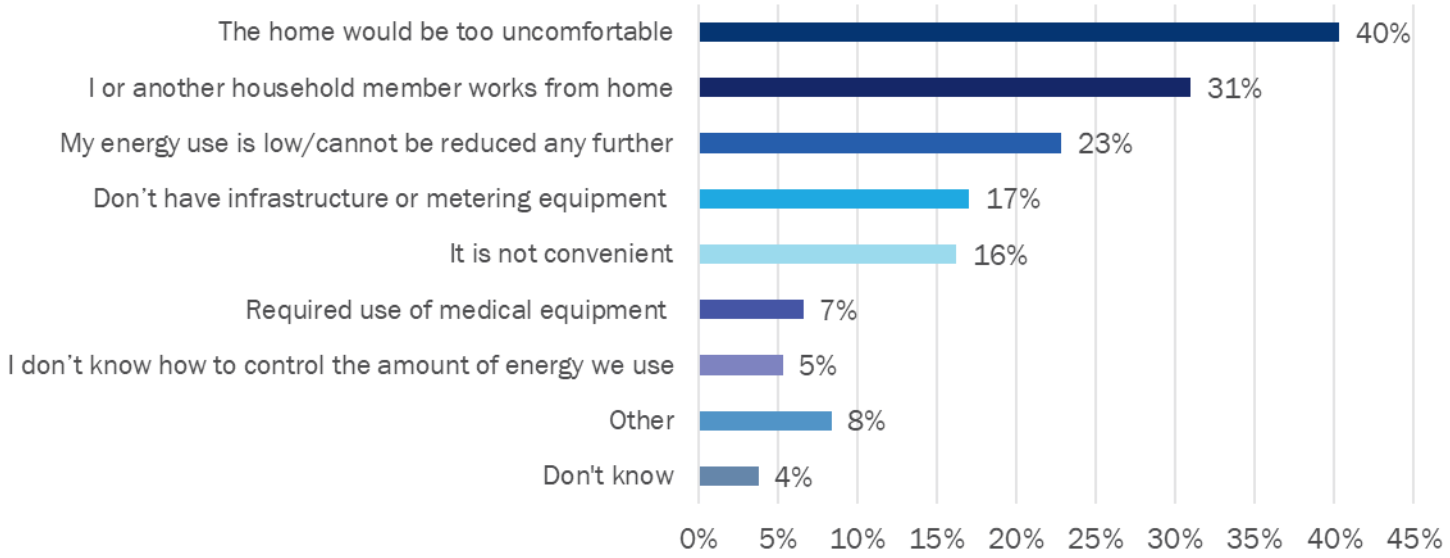
Figure 15. Ease or Difficulty of Controlling Home Energy Use



Pulse Check Survey Question: How easy or difficult is it for you to control the amount of energy that your household is using? (Single response permitted); n=96

The Pulse Check survey asked respondents who indicated controlling their home's energy usage was less than "very easy" what challenges they faced in **reducing** energy use. The figure below presents the overall results. Respondents most frequently cited concerns about household comfort (40%), themselves or a member of their household working from home (31%), and their home energy use already being low and not being able to reduce it any further (23%). Results were similar across utility and housing type subsegments but varied by income. Specifically, market rate respondents were significantly more likely than moderate income respondents to indicate they did not have the infrastructure or metering equipment needed to keep them on track (21% vs. 12%),[64] had a household member who worked from home (38% vs. 25%),[65] or felt it was inconvenient (19% vs. 12%).[66] Moderate income respondents were more likely than market rate respondents to indicate there was a household member that required medical equipment (10% vs. 4%).[67]

Figure 16. Challenges Reducing Home Energy Use



Pulse Check Survey Question: What are some of the challenges to controlling your home's energy use? (Multiple responses permitted); n=718

4.4.2 Barriers Facing Residential Customers

Overall Barriers to Adopting Energy Efficient Equipment

The landscape analysis and Pulse Check survey explored what barriers prevent customers from engaging with IOU-sponsored programs and pursuing select types of energy-efficient equipment. PA and 3P implementer interviews echoed the literature review findings regarding hurdles to customer participation in various programs. Reported hurdles included the following:

- **Level of ease and simplicity:** Customers want something simple and easy to do. Customers often do not want to spend the time and resources needed to educate themselves on all options and benefits of EE. Deep retrofits are time consuming and can require energy and resources customers may not have.

[64] Difference significant at conservative alpha value of 0.01
[65] Difference significant at conservative alpha value of 0.01
[66] Difference significant at alpha of 0.10, not at conservative alpha of 0.01
[67] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

- **Financial:** The cost of the upgrades is an even more pronounced barrier among the mobile and manufactured home segment than other segments. Some electrification measures require that customers upgrade their electric panel, which is an additional cost barrier on top of equipment and contractor installation costs. In addition, incentives and rebates are not always enough for customers to overcome the upfront cost barrier. Current high prices and general inflation seem to be leading customers to think about upgrades more judiciously relative to their overall financial position.
- **Structural:** The quality of construction, age of the home, quality of materials used to construct the home and the ability to add or adjust existing structures all impact the upfront cost to perform upgrades.
- **Level of trust in the IOU, vendor, and technology:** If a customer is already familiar with a product and they know it performs well then it can be difficult to convince them to try something new. Lack of trust and interest are more pronounced barriers among customers targeted with the Residential Direct Install and Comprehensive Manufactured Homes Programs. In an interview, SCE program staff stated, "Customers are cautious that it is a scam when implementers are doing door-to door-marketing."
- **Program eligibility rules:** For example, the Pay-for-Performance program required one year of consumption data from the home prior to participation so new tenants and new owners were not eligible.
- **Availability:** Product availability in the marketplace or delays in availability can be barriers to customers choosing energy-efficient equipment, especially if they need replacement equipment quickly.
- **Split incentives:** Staff noted they often see this barrier in the mobile/manufactured home market where the tenant does not own the property and the decision-making falls on the property owner or manager.

The Pulse Check survey explored barriers that prevent customers from pursuing two specific types of equipment: air source heat pumps and HPWHs. According to the Pulse Check survey, only 12% of customers currently have a heat pump for space heating/cooling and less than one percent of customers currently have a heat pump water heater. The barriers to adoption for air source heat pumps and HPWHs are listed in the table below.

Table 31. Adoption Barriers by Heat Pump Technology

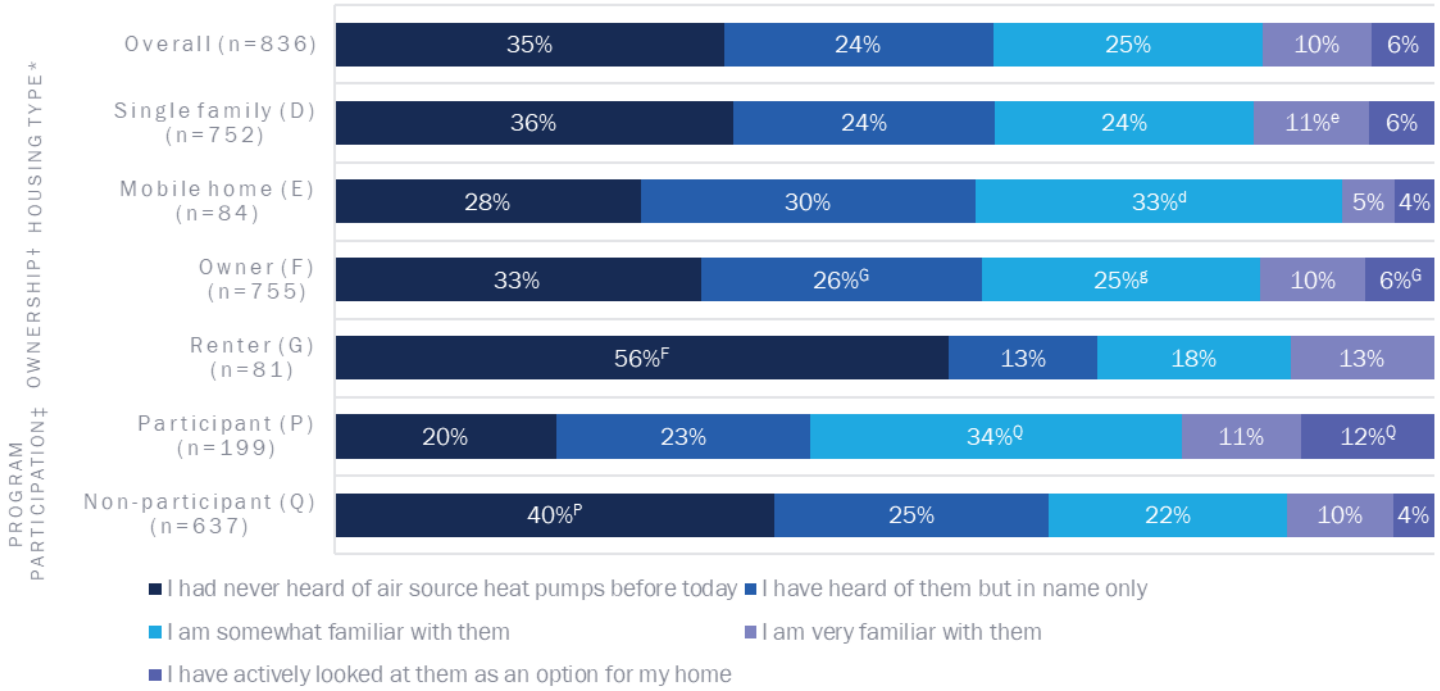
Barriers	Air Source Heat Pump	Heat Pump Water Heater
Lack of Awareness	60% of customers "never heard of" air source heat pumps before or "only knew the name"; renters and those who have not recently participated in an IOU-sponsored program were less familiar with the technology than owners and recent program participants (69% and 65% vs. 59% and 43%, respectively).	Half of customers "never heard of" HPWHs and an additional 25% were only "somewhat familiar." Market rate and recent IOU-sponsored program participants were more familiar with HPWHs than moderate-income participants and non-participants (29% and 37% vs. 21% and 21%, respectively).
Lack of Interest	Over half (55%) of customers were "slightly interested" or "not interested." Customers residing in mobile homes were less interested than those in single-family residences (69% vs. 53%).	Over half (51%) of customers were "slightly interested" or "not interested." Customers residing in mobile homes were less interested than those in single-family residences (58% vs. 50%).
No Need for Accelerated Replacement	Of those who were not interested in an air source heat pump, nearly half (49%) indicated it was because they simply were not in the market for a new system.	Of those who were not interested in an HPWH, 28% indicated it was because they simply were not in the market for a new system.
Cost	78% of customers cited cost as something that would keep them from considering energy-efficient HVAC in the future; moderate-income customers were more likely to cite this as a barrier than market rate customers (84% vs. 76%).	73% of customers cited cost as something that would keep them from considering an energy-efficient water heater in the future.
Need for Additional Construction	44% of customers cited the need for additional construction to install the unit as a barrier to them considering energy-efficient HVAC in the future.	38% of customers cited the need for additional construction to install the unit as a barrier to them considering an energy-efficient water heater in the future. Customers residing in a single-family residence were more likely to indicate this as a barrier than those residing in mobile/manufactured homes (74% vs. 67%).
Performance Information	One-fourth of customers felt that there was limited information on the performance of energy-efficient HVAC.	One-fourth of customers identified the capacity of HPWHs as a barrier.

Detailed Barriers to Air-Source Heat Pumps

Approximately 12% of respondents indicated they already use a heat pump for space heating/cooling; however, most respondents indicated they used a central forced air furnace to heat their home (85%) and central air conditioning to cool their home (63%).

The Pulse Check survey asked respondents who did not already have an air source heat pump how familiar they were with them. The figure below presents results overall and by subsegments. Overall, 60% had "never heard of them before" (35%) or "only knew of the name" (25%). Approximately 35% were "somewhat familiar" (25%) or "very familiar" (10%) with them. Only 6% indicated they "actively looked at them as an option." Results were similar across utility and income status subsegments, but varied by housing type, ownership, and IOU-sponsored program participation. Notably, renters and non-participants were significantly more likely to indicate they had "never heard of" air source heat pumps and significantly less likely to indicate they "actively looked at them as an option" than homeowners and participants respectively.

Figure 17. Familiarity with Air Source Heat Pumps



Note: d/e/f/g/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: de, fg, pq; D/E/F/G/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: DE, FG, PQ

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=4)

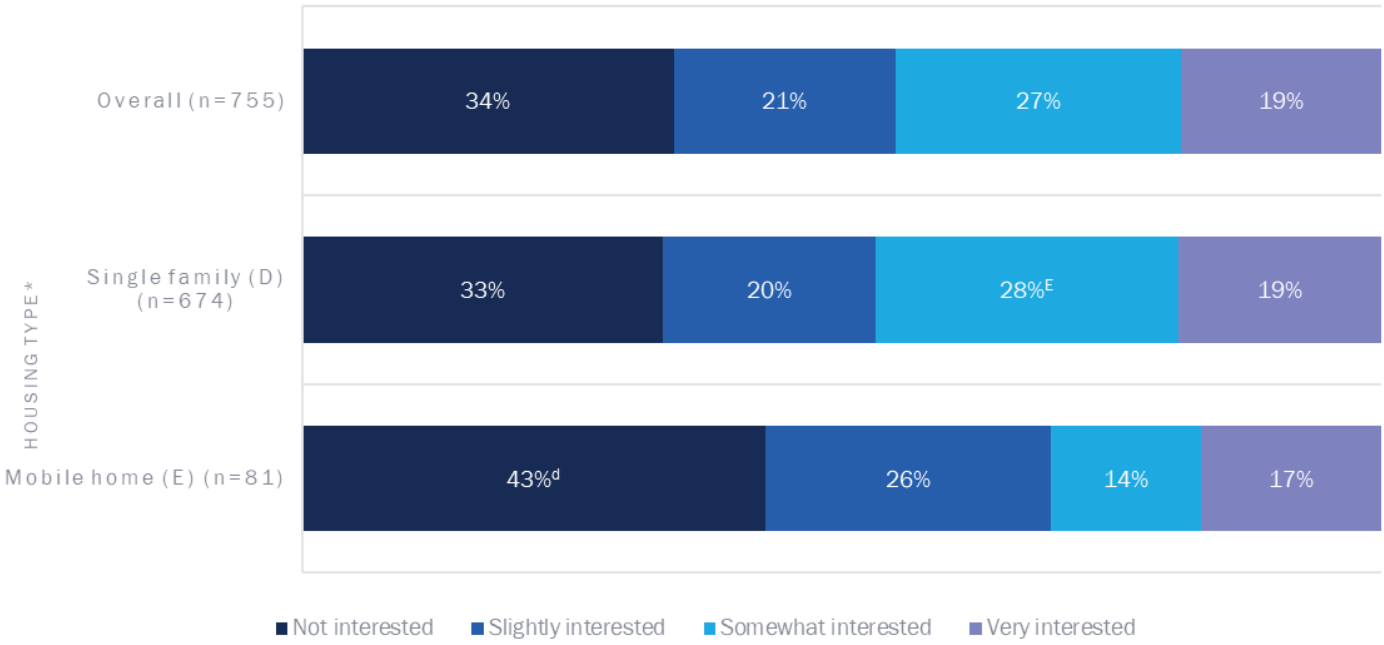
† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.23 (df=4)

‡ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.16 (df=4)

Pulse Check Survey Question: Thinking about air source heat pumps, which of the following statements describes you best? (Single response permitted)

The Pulse Check survey asked homeowners without an air source heat pump how interested they were in learning more about air source heat pumps next time they are in the market for new space heating or cooling. The figure below presents results overall and by housing type. Overall, 45% indicated they were "very interested" (19%) or "somewhat interested" (27%) and 55% indicated they were only "slightly interested" (21%) or "not interested" (34%). Results were similar across utility and income status subsegments but varied by housing type. Mobile home respondents were significantly more likely to indicate they were "not interested" and significantly less likely to indicate they were "somewhat interested."

Figure 18. Interest in Learning about Air Source Heat Pumps



Note: d/E indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: DE

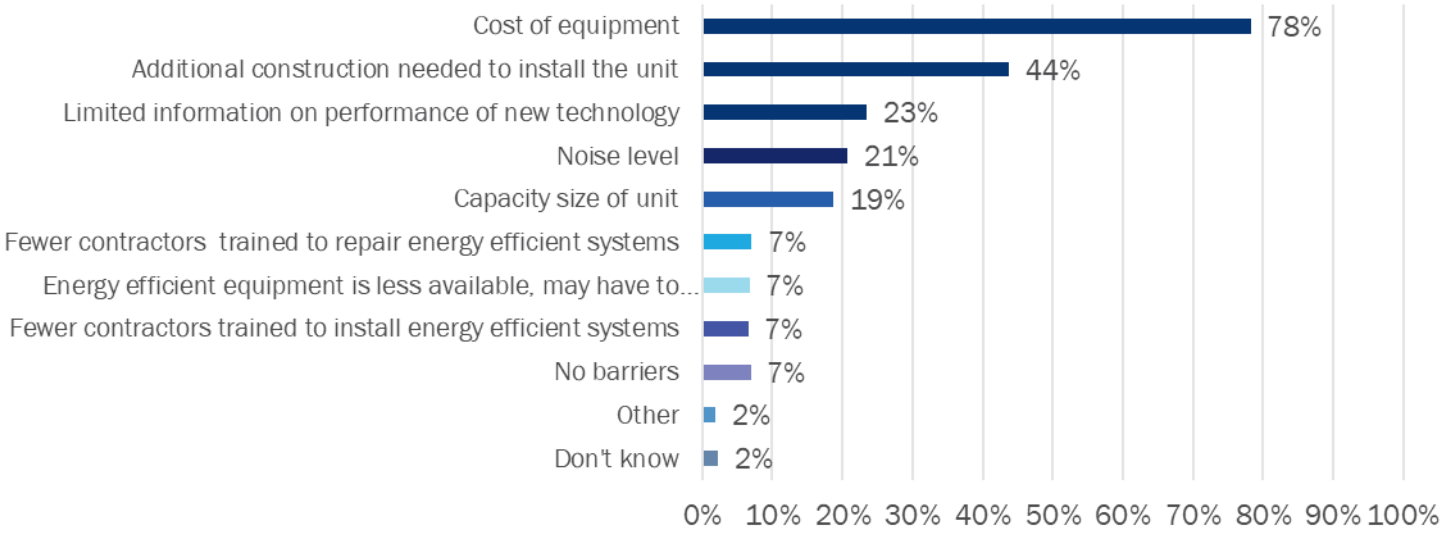
* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=4)
Pulse Check Survey Question: How interested would you be in learning more about an air source heat pump the next time you are considering a new space heating and cooling system for your home? (Single response permitted)

The Pulse Check survey asked respondents who indicated they were "not interested" in learning about air source heat pumps why they provided that response. Nearly half of respondents (49%) indicated they were not interested simply because they were not in the market for a new heating or cooling system; 24% could not cite a particular reason for their disinterest. Among more specific reasons for disinterest were dissatisfaction with air source heat pumps (7%), cost (6%), and the lack of a need for space conditioning in the home (4%). Results were similar across utility, housing type, and income subsegments.

The Pulse Check survey asked homeowner respondents what barriers would keep them from considering an energy-efficient space heating/cooling system over a standard model the next time they were in the market for a new system. The figure below presents the overall results. Overall, the most cited reasons were equipment cost (78%), additional construction that would be needed to install the unit (44%), and perceived limited information on performance of new technology (24%). Results were similar across utility and housing type subsegments but varied by income status. Specifically, moderate income respondents were significantly more likely than market rate respondents to select the cost of the equipment (84% vs. 76%)[68] and market rate responses were significantly more likely than moderate income respondents to select the capacity of the unit (22% vs. 12%).[69]

[68] Difference significant at conservative alpha value of 0.01
[69] Difference significant at conservative alpha value of 0.01

Figure 19. Barriers to Selecting Energy-Efficient Heating/Cooling Equipment



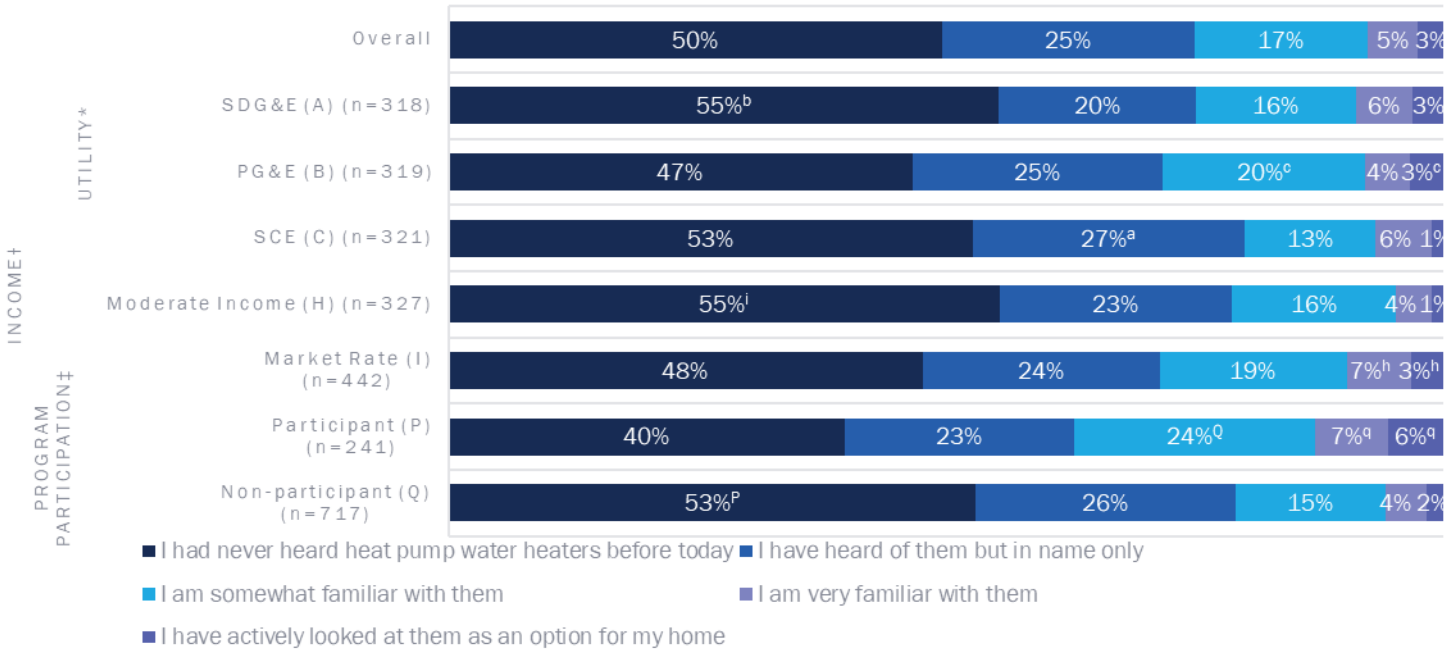
Pulse Check Survey Question: What barriers, if any, would keep you from considering an energy-efficient space heating and cooling system over a standard model the next time you are in the market for a new system? (Multiple responses permitted); n=872

Detailed Barriers to Heat Pump Water Heaters

Less than one percent of all respondents indicated they currently have a heat pump water heater. Most respondents indicated having a conventional storage tank water heater (80%). Approximately 17% of respondents indicated having a tankless water heater, and a small portion of respondents did not know what type of water heater they had (3%).

The Pulse Check survey asked respondents who did not already have a heat pump water heater how familiar they were with them. The figure below presents results overall and by subsegments. Overall, 75% of respondents indicated they had "never heard of them before" (50%) or "only knew of the name" (25%). Approximately 22% were "somewhat familiar" (17%) or "very familiar" (5%) with them. Only 3% indicated they "actively looked at them as an option." Results were similar across housing type and ownership subsegments, but varied by utility, income status, and IOU-sponsored program participation. PG&E respondents appear to be most familiar with heat pump water heaters (28% being at least "somewhat familiar"), followed by SDG&E (25%), and lastly, SCE (20%). Regarding income and program participation, market rate and participant respondents were significantly more likely to indicate they were "very familiar" or had "actively looked at them as an option" than moderate income and non-participant respondents, respectively. Inversely, moderate income and non-participant respondents were significantly more likely to indicate they had "never heard of them before today" than market rate and participant respondents respectively.

Figure 20. Familiarity with Heat Pump Water Heaters



Note: a/b/c/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, hi, pq; A/B/C/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, HI, PQ

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.09 (df=8)

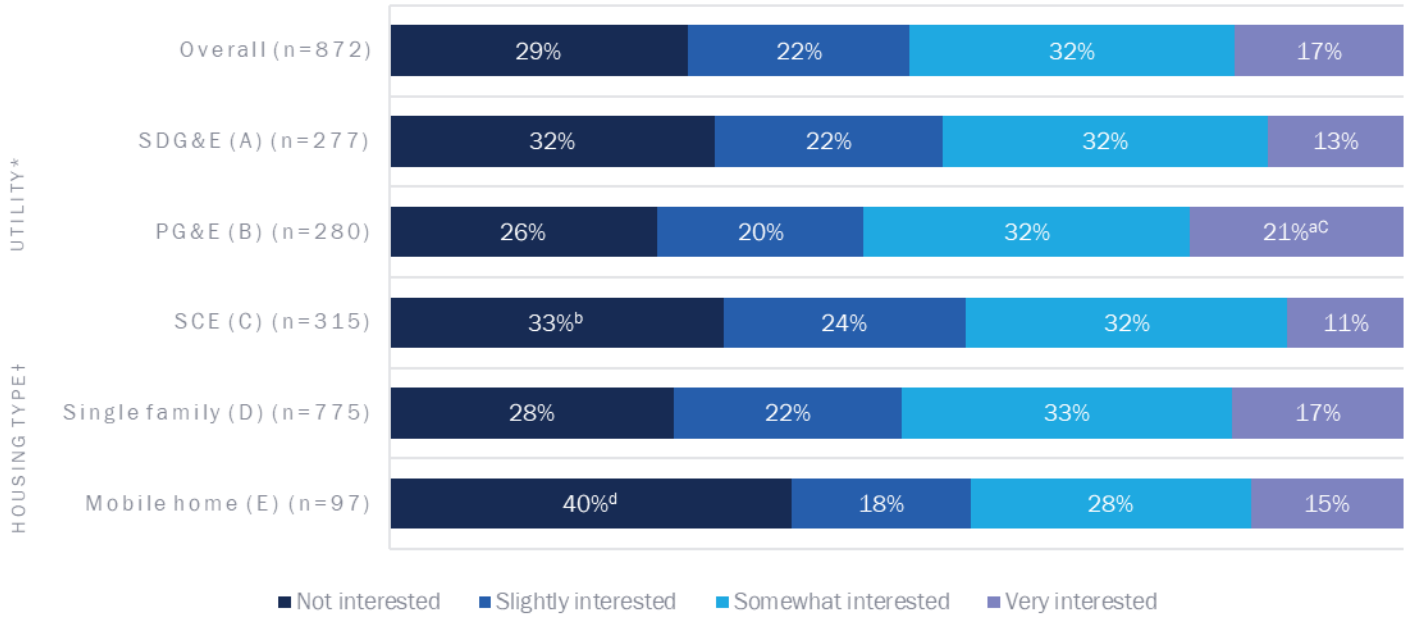
† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.11 (df=4)

‡ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.18 (df=4)

Pulse Check Survey Question: Thinking about heat pump water heaters, which of the following statements describes you best? (Single response permitted)

The Pulse Check survey asked homeowner respondents without a heat pump water heater how interested they were in purchasing a heat pump water heater next time they were in the market for water heating equipment. The figure below presents results overall and by subsegments. Overall, 49% of respondents indicated they were "somewhat interested" (32%) or very interested" (17%). Approximately 51% of respondents indicated they were "slightly interested" (22%) or "not interested" (30%). Results were similar across income status but varied by utility and housing type. Across utilities, 53% of PG&E, 49% of SDG&E, and 43% of SCE respondents were at least "somewhat interested" in a heat pump water heater. Regarding housing type, mobile home respondents were significantly more likely than single family respondents to indicate they were "not interested" in a heat pump water heater.

Figure 21. Interest in Heat Pump Water Heaters



Note: a/b/c/d/e indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de; A/B/C/D/E indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.09 (df=6)

ǂ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.08 (df=3)

Pulse Check Survey Question: How interested are you in an electric heat pump water heater the next time you are considering a new water heater for your home? (Single response permitted)

The Pulse Check survey asked respondents who indicated they were "not interested" in heat pump water heaters why they provided that response. Approximately 28% of respondents indicated they simply did not need a replacement and 23% did not provide an exact reason for their disinterest. Among more specific reasons were a preference for gas-fueled equipment over electric (15%), a preference for another type of equipment (12%), cost (8%), and lack of knowledge about the equipment (5%).

The Pulse Check survey asked homeowners what barriers would keep them from considering an energy-efficient water heating system over a standard model the next time they were in the market for a new system. The table below presents results overall and by subsegments. Overall, the most cited reasons were cost (73%), additional construction that would be needed to install the unit (38%), and capacity (25%). Results varied by utility, housing type, and income. Notably, single family respondents were significantly more likely than mobile home respondents to cite additional construction needed to install the unit and the fact they were a renter as reasons. Additionally, mobile home respondents were significantly more likely than single family respondents to indicate they had no barriers. These results align with the fact that mobile homes are structurally a good fit for heat pump water heaters. Regarding income, moderate income respondents were significantly more likely than market rate respondents to indicate they were a renter and therefore lacked decision-making authority.

Table 32. Barriers to Selecting Energy-Efficient Water Heating Equipment

	Overall	Utility			Housing Type		Income	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate Income (h)	Market Rate (i)
n	965	321	321	323	865	100	331	445
Cost of equipment	73%	74%	74%	72%	74%	67%	74%	75%
Additional construction needed to install the unit	38%	34%	40%[a c]	34%	39%[E]	23%	33%	43%[H]
Capacity of unit	25%	22%	27%	24%	26%	20%	20%	28%[H]
Limited data on the effectiveness of new technology	15%	21%[b c]	14%	16%	15%	13%	13%	19%[h]
Size of unit	15%	14%	14%	16%	15%	17%	12%	16%
Noise level	13%	11%	13%	12%	13%[e]	8%	13%	12%
Fewer contractors trained to install energy efficient systems	8%	6%	8%	8%	8%	7%	7%	8%
Energy-efficient equipment less available and may have to wait to get the system installed	7%	5%	7%	7%	7%	4%	7%	7%
Fewer contractors trained to repair energy efficient systems	7%	5%	8%[a]	6%	7%	4%	10%[i]	5%
Renter without decision making authority	3%	7%[C]	4%[C]	<1%	3%[E]	0%	6%[I]	1%
Other	4%	2%	2%	6%[a b]	3%	8%	3%	2%
No barriers	9%	9%	8%	11%	9%	15%[d]	10%	8%
Don't know	0%	0%	0%	0%	0%	0%	0%	0%

Note: a/b/c/d/e/h/i indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi; A/B/C/D/E/H/I indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI
Note: Chi-squared tests revealed a significant relationship between this question and the listed subsegments; however, measures of effect size were not calculated
Pulse Check Survey Question: What barriers, if any, would keep you from selecting an energy-efficient water heater over a standard model the next time you are in the market for a water heater? (Multiple response permitted)

4.4.3 Customers Not Participating in Programs

As noted in Section 3.2.3, the landscape analysis. Based on the PAs' 2024–2031 Portfolio and Business Plans, the types of customers not participating in EE programs are often renters, HTR, members of a DAC, or low-to- moderate income (LMI) customers.[70] The Pulse Check survey further explored who has been participating in energy efficiency programs. Overall, 74% of respondents were aware that their utility offered rebates and incentives for customers to save energy. Awareness did not vary by utility, housing type or income; however, owners were significantly more likely to indicate they were aware than renters (75% vs. 64%).[71]

Although approximately three-fourths of respondents were aware of IOU-sponsored programs, only 25% of all participants indicated they participated in one in the past two years. Again, participation did not vary by utility, housing type, or income; however, owners were significantly more likely than renters to indicate they had participated in that

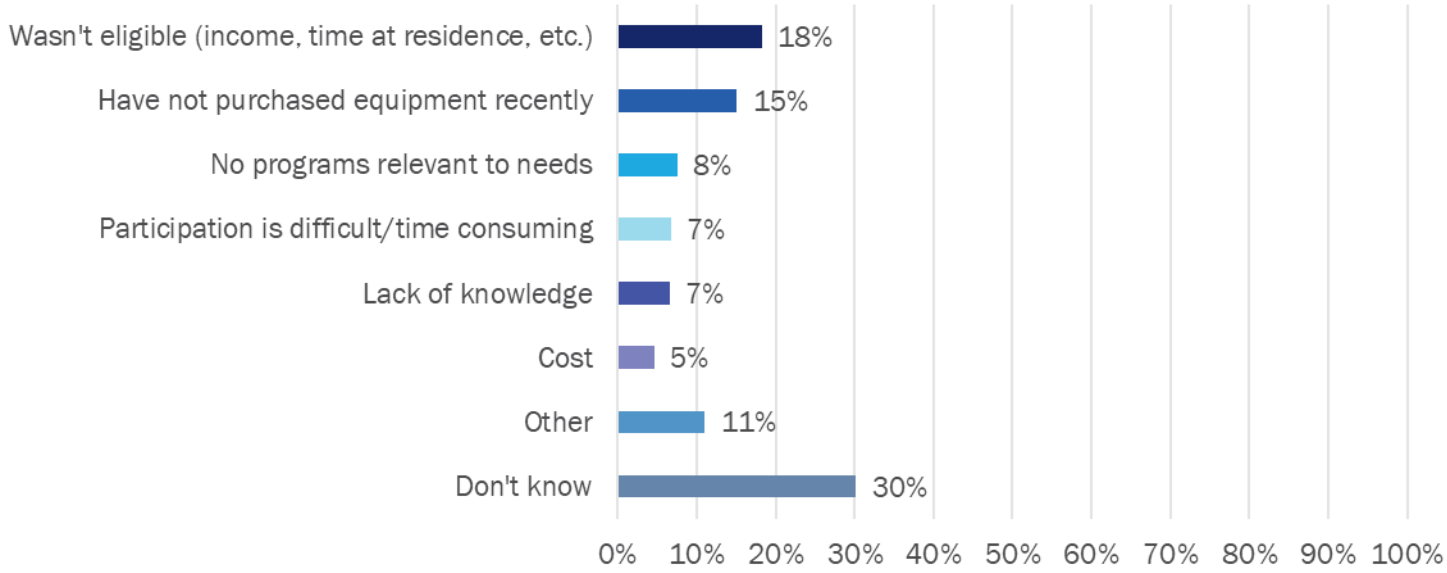
[70] Opinion Dynamics' Pulse Check survey attempted to segment respondents by HTR and DAC status, but not enough respondents from these segments responded to the survey to merit statistical comparisons.
[71] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

time frame (26% vs. 14%).[72] Additionally, respondents 65 or older were significantly more likely than those younger than 65 to have participated (30% vs. 23%).

Respondent demographics reveal additional insights into the average program participant. Looking at age with more granularity, participants were significantly older on average than non-participants (62 vs. 59).[73] Participants reported a significantly higher 2022 income before taxes on average than non-participants ($201,274 vs. $162,768);[74] however, this difference existed solely within the market rate bracket. There was no difference in education or race by IOU-sponsored program participation. Full results on respondent demographics can be found in the Pulse Check Survey Demographics section.

The Pulse Check survey asked respondents who were aware of programs but indicated they did not participate why they had not done so. The figure below details all reasons for non-participation among aware respondents. Overall, a large portion of respondents indicated not being able to pinpoint a particular reason for their non-participation (30%). Among popular responses were that they were not eligible due to their income/time at residence/etc. (18%) or had not purchased equipment eligible for a program recently (15%).

Figure 22. Reasons for Not Participating in IOU-sponsored Programs



Pulse Check Survey Question: Why have you not participated in a program in the past two years? (Multiple responses permitted); n=459

4.4.4 Opportunities for New Measures that Address Customers' Unmet Needs

The landscape analysis explored important considerations for including new measures into the IOU-sponsored program portfolio. Some residential programs may focus more on the behavioral aspects of energy use rather than equipment to achieve energy savings. The Potential and Goals Study identifies future opportunities for savings but shows that much

[72] Difference significant at conservative alpha value of 0.01
[73] Difference significant at alpha of 0.10, not at conservative alpha of 0.01
[74] Difference significant at alpha of 0.10, not at conservative alpha of 0.01

of the savings potential is in Behavior, Retro-commissioning, and Operations (BROs).[75] The Pulse Check survey explored customer adoption, awareness and interest in various controlling and monitoring technologies that can capture behavior savings.

Smart Thermostat Adoption and Interest

The Pulse Check survey asked respondents who had a thermostat (98%) what types of thermostats they owned. The table below presents the percentage of respondents who indicated having each type of thermostat overall and by subsegments. Overall, 51% of respondents had a programmable thermostat, 34% had a Wi-Fi connected smart thermostat, and 17% had a manual thermostat. Results for individual technologies varied by utility, housing type, and income. Regarding utility, SCE respondents were significantly more likely to have a manual thermostat than PG&E and SDG&E respondents. Additionally, SDG&E respondents were significantly more likely than SCE respondents to have a Wi-Fi connected smart thermostat. Across housing types, single family respondents were significantly more likely than mobile home respondents to have a programmable or Wi-Fi connected smart thermostat and significantly less likely to have a manual thermostat. Regarding income, market rate respondents were significantly more likely than moderate income respondents to have a Wi-Fi connected smart thermostat and significantly less likely to have a programmable thermostat.

Table 33. Types of Thermostats in Home

	Overall	Utility*			Housing Type†		Income‡	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate income (h)	Market rate (i)
n	950	315	316	319	852	98	324	441
Programable thermostat	51%	49%	53%	48%	52%[e]	42%	57%[I]	47%
Wi-Fi connected smart thermostat	34%	41%[c]	35%	31%	35%[e]	25%	27%	41%[H]
Manual thermostat	17%	14%	15%	21%[a b]	16%	31%[D]	19%	17%

Note: a/b/c/d/e/h/i indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi; A/B/C/D/E/H/I indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI

* Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of programmable thermostat (effect size = 0.08, df=4), Wi-Fi connected smart thermostats (effect size 0.08, df=4), and manual thermostats (effect size 0.07, df=4)

† Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of Wi-Fi connected smart thermostats (effect size 0.07, df=2) and manual thermostats (effect size 0.13, df=2); significant results of pairwise testing shown for programmable thermostat despite insignificant chi-squared

‡ Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of programmable thermostats (effect size = 0.14, df=2) and Wi-Fi connected smart thermostats (effect size 0.17, df=2)

Pulse Check Survey Question: Please indicate if you use any of the following technologies to help control or monitor your home's energy usage. (Single response permitted)

The Pulse Check survey asked respondents whether they had a variety of other types of control and monitoring technologies. The table below presents the percentage of respondents who indicated having each type of control/monitoring technology overall and by subsegments. Overall, the technologies most respondents indicated having were smart plugs connected wirelessly to their phone/other display device (24%), occupancy sensors/dimmers/smart outlets/voice controls connected to smart home devices (20%), and an online utility account connected to an AMI meter (16%). Only 8% of respondents indicated having a smart home energy management system

[75] Residential BRO includes Universal Audits, Home Energy Ratings (HERS), real-time energy use feedback, and challenges and competitions, https://file.ac/TDCoHibMwEY/

and 4% indicated having in-home display technology. Results for individual technologies varied by utility, housing type, and income. SCE respondents were significantly less likely than SDG&E and PG&E respondents to have occupancy sensors/dimmers/etc. connected to smart home devices and less likely to have a smart home energy management system. SCE respondents were also significantly less likely than SDG&E respondents to have an online utility account connected to an AMI meter. Single family respondents were significantly more likely than mobile home respondents to have all advanced technologies asked about. Regarding income, market rate customers were significantly more likely than moderate income respondents to have an online utility account connected to an AMI meter.

Table 34. Ownership of Select Control and Monitoring Technologies

	Overall	Utility*			Housing Type†		Income‡	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate income (h)	Market rate (i)
n	950	315	316	319	852	98	324	441
Smart plugs connected wirelessly to phone/other display device	24%	24%	25%	21%	25%^{e}	17%	24%	24%
Occupancy sensors, dimmers, smart outlets or voice controls connected to smart home devices	20%	23%^{c}	22%^{c}	16%	21%^{E}	11%	18%	22%
Online account with utility connected to AMI meter (to view real-time usage)	16%	20%^{c}	16%	14%	17%^{e}	9%	10%	21%^{H}
Smart home energy management system	8%	11%^{C}	9%^{c}	4%	8%^{E}	2%	6%	8%
In-home display technology (to view real-time usage, pricing, billing, etc.)	4%	6%	4%	4%	5%^{E}	1%	3%	4%

Note: a/b/c/d/e/h/i indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi; A/B/C/D/E/H/I indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI

* Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of smart home energy management systems (effect size 0.07, df=4) and occupancy sensor/dimmers/smart outlets/voice controls connected to smart home devices (effect size 0.07, df=4); significant results of pairwise testing shown for all technologies regardless of insignificant chi-squared

† Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of online utility account connected to home AMI meter (effect size 0.07, df=2), smart home energy management systems (effect size 0.08, df=2), and occupancy sensor/dimmers/smart outlets/voice controls connected to smart home devices (effect size 0.08, df=2); significant results of pairwise testing shown for all technologies regardless of insignificant chi-squared

‡ Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and ownership of online utility account connected to home AMI meter (effect size 0.15, df=2) and smart home energy management systems (effect size 0.08, df=2); significant results of pairwise testing shown for all technologies regardless of insignificant chi-squared

Pulse Check Survey Question: Please indicate if you use any of the following technologies to help control or monitor your home's energy usage. (Single response permitted)

The survey asked respondents who did not own the referenced technologies how interested they were in trying each in the future, with the exceptions of manual and programmable thermostats (as they are not control/monitoring technologies). The table below presents results overall and by subsegments. Overall, the technologies respondents indicated the highest interest in, as defined by the percentage of respondents who indicated they were "somewhat interested" or "very interested," were an online utility account connected to an AMI meter (54%), a smart home energy management system (48%), and in-home display technology (47%). Fewer respondents were at least "somewhat interested" in Wi-Fi connected smart thermostat (40%), connected smart plugs (35%), and occupancy sensors/dimmers/smart outlets/voice controls connect to smart home devices (32%). Interestingly, the control/monitoring technologies respondents appear to be less interested in are the same technologies more respondents indicated already owning in the previous question. These measures may have already reached early adopters and the portion of respondents who do not have these technologies are likely less interested in

control/monitoring technologies in general. Results were similar by utility but varied significantly by housing type and income for every type of control/monitoring technology. Generally, single family and market rate respondents were more likely to indicate higher levels of interest than mobile home and moderate-income respondents, respectively. The specific statistical differences observed varied slightly by technology but followed this trend.

Table 35. Interest in Select Control and Monitoring Technologies

		Overall	Housing Type*		Income	
			Single family (d)	Mobile home (e)	Moderate Income (h)	Market Rate (i)
Wi-Fi connected smart thermostat	n	613	539	74	236	252
	Very interested	13%	14%	10%	10%	18%H
	Somewhat interested	27%	29%E	14%	32%i	25%
	Slightly interested	18%	18%	19%	17%	19%
	Not interested	41%	39%	58%D	41%	38%
Smart plugs connected wirelessly to phone/other display device	n	737	654	83	258	331
	Very interested	12%	13%	9%	10%	16%h
	Somewhat interested	23%	24%e	14%	23%	25%
	Slightly interested	24%	24%	22%	26%	23%
	Not interested	41%	39%	55%D	42%	36%
Occupancy sensors, dimmers, smart outlets or voice controls connected to smart home devices	n	770	680	90	276	340
	Very interested	11%	11%	7%	8%	16%H
	Somewhat interested	21%	22%e	13%	21%	22%
	Slightly interested	20%	20%	20%	23%	19%
	Not interested	48%	47%	59%d	48%	43%
Online account with utility connected to AMI meter (to view real-time usage)	n	804	713	91	294	350
	Very interested	23%	23%	17%	18%	30%H
	Somewhat interested	31%	33%E	19%	35%	31%
	Slightly interested	20%	18%	32%D	20%	18%
	Not interested	26%	25%	33%	27%	21%
Smart home energy management system	n	886	788	98	312	404
	Very interested	18%	19%E	10%	14%	24%H
	Somewhat interested	30%	31%e	22%	30%	33%
	Slightly interested	22%	22%	26%	26%i	19%
	Not interested	30%	28%	42%D	30%i	24%
In-home display technology (to view real-time usage, pricing, billing, etc.)	n	920	821	99	322	423
	Very interested	18%	18%e	12%	11%	26%H
	Somewhat interested	29%	30%e	22%	35%	29%
	Slightly interested	24%	24%	22%	25%	21%
	Not interested	30%	28%	44%D	29%	24%

Note: d/e/h/i indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: de, hi
D/E/H/I indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: DE, HI

* Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and interest in Wi-Fi connected smart thermostats (effect size 0.14, df=3), smart plugs (effect size 0.11, df=3), occupancy sensors/dimmers/smart outlets/voice controls connected to smart home devices (effect size 0.10, df=3), online accounts with utility connect to AMI meter (effect size 0.14, df=3), smart home management systems (effect size 0.12, df=3), and in-home display technology (effect size 0.12, df=3)

ǂ Chi-squared tests with Cramer's V revealed significant relationships between this subsegment and interest in Wi-Fi connected smart thermostats (effect size 0.13, df=3), smart plugs (effect size 0.11, df=3), occupancy sensors/dimmers/smart outlets/voice controls connected to smart home devices (effect

size 0.12, df=3), online accounts with utility connect to AMI meter (effect size 0.14, df=3), smart home management systems (effect size 0.16, df=3), and in-home display technology (effect size 0.18, df=3)

Pulse Check Survey Question: How interested are you in trying [TECHNOLOGY] in the future? (Single response permitted)

APPENDIX A. Detailed Landscape Analysis Findings

The following subsections detail the results from reviews of the existing data and literature by first presenting the overarching policy context and energy efficiency potential in the residential sector. Findings are summarized by research objectives and questions posed by this study.

The content included in this appendix was provided by Opinion Dynamics to the IOUs overseeing this study as an interim memo in November 2022. This appendix details all the findings from the landscape analysis. To provide context for the synthesized findings across the landscape analysis and the Pulse Check survey, some of this appendix's content was referenced in the Findings section of this report.

APPENDIX A-I.I. Policy Context and EE Program Administrators

The regulatory policies regarding EE, renewables, and carbon reduction have evolved rapidly and have become more aggressive. Two California Assembly Bills (ABs) had a significant impact on the residential marketplace. In 2006, AB 32 established a comprehensive program to reduce GHG emissions from all statewide sources to 1990 levels by the year 2020. This goal represents approximately a 30% reduction statewide. In 2015, California State Bill (SB) 350 increased California's renewable electricity procurement goal to 50% by 2030. In addition, SB 350 requires the state to double statewide savings in electricity and natural gas end uses by 2030. Then, in 2018, SB 100 set a planning target of 100% zero-carbon electricity resources by 2045. In addition, it increased the 2030 renewables target from 50% to 60%. On the same day that SB 100 was signed, Executive Order B-55-18 set a new statewide goal to achieve carbon neutrality (zero-net GHG emissions) by 2045 and to maintain net negative emissions thereafter.

This aggressive GHG emission reduction and renewable electricity procurement strategy increases the use of Renewable Portfolio Standard-eligible resources, including solar, wind, biomass, geothermal, and others. This strategy also places enormous pressure on the California Program Administrators (PAs) to seek innovative technologies and approaches to improve the design and cost-effectiveness of their EE, demand response, and Resource Acquisition (RA) portfolios. These aggressive goals are becoming increasingly difficult over the years as the number of savings opportunities is reduced. For example, increasingly stringent EE building codes and appliance standards along with decreasing avoided costs have made certain measures, such as Compact Fluorescent Lamps (CFLs), no longer available to programs.

Lastly, in 2018 CPUC D. 18-01-004 increased the required minimum percentage of third-party programs from 20% of total budgeted portfolio in 2020 to 60% by the end of 2022.[76] The rationale for third-party requirements is based on supporting innovation in program design, as well as the potential for cost savings associated with EE programs and portfolios through the competitive solicitation of programs.

In addition to 3P-implemented and PA-solicited and -contracted programs that are available through the California IOUs, Regional Energy Networks (REN) throughout the state may also offer Resource Acquisition programs to customers who reside within the same IOU territory. CPUC D.12-05-015 originally introduced the concept of RENs which were "intended to augment or supplement the existing utility energy efficiency portfolio."[77] RENs were first approved in D.12-11-015 if they met the following criteria:

- Activities that utilities cannot or do not intend to undertake

[76] CPUC D. 18-01-004 Decision Addressing Third Party Solicitation Process for Energy Efficiency Programs
[77] CPUC D. 19-12-021 Decision Regarding Frameworks for Energy Efficiency Regional Energy Networks and Market Transformation, p.5

- Pilot activities where there is no current utility program and where there is potential for scalability to a broader geographic reach
- Pilot activities in hard-to-reach markets, whether or not there is a current utility program that may overlap[78]

In 2019, D.19-12-021 authorized continued operation of existing RENs, invited new REN proposals and further emphasized that RENs are "designed to fill gaps in the portfolios of all other PAs and to serve hard-to-reach customers."[79] As of July 2022, the RENs throughout the state include: BayREN, SoCalREN, 3CREN, I-REN, and RuralREN, however BayREN is the only one that is currently administering a residential Resource Acquisition program. While BayREN is currently administering an RA program, their 2024-2031 Portfolio and Business plan does not mention any plans for RA programs to the residential market. Community Choice Aggregators (CCAs) can also apply to administer programs. As of July 2022, one CCA, Marin Clean Energy (MCE), is offering a RA program to the residential single-family market.

The following table provides a summary of the PAs offering RA programs to residential customers, including some unique characteristics of their jurisdictions. This information is a high-level overview of the 2024–2031 EE Strategic Business and Portfolio Plans.

Table 36. PAs Offering RA Programs based on 2024–2031 EE Rolling Portfolio Business Plan Applications

PA	Areas/Customers Served	Territory Unique Characteristics
SDG&E[A]	▪ 4,100 square miles in Southern California ▪ 3.6 million residents ▪ 1.4 million electric meters	▪ Milder climate, majority residential customer base ▪ New CCA San Diego Community Power (SDCP) will serve 50% of customers, may file to become a PA in the future ▪ Residential sector accounts for 34% of electric consumption ▪ EVs and self-generation expected to increase ▪ More than half of residents are renters
PG&E[B]	▪ 70,000 square miles in northern and central California ▪ Serves ~16 million residents ▪ 5.5 million electric customer accounts ▪ 4.5 million natural gas customer accounts	▪ Includes 5 regions: North Coast, North Valley/Sierra, Bay Area, South Bay/Central Coast, and Central Valley ▪ More than half of the service territory lies in High Fire Threat Districts (HFTD)
SCE[C]	▪ 50,000 square miles in central, coastal, and southern California ▪ Serves ~15 million people ▪ 4.5 million residential customers ▪ 5 million metered accounts	▪ Includes a number of diverse climate zones across central, coastal, and southern California.
SCG[D]	▪ 24,000 square miles of service territory in central and southern California ▪ 21.8 million customers ▪ 5.9 million metered accounts	▪ Diverse terrain in central and southern California ▪ The largest natural gas distribution utility in the US ▪ Includes 12 counties and 500 communities ▪ SCG residential customers consumed over 2.4 million therms in 2021
MCE[E]	▪ 800,000 service accounts ▪ 721,000 residential accounts (90% of MCE total customer accounts)	▪ Includes four Bay Area counties: Marin, Napa, Contra Costa, and Solano within three different climate zones ▪ Diverse household income from under 50k to over 200k ▪ One-third of MCE residents speak a language other than English

Sources: SDG&E EE Business Plan Testimony (2024–2032) – Exhibit 1

PG&E 2024–2031 EE Business Plan Testimony – Exhibit 1; SCE EE Business Plan Testimony (2024–2032) – Exhibit 1

SCG EE Business Plan Testimony (2024–2032) – Exhibit 1; MCE EE Business Plan Testimony (2024–2032) – Exhibit 1

[78] Ibid, p.4-5

[79] Ibid, p.2

APPENDIX A-I.II. Customer Energy Needs and Priorities

Currently, "the residential sector accounts for 17 percent of the state of California's energy consumption. The sector is comprised of more than 14 million single- and multifamily homes that house more than 39 million Californians. California investor-owned utilities (IOUs) account for approximately three-quarters of the electricity supply in the state."[80]

Customer Research on Energy Needs and Priorities

There are several recent market research and evaluation studies that touch upon customer energy needs and priorities, the impact of COVID-19, the factors that motivate customers, and the variation across customer segments.

1. The California EE Market Adoption Characteristics Study surveyed 598 single-family non-low-income residential customers across the four IOU service territories in 2021.[81] The survey captures customer characteristics, attitudes, and behaviors to inform technology adoption decision-making for EE technologies, fuel substitution technologies, and DR program participation. Findings supported the latest Potential and Goals update.
2. The California COVID-19 Customer Support ME&O General Population Study surveyed 2,000 Californians living in single family and multifamily dwellings.[82] The sample included low-income and non-low-income customers. The study was conducted in May 2020, a few months into the "shelter-in-place" order. The survey explored how the COVID-19 pandemic policies impacted Californians and how effective recent Energy Upgrade California (EUC) marketing campaign efforts were during the pandemic.
3. PG&E's 2024–2031 EE Portfolio and Business Plan Exhibit 2, describes a recent internal study of residential customer energy needs. In 2021, PG&E commissioned a customer insights study to learn about customer perceptions and needs regarding EE and energy management. The study was conducted using interviews and focus groups with residential customers. The purpose was to inform PG&E's strategies and tactics to create a more customer-centric approach for its 2024–2027 portfolio plan.
4. PY2020 HVAC Fuel Substitution Impact Evaluation explored motivations for installing heat pumps. Saving energy and reducing carbon emissions were the top motivators reported amongst participants in the program.[83]

Relevant information from these studies is summarized below.

PG&E's 2024–2031 EE Portfolio and Business Plan Exhibit 2, they describe a recent study of residential customer energy needs. In 2021, PG&E commissioned a customer insights study to learn about customer perceptions and needs regarding EE and energy management. The study was conducted using interviews and focus groups with residential customers. The purpose was to inform PG&E's strategies and tactics to create a more customer-centric approach for its 2024-2027 portfolio plan. The information below is derived directly from PG&E Business Plan. Further specifics are not available from that source. These findings should be considered qualitative, however, given they are based on focus groups and in-depth interviews.

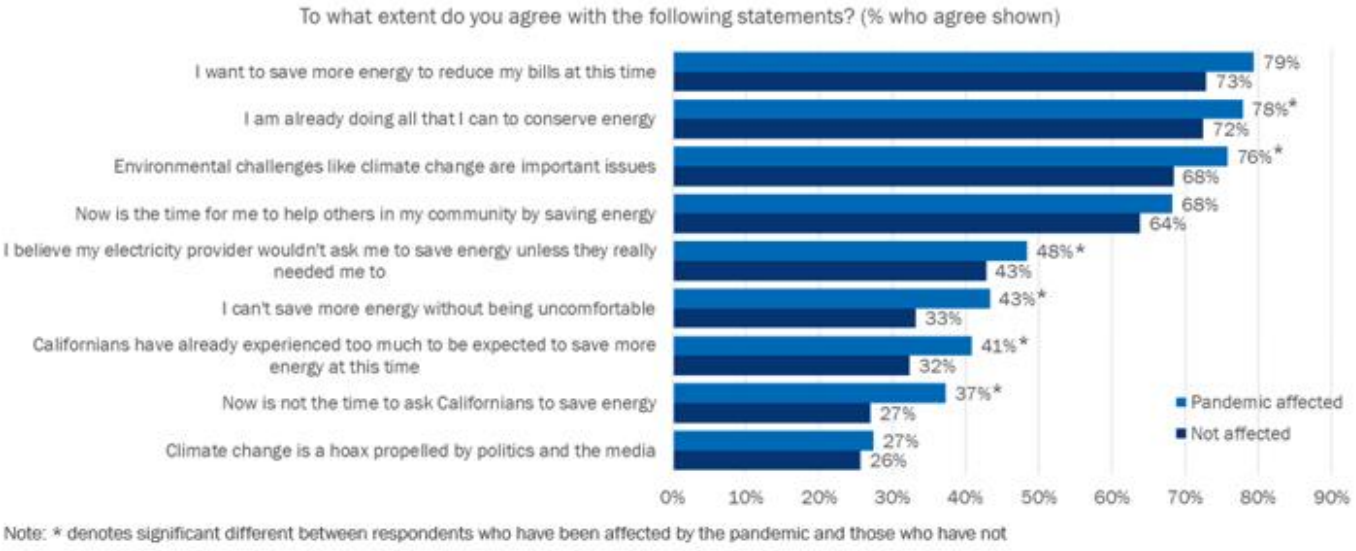
[80] Impact Evaluation of Home Energy Reports Residential Sector – PY2018, p. 5
[81] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021
[82] COVID-19 Customer Support Campaign Gen Pop Survey Report
[83] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

Some of the key themes include:

1. **Concern for Climate Change**: There was broad concern among most customers regarding climate change and the threat it poses to our planet.
2. **Personal Ownership**: Of those concerned about climate change, the majority also acknowledged at least some ownership and responsibility to do something about it.
3. **Approach to EE**: While some customers may be willing and able to invest extra time and/or money in pursuit of EE, most want solutions that are low-cost, low-hassle, and not an inconvenience to them.
4. **Passive Engagement**: Though many customers are concerned with climate change, most will not proactively upgrade their appliances, instead opting to wait until their appliances stop working.
5. **Tools for Self-Sufficient Energy Management**: A growing number of customers want tools that will help them manage their energy independently (e.g., customizable tools, smart appliances, real-time tracking).
6. **Independence**: There is a sizable contingent of customers who want to retain choice (how to manage their energy and choice of fuel type) and do not want to be constrained by PG&E or the government.
7. **Trust is a major theme:** Responses indicated a lack of trust in market actors, a lack of trust in the information provided to customers, and a desire to work with partners they can trust.

The COVID-19 Customer Support ME&O General Population Survey, as shown in the figure below, indicated most residential customers (single and multifamily) have a strong desire to reduce their energy bills, though most believe they are already doing all they can to conserve energy.

Figure 23. Customer Perspectives



Program Administration and Implementation Perspective

Program administrators and implementers agreed that customers have a wide range of energy needs and priorities depending on income, accessibility, and interest. They try to frame their program portfolio to address that wide range. Customer needs and priorities vary largely across income levels for energy upgrades. Depending on the funding customers have available for energy upgrades, household income can largely determine whether customers can replace appliances upon failure or if they need to keep repairing it. Program administrators and implementers also noted that the needs of the mobile and manufactured segments differ slightly in a few ways.

- In terms of equipment needs, mobile/manufactured homes have a more pronounced and nuanced need for high performing ductwork. The ductwork in these homes is often underneath the home, if present at all, and tends to need major improvement. Coincidentally ductwork tends to be the most cost-effective measure for this customer segment.
- Further, this customer segment tends to have more space constraints, or structural barriers, to doing upgrades, e.g., HPWHs are taller than other models and will not fit in water heater closet spaces typically found in this segment.
- A unique complexity to the mobile and manufactured home market is whether they are individually or master-metered homes. Currently this segment often is master metered making it a challenge in terms of how to administer programs to them and comply with data collection requirements.
- This customer segment, alongside older single-family homes, may need upgrades largely from a health and safety perspective before addressing other EE upgrades, i.e., repairing or replacing ductwork instead of installing a heat pump water heater.
- Customers in this segment tend to be older and not very tech savvy, e.g., they do not tend to like to try new technology such as smart thermostats. They also tend to interact with cell phones and computers differently than other segments. For example, many mobile and manufactured home parks are 55+ communities.[84] The majority of these residents (84%) are between 60 to 74 years old and the remainder 75 or older.[85]
- Customers in this segment are largely focused on recovering from the pandemic and dealing with the economic impact of inflation. These customers need bill relief regardless of where it comes from, some of that bill relief can come from EE upgrades, but the first cost can be a barrier.

Program staff reiterated that customer energy efficiency needs, and priorities are different for each customer but that a common focus is on reducing their utility bill. IOU staff expect to see customers focus more on both reducing their utility bill and contributing to environmental improvements as customers become more educated about energy efficiency and its relationship to California's environmental goals to reduce GHG emissions. SDG&E staff noted that the PLA and HVAC programs are moving towards decarbonization/electrification measures, and they will need to deliver more education around those products.

When asked how much of a priority energy efficiency is for customers:

- Program administrators and implementers mostly responded "it depends" as everyone has different priorities. PG&E staff said their customers largely prioritize safety over EE. In their experience, EE tends to be most important to people as a means to reduce their bill and convincing them that they will see a reduction on their bill from various actions is a challenge because they cannot guarantee bill savings. For example, potential rate increases may offset energy savings for the total bill amount.
- For programs targeting IOU staff asserted that the lower income and mobile/manufactured homes customer segments prioritize energy efficiency somewhat highly (assigning a priority level of 5 on a 7-point scale where 7 means "high priority"), but their main priority is "putting food on the table." As such these customers want their energy use or bill to be as low as possible.

[84] There are 363,389 mobile home spaces in California. Of the 180 resident owned communities, 112 are 55+. https://mhphoa.com/ca/mhp/statistics

[85] https://www.consumerfinance.gov/consumer-tools/educator-tools/resources-for-older-adults/data-spotlight-profiles-of-older-adults-living-in-mobile-homes/

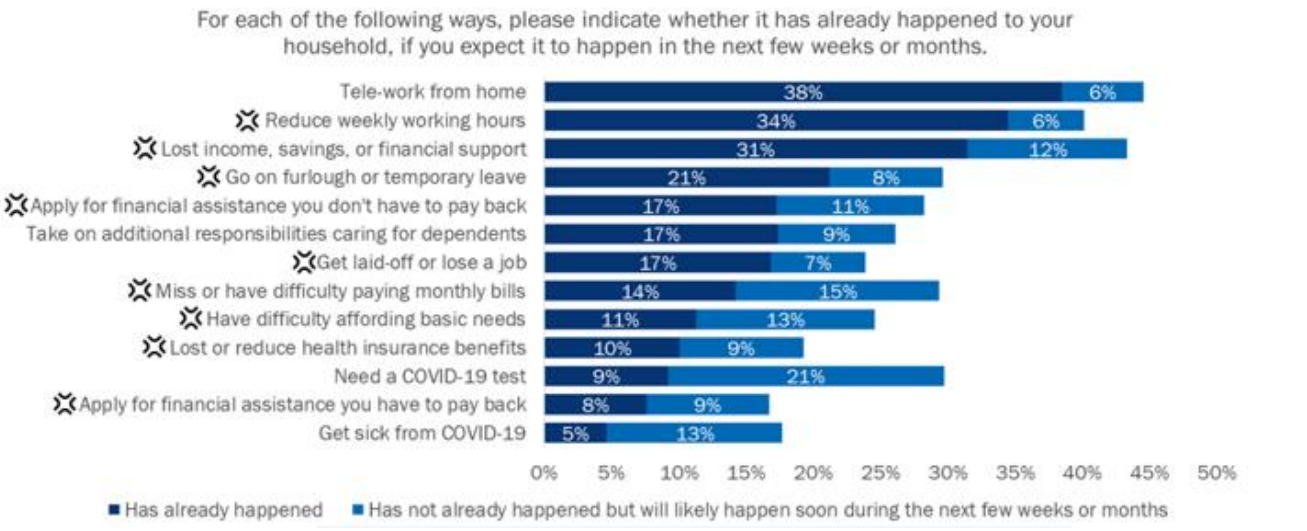
- Staff noted that customers in the Plug Load and Appliance Program would likely prioritize energy efficiency somewhat low (rating the priority level a 2 on a 7-point scale where 7 means "high priority") as those customers tended to enter the program when an appliance failed, and they needed a replacement. For these customers, purchases are based on need rather than energy efficiency. These customers are also often motivated by new and "cool" features of the appliances rather than energy efficiency. Currently, the Plug Load and Appliance Program participation opportunities are further limited by only offering the following three items:
    - Smart thermostats
    - Room air conditioners
    - Water heaters
- SDG&E program staff largely focused on economic conditions in the San Diego area and the high rate of inflation. They indicated customers place more emphasis or priority on how to reduce all of their monthly bills—including their energy bill—due to these factors.

APPENDIX A-I.III. Impact of COVID-19 on Energy Needs and Priorities

The COVID-19 pandemic continues to impact how PAs design and implement EE programs, as well as how California residents generally think about energy upgrades. The statewide shelter-in-place order that went into effect on March 19, 2020, temporarily halted direct install and other face-to-face programs and also re-aligned residents' priorities. Simultaneously, it increased residential customer engagement in online and virtual platforms.

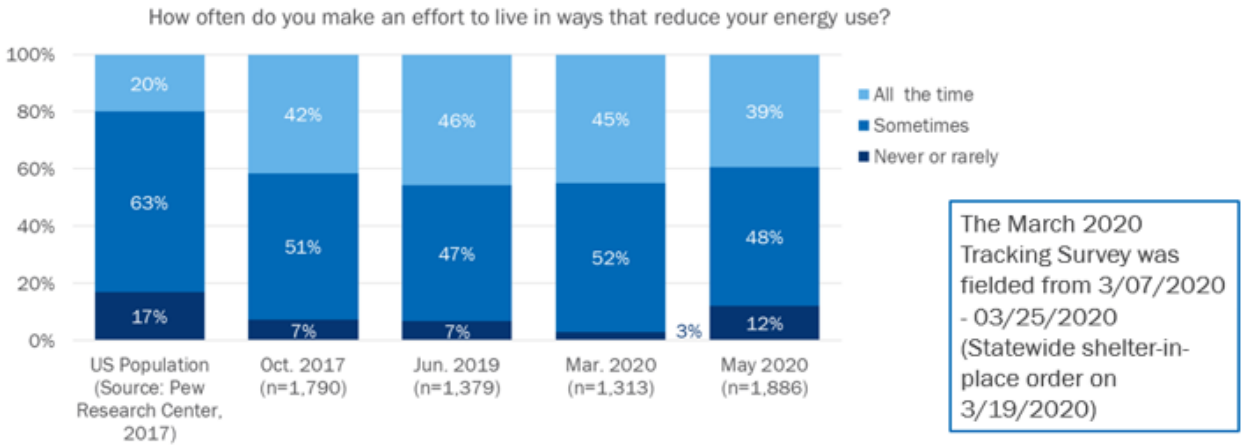
The COVID-19 Customer Support ME&O General Population study reported that customers had experienced multiple COVID-19 impacts just a few months into the shelter-in-place order. The following figures illustrate the findings from this study.

Figure 24. Activities Resulting from Pandemic Policies



Respondents reported trying to reduce their energy less frequently a few months into the shelter-in-place order.

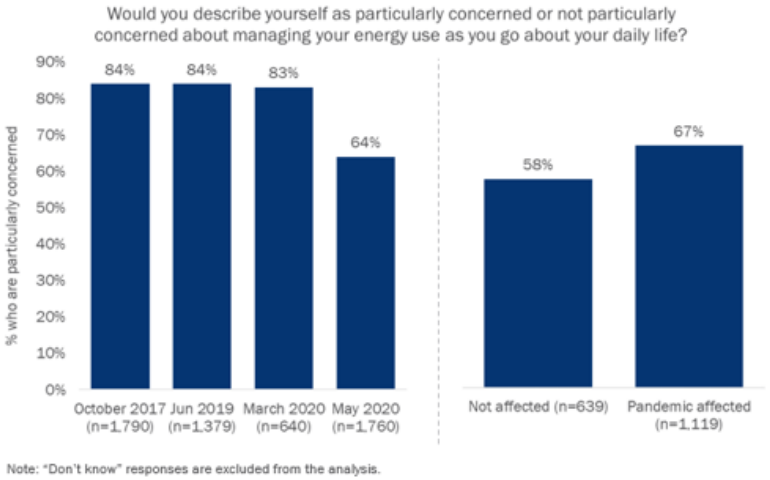
Figure 25. Customer Energy Use Changes



Respondents' level of concern with managing their energy use decreased significantly during the shelter-in-place order, though a majority were still concerned.

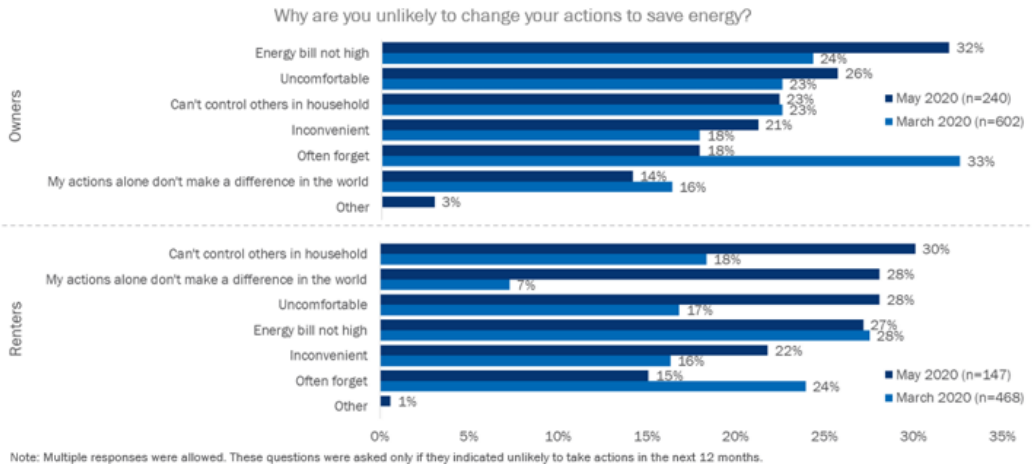
Figure 26. Customer Concern with Control of Energy Use

- Respondents who are particularly concerned with managing their energy use were more likely to be:
  - Nonwhite
  - Lower income
  - More liberal regarding political ideology
  - Higher in CA identity
  - Affected by the pandemic



Renters reported they increasingly face barriers related to perceived control of their energy use and home comfort during shelter-in-place.

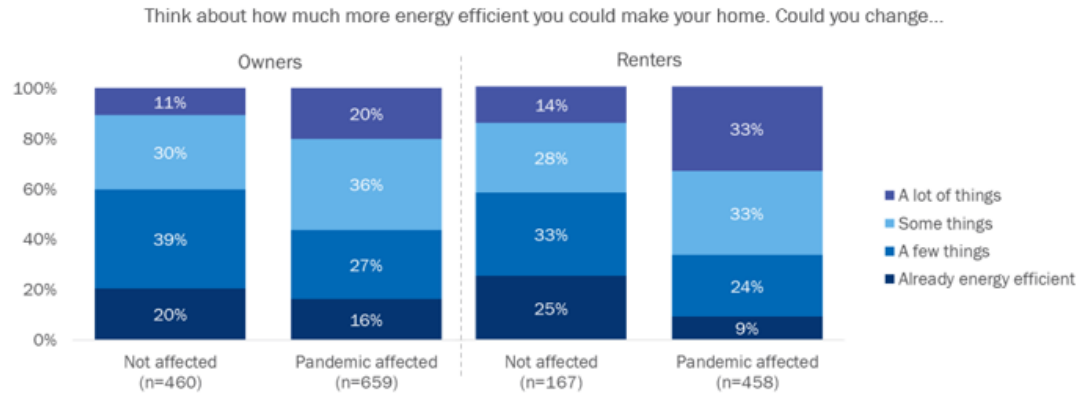
Figure 27. Customer Actions Regarding EE



Note: Multiple responses were allowed. These questions were asked only if they indicated unlikely to take actions in the next 12 months.

Pandemic-affected customers reported they have more opportunities to make their homes more energy efficient.

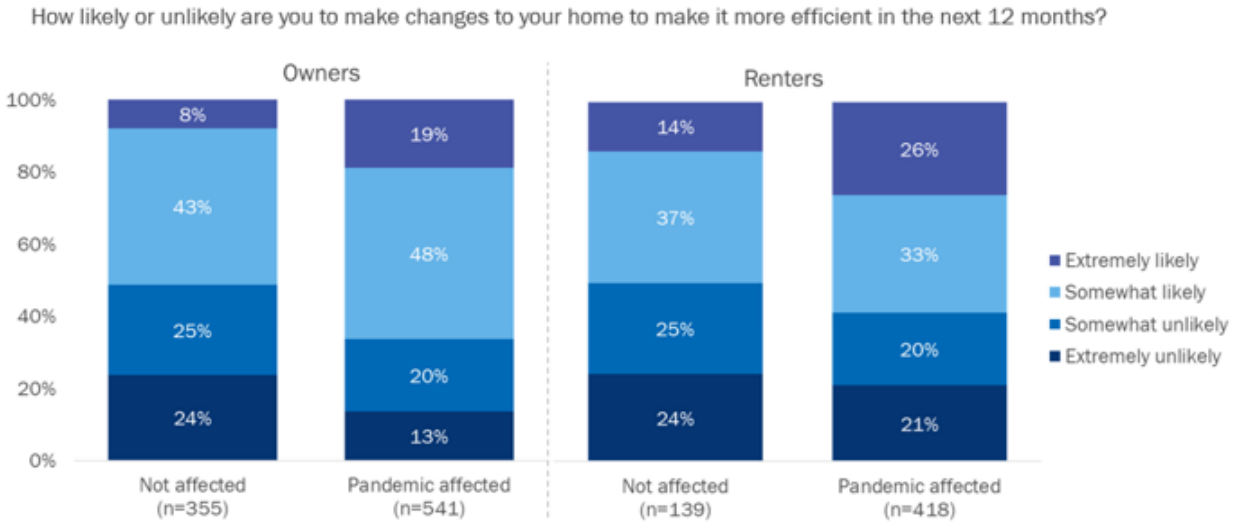
Figure 28. Opportunities to Improve Home Efficiency



Note: "Don't know" responses are excluded from the analysis.

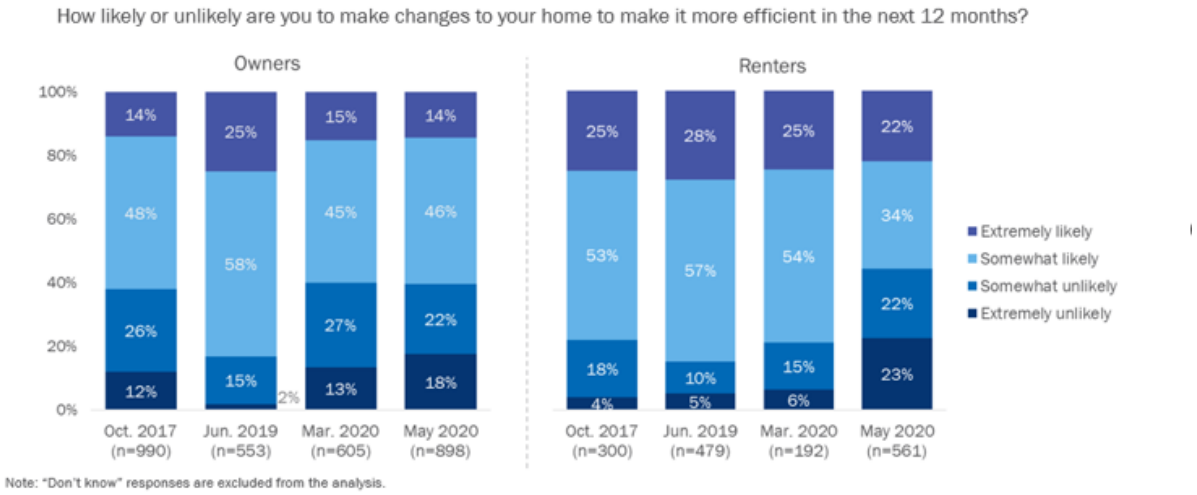
Customers who were affected by the pandemic indicated a greater likelihood to make home efficiency upgrades.

Figure 29. Likelihood of Making EE Upgrades



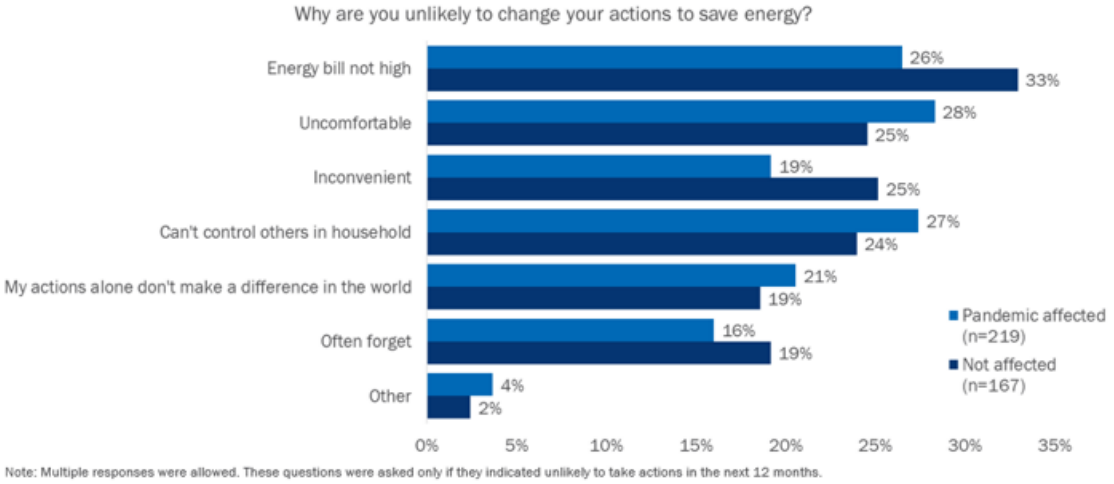
Renter's likelihood of making home efficiency upgrades decreased considerably during the shelter-in-place order.

Figure 30. Likelihood of Making EE Upgrades Over Time



Respondents were asked why they were unlikely to change their actions to save energy. The most common reason provided was that energy bills were not high enough and they did not want to be uncomfortable in their homes.

Figure 31. Reasons for Not Changing Actions



The California EE Market Adoption Characteristics Study[86] explored the impact of COVID-19 on residential single family non-low-income customers in 2021. The following tables show findings from about one year after the shelter-in-place order (pages C-17 and C-18). For 62% of customers, COVID-19 had a negative impact on their daily life but roughly the same percentage claimed their financial situation did not change. Further, at the time, the majority (62%) of customers were still very or somewhat comfortable with a contractor working inside their home during the pandemic.

[86] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages C-17 and C-18.

Table 37. Single Family Residential Customers' Reported Impacts of COVID-19 Pandemic on Their Lives

Impacts	Percent (n=598)
Impact on everyday life:	
Large negative impact	19%
Moderate negative impact	43%
Little or no impact	28%
Moderate positive impact	7%
Large positive impact	2%
Changes to financial situation since January 2020 (before start of pandemic):	
Worsened	29%
No change	63%
Improved	8%
Expected changes to financial situation in 12 months (from time of survey):	
Will worsen	19%
Will not change	60%
Will improve	21%

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

Table 38. Single Family Residential Customers' Reported Comfort Level with Contractors Working Inside Their Home During the COVID-19 Pandemic

Comfort Level	Percent (n=598)
Very comfortable	26%
Somewhat comfortable	36%
Somewhat uncomfortable	23%
Very uncomfortable	14%

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

As stated in SDG&E's 2021 Annual Energy Program and Portfolio Budget Advice Letter (ABAL), "the pandemic has led to an unprecedented reduction in the ability of energy efficiency implementers and contractors to deliver certain types of energy savings projects in their homes. In addition, the pandemic and resulting economic impact has resulted in a decline in customer demand for many of the program administrators' equipment rebate programs, causing uncertainty for the administrators and their third-party implementers about energy savings forecasts."[87] Further, SCG's ABAL mentioned that "the COVID-19 pandemic has impacted the economy, customers willingness and ability to invest in energy efficiency, and how energy efficiency programs are implemented, among other impacts. This pandemic is ongoing and may have a long-term effect on the EE market that is not yet known. SoCalGas would like to lead a study on the effect of the COVID-19 pandemic."[88]

[87] SDG&E ABAL 2021, p. 3
[88] SCG 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 105

The impact evaluation of the PY2020 Residential HVAC Measures noted that installations in 2020 were approximately one-third lower than the prior two years.[89] Further, changes in customer habits at home during the pandemic impacted smart thermostat use, such as optimizing set points. Optimizing set points was more difficult when occupants were home all the time. This increased occupancy time reduced opportunities for setbacks that help achieve savings. Direct installation programs came to a halt in March 2020 and only picked up steam again in the latter half of the year.

SCE's 2024–2031 EE Portfolio and Business Plan described how energy usage among residential customers changed with COVID-19 and how those changes may continue in the near future.

> "Prior to Covid-19, electricity usage in the Residential sector had been slowly transitioning from historically high demand periods to a flattened demand curve throughout the day. This trend accelerated when Covid-19 hit, forcing a significant portion of the population to alter its work, schooling, and social behaviors. Because more people were in their homes during this period, consumption increased in this sector, as expected. As the pandemic moderates however, there is an expectation that a gradual shift back to the Commercial sector may occur, but based on industry trends, this new work/study-from home model may resume indefinitely – permanently altering the usage profiles of the past. This observation is important to note in light of the Potential and Goals study on opportunities for fuel substitution. As the work-from-home population grows, demand for electricity during daytime hours may continue to increase. For instance, on a cool winter day when demand for heating increases to serve more people at home, the requirement for increased EE is compounded if gas heaters are swapped for electric heat pumps. This type of trade-off between increased electricity usage that results from fuel substitution factors heavily in how SCE composes its portfolio to balance requirements for GHG reduction while minimizing impact to the grid with incremental load."[90]

During the shelter-in-place period more residents stayed at home and therefore used more energy. This, in turn, motivated some residential customers to make changes to save energy and participate in energy efficiency programs.[91] Opinion Dynamics conducted a bilingual online survey of 2,000 Californians in May 2020, a few months into shelter-in-place.[92] Results were weighted to represent the State's residential population based on gender, age, race, homeownership, education, and income. The survey explored how the COVID-19 pandemic impacted Californians and how effective recent Energy Upgrade California (EUC) marketing campaign efforts were during this period. The study found that those most financially affected by the pandemic were most likely to be aware of Energy Upgrade California's Flex Alerts marketing campaign surrounding energy usage.[93]

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[89] Impact Evaluation of Residential HVAC Measures Residential Sector PY2020, DNV April 2022

[90] SCE 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 132

[91] Ibid, p. 11

[92] Formally known as the CPUC COVID-19 Customer Support ME&O General Population Survey Report

[93] Based on the following question: The COVID-19 coronavirus situation can affect households in multiple ways. For each of the following ways, please indicate whether it has already happened for your household, if you expect it to happen in the next few weeks or months, if you do not expect it to happen anytime soon, or if it is not applicable to your household. If a respondent indicated that they had experienced or expected to experience any one of these financial impacts, we designated them as 'pandemic affected:' B. Reduce weekly working hours; C. Go on a furlough or temporary leave from a job; D. Get laid-off from or lose a job; E. Lose income, savings, or other financial support; F. Lose or reduce health insurance benefits; G. Miss or have difficulty paying monthly bills; H. Have difficulty affording basic needs like food, medical care, cleaning products, etc.; L. Apply for any type of financial assistance that you don't have to pay back from local, state, or federal governments, nonprofit organizations, family/friends, or others; M. Apply or ask for loans or other types of financial support that you will have to pay back from banks, financial lenders, family or friends, or others

Additionally, customers who reported financial impacts as a result of COVID-19:

- thought it more important for their household to do its part in making California more energy efficient (79%),
- were more willing to want to save energy and reduce their bills during the pandemic (79%), and
- were willing to change their actions to achieve such reductions (78%).[94]

COVID-19 also shifted marketing and communication methods. For example, PG&E's Energy Access Single Family implementation plan mentioned how "the pandemic has significantly shifted outreach from in-person to digital.[95] SDG&E's 2024–2031 EE Portfolio and Business Plan referenced a need to maintain health and safety for program staff and customer interactions while minimizing project interruptions. Activities and services were converted to online platforms where appropriate. "For example, on-site inspections/ verifications were converted to virtual verification processes."[96]

SCE's 2024–2031 EE Portfolio and Business Plan described a strategy to implement should an event similar to COVID-19 occur in the next cycle. "In 2020, the COVID-19 pandemic impacted industries focused on customer-oriented energy program. If a major unplanned event occurs during the four-year portfolio period, SCE will communicate with implementers to determine the situation and likelihood of meeting contractual obligations, establish a mitigation plan unique to the circumstances faced, leverage pay-for-performance contracts to ensure customers are protected, and assess SCE's ability to meet the four-year goals. Next, SCE will leverage the experience gained through the COVID-19 pandemic to establish a mitigation plan specific to new circumstances, potentially including different delivery models, incentive approaches, technologies, or other appropriate strategies."[97]

While all PAs' 2024–2031 EE Portfolio and Business Plans mention COVID-19 to some degree, they do not specifically state how their program plans address COVID-19 concerns for the residential market. Instead, most PAs discuss how they will approach the commercial market differently due to COVID-19.

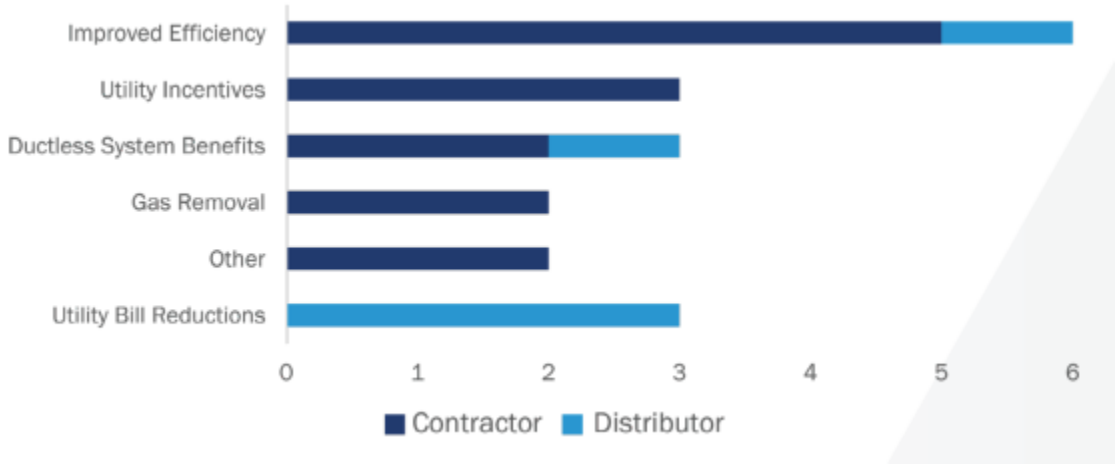
APPENDIX A-I.IV. Customer Motivators and Segments

There are multiple factors that motivate customers' decision-making when it comes to energy efficiency upgrades. Through the literature review, the study team identified several motivating factors that play an important role in customer decision-making around EE upgrades and actions.

Contractors and distributors noted that customers are motivated to adopt heat pump technologies such as heating and cooling units, clothes dryers, and water heaters for several reasons. These include, reduced utility bill costs, desire to eliminate gas usage, desire to control temperature in individual rooms, and availability of incentives.[98]

[94] COVID-19 Customer Support Campaign Gen Pop Survey Report, slide 4
[95] PG&E Energy Access Implementation Plan, p. 11
[96] SDG&E 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 217
[97] SCE 2024-2027 EE Rolling Portfolio Business Plan Exhibit 2, Page 28
[98] California Heat Pump Residential Market Characterization and Baseline Study, ODC, May 13, 2022, p 66

Figure 32. Trade Ally Perceived Customer Motivations



Source: California Heat Pump Residential Market Characterization and Baseline Study
n=14; *Interview Question: What motivates customers to adopt heat pump technologies?*

The PY2020 HVAC Fuel Substitution Impact Evaluation explored motivations for installing heat pumps with saving energy and reducing carbon emissions as the top motivators.[99] The report noted,

"A majority (61%) of those with central heat pumps reported the desire to save energy and reduce carbon emission for motivating their installations while the majority of those with ductless heat pumps (69%) reported safety and comfort as their motivation for installing their system. These motivations explain the load building and lower savings estimated at the meter for the latter group. Recommendations, saving money, equipment failure, and better use of renewable energy round out the other top motivations for installing the heat pumps. The majority of both groups (54% and 59% for those with central and ductless heat pumps, respectively) reported no barriers or challenges in connection with their heat pump installation. But for those who did experience barriers, installation and cost posed challenges."

[99] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

Figure 33. Participant Motivations and Barriers to Installation

Characteristics	PY 2020 Central Heat Pump Participants (n=171)	PY 2020 Ductless Heat Pump Participants (n=394)
Motivations		
Save energy/reduce carbon emissions	*61%	47%
Improve safety and comfort	*43%	69%
Based on recommendation	*37%	33%
Save money	*34%	32%
Equipment Failure	*31%	16%
Better use of renewable energy	*30%	15%
Based on reputation of heat pumps	21%	20%
Adding air conditioning	*13%	44%
No other options	*2%	14%
Barriers		
No barriers or challenges	*54%	59%
Installation Barriers	*23%	16%
Cost Barriers	*21%	18%
Availability of equipment	*3%	4%
Knowledge Barrier	*6%	5%
Qualified contractors	5%	4%

* Statistically significantly different from ductless installation responses, at least at the 90% confidence level

The California EE Market Adoption Characteristics Study[100] identified key value factors that customers consider in their decision-making processes. It created distinct clusters of customers who share similar attitudes about the environment, energy conservation, social signaling, and financial outlook.

> "The cluster analysis yielded four discrete groups (or segments) of residential customers who shared similar survey response patterns on the attitudinal and behavioral survey items. The table below summarizes the segments, including their ascribed segment name, their relative incidence among non-low-income Californian adults residing in single-family dwellings, and the attitudinal and behavioral trends that characterize each segment. These attitudes and clusters are unique to this study and there are no comparable prior studies in California or elsewhere.
>
> - The largest cluster is **Average Californians**, who reported an average, normal distribution of environmental concern, conservation attitudes, social signaling, and financial well-being. Average Californians are likely to require moderate to high amounts of ME&O with a mix of environmental, social, and financial messages.
> - Next is the **Eager Adopters**, who are defined by positive environmental concern, conservation attitudes, social signaling, and financial well-being. Eager Adopters are

[100] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages 29-31.

likely to require low amounts of ME&O targeted to their environmental attitudes and are less likely to need financial aid to afford EE technologies.

- **Likely Laggards**, who have negative environmental concerns, conservation attitudes, and social signaling but have positive financial well-being, are similar in size to the Eager Adopters. Likely Laggards are likely to change with the market and be less responsive to most ME&O and other program efforts.
- The smallest cluster is the **Economically Strained Environmentalists**, who have positive environmental concerns, conservation attitudes, and social signaling but negative financial well-being. Economically Strained Environmentalists are likely to require moderate to high amounts of ME&O targeted to their environmental attitudes, social signaling, and financial concerns, and are most likely to need financial aid to afford EE technologies."

Table 39. Single-Family Residential Cluster Analysis Results [a]

Segment Name	Segment Size (Weighted Proportion of Sample)	Attitudinal and Behavioral Characteristics
Average Californians	50%	Attitudes and values are average and normally distributed (does not strongly skew in either direction on most items).
Eager Adopters	20%	Believes strongly in environmental issues, wants to save energy, and has the financial means for energy upgrades.
Likely Laggards	19%	Not very concerned with environmental issues, saving energy, or social signaling but has financial means for energy upgrades.
Economically Strained Environmentalists	11%	Extremely concerned with environmental issues but efficiency upgrades can be out of financial reach, so desire to save energy is both altruistic and pragmatic; social signaling is important.

[a] Non-low-income residential customers whose 2019 household income was greater than 200 percent of the federal poverty guidelines.

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

The California EE Market Adoption Characteristics Study[101] also describes demographic differences between clusters. Mobile and manufactured homes are most often included in the "likely laggards" cluster.

"The demographic and household characteristics of the non-low-income single-family residential survey respondents further highlight key differences between the clusters.

- **Eager Adopters** are most likely to live in a detached house, have a smaller household, be older, non-Hispanic, White, and to have higher education and income.
- **Economically Strained Environmentalists** are most likely to live in a single-family attached house, have a larger household, be younger, Hispanic, non-White, and to have lower education and income.

  In between the Eager Adopters and the Economically Strained Environmentalists are the Average Californians and Likely Laggards.

[101] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages 30.

- **Average Californians** are closer to the Eager Adopters in regard to their housing type, household size, age, and race/ethnicity but are closer to the Environmentalists in terms of their education and income.
- **Likely Laggards** are closer to the Environmentalists in regard to their housing type, household size, age, race/ethnicity but are closer to the Eager Adopters in terms of their education and income."

Table 40. Single-Family Residential Cluster Demographic and Household Characteristics [a]

Characteristics	Average Californians	Eager Adopters	Likely Laggards	Economically Strained Environmentalists
Housing Type				
Single-family detached	91%	97%	85%	83%
Single-family attached	8%	3%	8%	17%
Other [a]	1%	0%	7%	0%
Household Size				
1 to 2 members	50%	61%	44%	37%
3 to 4 members	33%	33%	46%	48%
5 or more members	17%	6%	10%	15%
Average Age	57	58	55	55
Latino/a, Hispanic, Spanish Ethnicity	20%	9%	23%	28%
Race [b]				
White or Caucasian	67%	70%	63%	50%
Asian	13%	21%	16%	28%
Black or African American	2%	5%	0%	7%
Other	18%	4%	21%	15%
Education				
High school or less	23%	15%	19%	15%
Some college, no degree	23%	19%	25%	24%
2-year college degree	8%	8%	13%	19%
4-year college degree	26%	21%	27%	19%
Graduate or professional degree	21%	37%	15%	24%
Annual Household Income (2019)				
$25,000 to under $50,000	20%	2%	8%	9%
$50,000 to under $75,000	12%	10%	6%	33%
$75,000 to under $100,000	18%	14%	10%	9%
$100,000 to under $150,000	16%	22%	18%	20%
$150,000 to under $200,000	10%	8%	10%	7%
$200,000 or more	10%	24%	18%	9%
Prefer not to say/Don't know	13%	21%	27%	11%

Note: Non-low-income residential customers whose 2019 household income was greater than 200 percent of the federal poverty guidelines.

[a] Other includes apartments, manufactured/mobile homes, and other.

[b] Respondents could select more than one race; Other includes American Indian or Alaska Native, Pacific Islander, and other.

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

The study also explored motivating factors in decision-making around purchasing:

- high-touch technologies (refrigerators, clothes dryers, and smart thermostats),
- low-touch technologies (furnaces, central air conditioners, water heaters, and insulation),
- fuel-substitution technologies, and
- demand response with smart thermostat technologies.

The motivating factors uncovered here were then used in a value factor analysis and presented in the California EE Market Adoption Characteristics Study.[102]

> "The values reported in the tables in each subsection below are converted to percentages and used as inputs to the PG Model in the Potential and Goals Study.[103] Any indication of value factor impacts on market adoption will be part of the Potential and Goals Study in its aggregated reporting of savings. The Potential and Goals Study will explain the use of the value factors in the adoption logic and how the values provide indicators for market share analysis between technologies."

According to the California EE Market Adoption Characteristics Study,[104] discusses the high-level takeaways resulting from the value factor analyses for each residential customer cluster.

> "Overall, single-family residential respondents perceived the ecological impacts (environmental issues and repercussions) as highly important considerations in their decision-making about replacing or upgrading technology in their homes. Respondents also rated the lifetime costs of technologies as very important, followed by the hassle factor, non-consumption performance, and social signaling as moderately important. Respondents rated the upfront costs of a technology as a somewhat important aspect of making a purchase decision, and the least important of the six value factors.
>
> These overall trends were also found across the residential clusters and across the technologies asked about in the survey. There were few significant differences on each value factor between clusters or between the high-touch, low-touch, and fuel substitution technologies, but a few are discussed below:
>
> - **Lifetime Costs.** The Likely Laggards cluster reported that lifetime costs of technology are of lower importance compared to the other clusters, especially the Eager Adopters who rated lifetime costs as very important. Additionally, the clusters rated the lifetime costs of the fuel substitution technologies as slightly less important than the high- and low-touch technology lifetime costs.
> - **Upfront Costs.** The Economically Strained Environmentalists rated upfront costs of technology as much more important than the other clusters. At the technology level,

[102] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Page 32.
[103] Guidehouse. 2021 Energy Efficiency Potential and Goals Study – DRAFT. April 2021. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/energy-efficiency/energy-efficiency-potential-and-goals-studies/2021-potential-and-goals-study
[104] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages 32-34.

all the clusters rated the upfront cost of installing high efficiency insulation as more important compared to most other technologies (not shown in table).

- **Hassle Factor.** The Economically Strained Environmentalists rated the hassle factor of purchasing and installing technology as slightly more important compared to the other residential clusters. All the clusters rated the hassle factor of a refrigerator purchase and installation as more important than for the other high touch technologies (not shown in table). In addition, across all the clusters, the surveyed customers who reported not having a smart thermostat rated the hassle factor of participating in a DR program as more important compared to those who reported having a smart thermostat (not shown in table).
- **Non-Consumption Performance.** The Likely Laggards cluster reported that the non-consumption performance of technologies is of lower importance compared to the other clusters. Additionally, all the clusters rated the non-consumption performance of the refrigerator and central AC technologies as more important than for the other high and low touch technologies (not shown in table).
- **Eco Impacts.** The eco impacts value factor was not technology-specific (unlike the value factors above) except for the fuel substation technologies, which included additional eco impacts questions in the survey. There was significant variation in the reported importance of eco impacts among the customer clusters: Eager Adopters and Economically Strained Environmentalists perceived eco impacts as substantially more important than Average Californians and especially the Likely Laggards.
- **Social Signaling.** The social signaling value factor was not technology specific. There is some variation in the reported importance of social signaling across the clusters where the Eager Adopters and Economically Strained Environmentalists rated as more important than the other customer clusters.
- **COVID-19 Adjustment Factor.** Respondents reported that the COVID-19 pandemic has slightly to somewhat increased the importance of lifetime costs, upfront costs, and hassle factors in their decision-making. The pandemic appears to have had a greater impact on the hassle factor (respondents were periodically not very comfortable allowing contractors in their homes) and has had a lower impact on upfront costs and an even lower impact on lifetime costs."

Table 41. Single-Family Residential Customer Value Factor Mean Scores by Cluster and Technology Type [a,b]

Technology Type/Cluster	Lifetime Costs	Upfront Costs	Hassle Factor	Non-Consumption Performance	Eco Impacts [c]	Social Signaling [c]
Overall (n=598)	3.6	2.7	3.2	3.2	4.1	3.1
High Touch Technologies (n=598)	3.6	2.6	3.2	3.0	N/A	N/A
Average Californians (n=299)	3.6	2.7	3.2	3.0	N/A	N/A
Eager Adopters (n=120)	3.9	2.0	3.2	3.2	N/A	N/A
Likely Laggards (n=114)	3.1	2.3	3.1	2.9	N/A	N/A

Technology Type/Cluster	Lifetime Costs	Upfront Costs	Hassle Factor	Non-Consumption Performance	Eco Impacts [c]	Social Signaling [c]
Economically Strained Environmentalists (n=66)	3.6	3.2	3.3	3.0	N/A	N/A
Low Touch Technologies (n=598)	3.7	2.8	3.2	3.2	N/A	N/A
Average Californians (n=299)	3.7	2.9	3.2	3.4	N/A	N/A
Eager Adopters (n=120)	4.1	2.3	3.3	3.2	N/A	N/A
Likely Laggards (n=114)	3.2	2.5	3.0	2.8	N/A	N/A
Economically Strained Environmentalists (n=66)	3.9	3.6	3.4	3.2	N/A	N/A
Fuel Substitution (n=513)	3.4	2.8	3.2	3.3	3.4	N/A
Average Californians (n=248)	3.4	2.9	3.2	3.2	3.4	N/A
Eager Adopters (n=105)	3.4	2.4	3.1	3.5	3.9	N/A
Likely Laggards (n=107)	3.0	2.9	3.4	2.9	2.4	N/A
Economically Strained Environmentalists (n=53)	3.9	2.3	3.5	3.6	3.9	N/A
Demand Response with Smart Thermostat (n=314) [d]	N/A	N/A	3.0	N/A	N/A	N/A
Average Californians (n=152)	N/A	N/A	3.1	N/A	N/A	N/A
Eager Adopters (n=79)	N/A	N/A	2.5	N/A	N/A	N/A
Likely Laggards (n=51)	N/A	N/A	3.0	N/A	N/A	N/A
Economically Strained Environmentalists (n=32)	N/A	N/A	3.1	N/A	N/A	N/A
COVID-19 Adjustment Factor (n=598)	1.2	1.7	2.6	N/A	N/A	N/A

Technology Type/Cluster	Lifetime Costs	Upfront Costs	Hassle Factor	Non-Consumption Performance	Eco Impacts [c]	Social Signaling [c]
Average Californians (n=299)	1.2	1.7	2.7	N/A	N/A	N/A
Eager Adopters (n=120)	1.1	1.4	2.6	N/A	N/A	N/A
Likely Laggards (n=114)	1.2	1.5	2.8	N/A	N/A	N/A
Economically Strained Environmentalists (n=66)	1.2	2.0	2.4	N/A	N/A	N/A

[a] Non-low-income residents whose 2019 household income was greater than 200 percent of the federal poverty guidelines.

[b] Mean value factor scores on a 5-point scale where 1 means not at all important and 5 means extremely important in decision-making. Counts of less than 67 have less than 90/10 confidence/precision.

[c] The eco impacts and social signaling value factors are not technology-specific, except for the eco impacts value factor for fuel substitution.

[d] The only value factor for DR participation is the hassle factor since participating in a DR program does not involve any other factors.

Source: California Energy Efficiency Market Adoption Characteristics Study; Opinion Dynamics Analysis

The table below shows customers' program awareness, important factors in decision-making and top barriers around EE technology adoption, fuel switching, and demand response.

Table 42. Customer Awareness of Programs

Awareness/Participation	Single-Family Residential Customers [a]	Multifamily Residential Customers [b]	Commercial Customers [c]
Awareness of Programs and EE Technologies			
Aware that utility offers rebates and incentives to save energy	75%	71%	59%
Received a rebate or incentive for EE technology from utility	28%	18%	12%
Aware that utility offers demand response program	56%	N/A [d]	44%
Participated in demand response program	9%	N/A [d]	13%
Aware of smart thermostats	81%	80%	83%
Aware of heat pump water heater	23%	26%	18%
Aware of air source heat pump	21%	N/A [e]	N/A [e]
Aware of EMS	N/A [e]	N/A [e]	21%
EE Technology Adoption			

Awareness/Participation	Single-Family Residential Customers [a]	Multifamily Residential Customers [b]	Commercial Customers [c]
Extremely to moderately important factors	-Ease of use -Energy savings -Noise level -Comfort benefits -Ease of install -Info on models	-Ease of use -Time to install -Ease of install -Life span -Energy savings -Noise level -Comfort benefits	-Ease of use -Energy savings -Comfort benefits -Noise level -Info on models -Time to install
Major to moderate barriers	-Uncertain savings -Upfront cost	-Upfront cost -Uncertain savings -Install disruption	-Uncertain savings -Upfront cost -Install disruption
Fuel Switching			
Extremely to moderately important factors	-Energy savings -Life span -Comfort benefits -Lower impacts	-Life span -Energy savings -Performance -Lower impacts	-Life span -Energy savings -Lower impacts
Major to moderate barriers	-Install disruption -Upfront costs -Uncertain savings -Unfamiliarity	-Install disruption -Upfront costs -Uncertain savings	-Install disruption -Upfront costs -Uncertain savings -Unfamiliarity
Demand Response Participation			
Major to moderate barriers	-Allowing utility to adjust settings -Adjusting settings during events -Sharing data	N/A [d]	-Allowing utility to adjust settings -Adjusting settings during events

[a] Non-low-income residential customers whose 2019 household income was greater than 200 percent of the federal poverty guidelines and who reside in a single-family building with fewer than five units.
[b] Owners and managers of multifamily properties with five or more market rate units.
[c] Excludes industrial, agricultural, and government customers.
[d] Not asked about demand response programs.
[e] Not asked about technology.
Source: California Energy Efficiency Market Adoption Characteristics Study; Opinion Dynamics Analysis

Program Administration and Implementation Perspective

Interviewees reported the motivation for customer decision-making related to new equipment purchases, or upgrades typically include the following factors:

- **Customer Need for Upgrade**: A large motivating factor is when current equipment reaches its end of useful life, or "breaks." Customers want a replacement "right now" rather than later. This is especially true with water heaters, furnaces, and air conditioners.
- **Connecting Customers:** Another motivating factor is when customers find the equipment that is right for them, which is a large focus of PG&E's Energy Action Guide.
- **Rebates**: Rebates and discounts help motivate customers, particularly when they are downstream and visible to customers at the time of decision-making.
- **Climate Change:** The effects of climate change are noticeable already to customers in California and it is motivating some to reduce energy.

- **Cool Factor**: Especially for plug load and appliances, customers are motivated by "cool" features. For example, often smart thermostats are considered a "cool technology" that customers are excited to try, and this often becomes an opportunity to lead to more HVAC-related work with the customer. "Our most popular measure is the smart thermostat because it is offered at no cost. HVAC programs are not as appealing to customers but are more cost effective. We use the smart thermostat as a "foot in the door" leading to more work in those areas." – SCE Program Staff

These motivating factors also apply to the statewide HVAC and PLA Programs.

- **High Efficiency**: The HVAC program has experienced a significant increase in Heat Pump technology enrollment and attributes that to the high level of efficiency and that customers have really noticed significant savings on their bill and that is motivation enough regardless of the rebate. A significant technological improvement is very motivational to customers.
- **Ease of Use:** One additional factor mentioned by implementers was the program "ease of use." Specifically, the statewide PLA program has created an online instant rebate process to reduce the participation hassle factor. Once equipment is selected, customers still need to sign onto a website to answer a few demographic questions. If they are eligible, they receive a code to use with any participating retailer they choose. This greatly reduces point-of-sale paperwork and time.

APPENDIX A-II. How Programs are Addressing Market Needs

This section details how residential programs are currently addressing the needs of the EE market, what program offerings are available to customers now and in the near future, to what extent these customers have been served, and what segments, if any, are not being served.

APPENDIX A-II.I. Potential and Goals Study

The P&G study is used by the CPUC to, "…conduct robust quantitative scenario analysis to examine the complex interactions among various inputs and policy drivers for the full EE portfolio."[105] The P&G study also provides some guidance on customer segments. The emphasis of the P&G study is providing savings potential for three categories of savings and three main scenarios of cost-effectiveness. The savings potential category definitions are below:[106]

- **Technical potential** refers to the energy savings available each year if all opportunities were captured regardless of cost-effectiveness. These savings are above applicable building codes and appliance standards.
- **Economic potential** is a subset of Technical potential. It is the energy savings that meets specific cost-effectiveness criteria.
- **Achievable potential** is a subset of Economic potential. This is a first-year savings estimate based on specified incentive levels, program delivery methods, assumptions about existing CPUC policies, market influences, and barriers. This is not a forecast of what will happen, it is only an estimate of what might be achieved based on historical relationships. Implementers can use this as a guide to understanding historical relationships between equipment dollar incentive levels, marketing spend, and program activity for a given set of CPUC rules. The standard caveat that past performance is no guarantee of future results applies equally to the P&G study.

[105] 2021 Energy Efficiency Potential and Goals Study - Draft, April 23, 2021, Guidehouse, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/energy-efficiency/2021-potential-goals-study/2021-pg-study-draft-report.pdf
[106] Potential Type https://public.tableau.com/app/profile/2021.cpuc.pg.study/viz/CPUC_V01_16184220382340/LandingPage

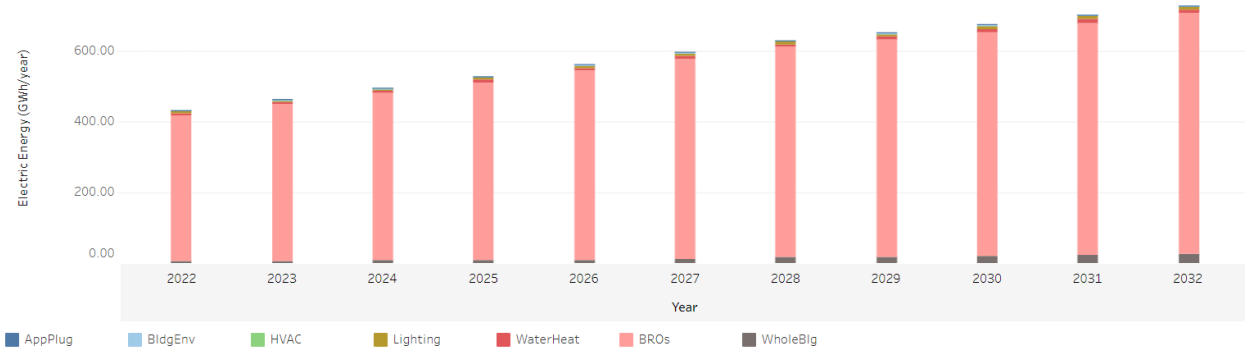
The cost-effectiveness scenarios are the following:

- **Total Resource Cost (TRC), Low:** Cost-effectiveness threshold is 1.0 for individual measures and a 50% incentive cap.
- **Reference:** Business as usual. Cost-effectiveness threshold is 0.85 and a 50% incentive cap. The portfolio TRC of 1.25 is still implied, but a lower threshold on individual measures allows more flexibility when developing product or service bundles.
- **TRC, High:** This is the reference case with greater integration of Behavior, Retro-commissioning and Operational Efficiency (BRO) programs, available financing, higher marketing and outreach spending, and a 75% incentive cap.

According to the 2021 EE Potential and Goals Study achievable reference scenario, there are between 400–600+ GWh and 17–30+ MMTherms savings available annually between 2022 and 2032 throughout the entire residential sector, including single-family, multifamily, and mobile home markets. The next two figures come from the 2021 EE Potential and Goals Study and depict a breakdown of the energy and gas potential by end use.[107]

These figures show that much of the savings potential is in BROs (drive by audit, information, and testing services) as opposed to equipment installations.[108] Historically however, BRO elements, such as real-time feedback, produce 1%–2% annual savings if the customer is actively participating in the program.

Figure 34. Electric Residential Incremental Achievable Potential TRC Reference Scenario[109]

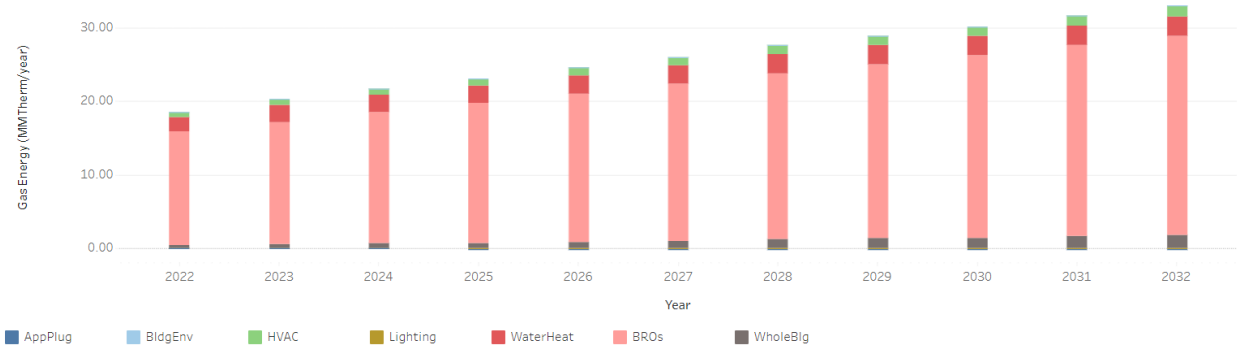


[107] 2019 Energy Efficiency Potential and Goals Study Final Public Report (PG Study); this was the latest Potential and Goals Study available at the time the landscape analysis was conducted in 2022.

[108] Residential BRO includes Universal Audits, Home Energy Ratings (HERS), real-time energy use feedback, and challenges and competitions, https://file.ac/TDCoHibMwEY/

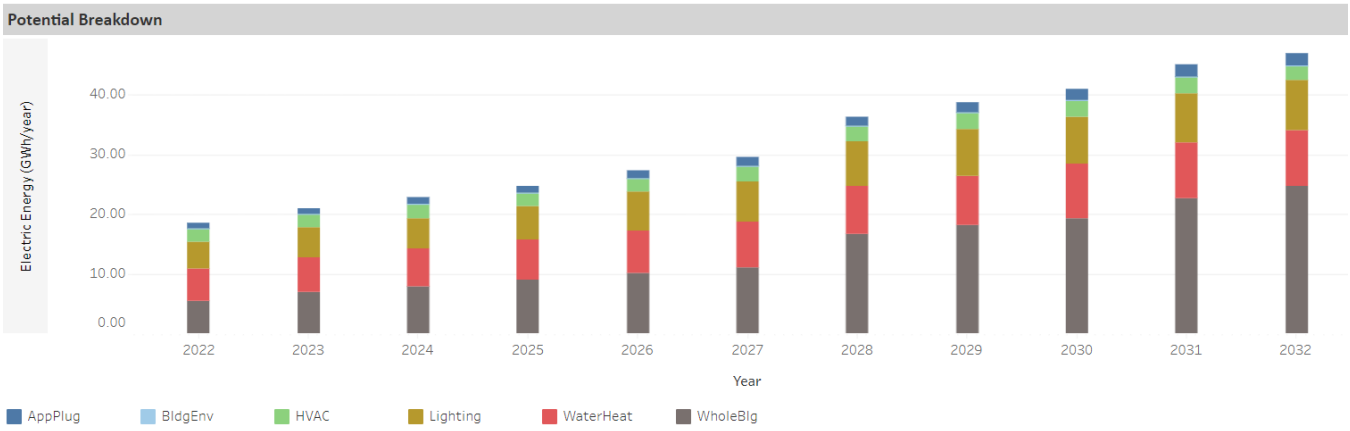
[109] 2021 PG Study Results Viewer | Tableau Public

Figure 35. Gas Residential Incremental Achievable Potential TRC Reference Scenario[110]



Removing BROs and focusing on end uses that would likely be a part of RA programs reveals that the "whole building," water heating, lighting and HVAC measures account for a majority of residential savings potential each year the distribution of electric savings by end use demonstrates. The next two figures show the electric and gas potential by end use for the entire residential market, including multi-unit dwellings, focusing on equipment rebate programs.

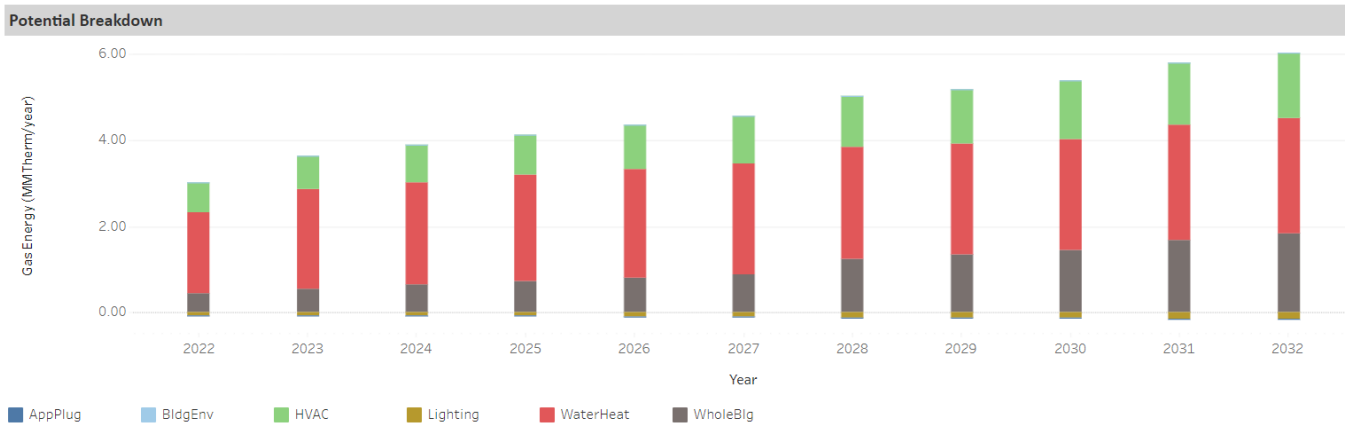
Figure 36. Statewide Residential Incremental Electric Market Potential by End Use for Equipment Rebate Programs (TRC Reference Scenario)



Source: *2021 PG Study Results Viewer | Tableau Public*

Figure 37. Statewide Residential Incremental Gas Market Potential by End Use for Equipment Rebate Programs (TRC Reference Scenario)

[110] 2021 PG Study Results Viewer | Tableau Public



Source: [2021 PG Study Results Viewer | Tableau Public]

Finally, the 2021 P&G Study for program year 2024 includes 3,709 residential sector entries. We grouped these by TRC bins. HVAC makes up the majority of the modeled technologies in the TRC bins after BRO measures.

The TRC implies a risk level for each group in addition to relative cost-effectiveness. Low TRC type is a high-risk category, and High TRC type is a low-risk category. Risk revolves around uncertainty. At Low TRC, small changes in equipment costs, equipment performance, or program administrative costs put cost-effectiveness at risk. High TRC equipment can tolerate more uncertainty and remain cost-effective. According to the 2021 P&G Study, BRO measures offer the greatest opportunity for savings. These are in the Low–Mid TRC group, however, and should be considered for program inclusion with some caution.

The High TRC group is the least risk group but also is associated with the least amount of first-year savings. Duct Sealing and testing account for 66% of the achievable savings in this group. Mini-split heat pumps account for 76% of the achievable savings in the High–Mid TRC bin. We summarize the P&G groups in the table below.

Table 43. P&G Residential Measures Grouped by TRC Bins

TRC Type	TRC Group	Sum of first-year gross kWh	Group Primary Savings Drivers	% of TRC Group Savings	End Use
Low	<1.10	146,266,864	Heat pump technologies	26%	HVAC
Low–Mid	1.10>X<1.50	449,247,629	Reports / Behavior	88%	BRO
Mid–High	1.50>X<2.00	22,998,877	Mini-split heat pumps	76%	HVAC
High	X>2.00	13,904,033	Duct seal & test	66%	HVAC
	Grand Total	**632,417,403**	—	—	

APPENDIX A-II.II. Residential Appliance Saturation Survey

In addition to the overall residential energy saving potential, the 2019 California Residential Appliance Saturation Survey (RASS) determined the average electricity use per household in the state was 6,174 kWh.[111] The figure below shows the breakdown of the average household's electricity consumption by end use.

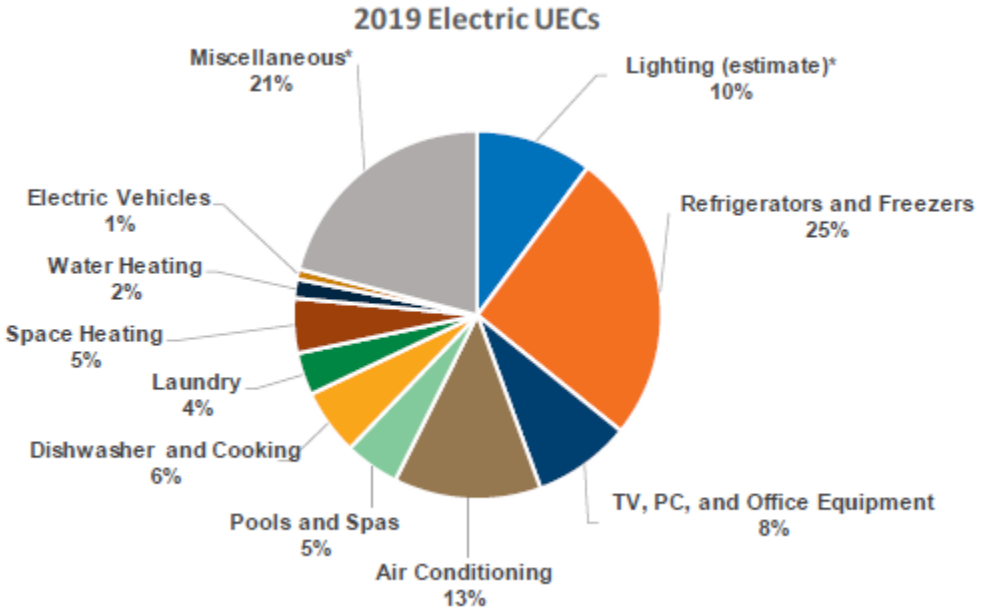
[111] Household use decreased from 6,296 kWh in 2009 to 6,174 kWh in 2019. https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study, September 19, 2020, DNV

This California Energy Commission–sponsored study is a recurring study to determine saturation of residential appliances, how they are used, and unit energy savings. The study has been running since 2008 and highlights changes over time. For example, by comparing studies from 2009 to 2019, trends in household electric use emerge:

- Lighting as a percentage of household use has dropped from 22% to 10%
- Refrigerators and freezers have increased from 20% to 25%
- Air Conditioning has increased from 7% to 13%
- TV, PC, and Office Equipment has dropped from 20% to 8% (pre-pandemic)

Reasons for these changes include more efficient equipment (Lighting and TV, etc.), larger appliances with more features (larger refrigerators with ice makers), and higher market saturations (air conditioning). The RASS can be one source for identifying end uses to consider for EE programs.

Figure 38.Statewide Electricity Consumption per Household: 2019 RASS: 6,174 kWh per Household



Source: 2019 California Residential Appliance Saturation Study (RASS) Consultant Report Executive Summary Figure ES-1, p.3

APPENDIX A-II.III. Technical Reference Manual

Developed by the California Technical Forum,[112] the electronic TRM (eTRM) is an online application that serves as the repository for all statewide deemed measures for California (e.g., workpapers).[113] Technical documentation can be submitted by program administrators or implementers to the eTRM working group for consideration as a deemed measure. Deemed measures have standardized specifications and savings, which enables PAs and implementers to know the approved energy savings and other factors that affect TRC calculations for the measure before installation.

[112] http://www.caltf.org/etrm-overview

[113] https://www.caetrm.com/measures/, registration is required to access the manual.

APPENDIX A-III. Current EE Programs Offered to Residential Customers

We looked at each PA's 2021 Annual Report Narratives and Budget Filing Detail Reports to identify the resource acquisition programs offered to residential single-family customers.[114] The table below summarizes these current programs. To the extent possible, we focused on programs considered resource acquisition programs as defined in the most recent 2024–2031 PA EE Portfolio and Business Plans.

[114] https://cedars.sound-data.com/filings/list/2022/?include_c_n_s=true&include_cca_rens=true

Table 44. Residential EE Programs for Existing Homes Offered in 2021 [a]

PA	Program	Target	Budget	First Year Net GWh	Type
SDG&E	SDGE3204 SW-CALS – Plug Load and Appliances – POS Rebates	Residential All Types	$1,518,172	1.02	EE; Midstream rebates at point of sale for pool pumps, gas water heaters, electric heat pump water heaters
SDG&E	SDGE_SW_HVAC_Up - SW Upstream HVAC Program	Residential All Types	$2,232,092	1.21	EE; Upstream and midstream incentives for HVAC measures
SDG&E	SDGE4002 - Multi Family Program	Multifamily; Manufactured Homes	$5,345,438	1.30	EE; Direct install measures, complimentary ASHRAE Level 1 audits, incentives for advanced energy efficiency, solar PV installations, and battery storage
SCG	SCG3702 Residential – Residential Energy Efficiency Program	Single-Family	$11,655,724	0.90	EE; Gas measure rebate program for gas appliances
SCG	SCG3706 Residential – Residential HVAC	Single-Family	$500,000	0.0	EE; Incentives to distributors for EE furnaces
SCG	SCG3810 Residential – Smart Home Optimization Program	Single-Family	$828,707	0.0	EE; Installation of energy management technologies such as smart thermostats, cloud optimization protocols, water heater controllers, thermostatic control valves
SCG	SCG3829 Residential – Marketplace	Residential, All Types	$1,417,500	0.0	EE; Website with incentives for home appliances and consumer electronics
SCG	SCG3831 Residential – EE Kits	Residential in DACs and HTR customers	$150,000	0.0	EE; Kits include low-flow showerheads, faucet aerators
SCG	SCG3832 Residential – Pasadena Home Upgrade	Residential in Pasadena	$447,300	0.0	EE; Home survey and weatherization services; no-cost direct install
SCG	SCG3833 Residential – Burbank Home Upgrade	Residential in Burbank	$374,525	0.0	EE; Electric, water, and gas measures at no cost; whole house approach
SCG	SCG3836 Residential – LADWP HVAC	Residential, All Types	$1,329,300	0.0	EE; No-cost installation of smart thermostats
SCG	SCG 3861 Residential – Community Language Efficiency Outreach – Direct Install (C–EO - DI)	Residential in Limited English and HTR communities	$1,166,123	0.22	EE; Direct install aerators, showerheads, tub-spout diverters, Nest® thermostats,[b] pipe sleeves, water heaters Shifting to an equity program
SCG	SCG3883 Residential – Residential Advanced Clean Energy Program	Single-Family	$0	0.0	EE; Direct install audit with electric, gas and water savings (i.e., aerators, furnaces, water heaters)

PA	Program	Target	Budget	First Year Net GWh	Type
SCG	SCG3884 Residential – Comprehensive Manufactured Home Program	Manufactured & Mobile Homes	$0	0.0	EE; Direct install in-home energy and water efficiency survey and weatherization services, specific measures vary depending on audit results (i.e., insulation, ductwork, water heater) Shifting to an equity program
SCG	SCG 3885 Residential – Residential Manufactured Home Program	Manufactured & Mobile Homes	$0	0.0	EE; Direct install measures and incentives for EE measures vary depending on results of comprehensive modeling; Includes SCG3884 and more EE (i.e., lighting, whole house fan, windows) Shifting to an equity program
SCE	SCE-13SW-001B Plug Load and Appliances	Residential, All Types	$3,877,122	14.48	EE; Eco Financing as a payment method for a wide range of product categories; leverages instant point-of-sale rebates on heat pump water heaters from TECH/SGIP
SCE	Residential Direct Install	Residential HTR and LMI customers, Customers in DACs	$3,010,900	4.46	EE; Direct install weatherization and water savings provided and installed at no cost
PG&E [c]	Residential Energy Efficiency Program (PGE21002)	Residential, All Types	$954,279	0.26	EE; Incentives for smart thermostats and electric heat pump water heaters
PG&E [c]	Residential Pay for Performance (AKA Comfortable Home Rebate)	Residential, All Types	$3,472,922	3.41	EE & Behavior; Whole home upgrade rebates and home energy use analysis and reports, used NMEC approach
BayREN	Single-Family Home+	Single-Family, moderate income	$9,176,525	3.26	EE; bundles measures for electrification of water and space heat, cooking, and clothes drying. This program is filed under the “equity” program category.

[a] Opinion Dynamics conducted the landscape analysis in 2022. We reviewed each PA’s 2021 Annual Report Narratives and Budget Filing Detail Reports to identify the resource acquisition programs offered to residential single-family customers. To the extent possible, we focused on programs considered resource acquisition programs as defined in the most recent 2024–2031 PA EE Portfolio and Business Plans.

[b] Nest is a registered trademark of Google LLC, Limited Liability Company, Delaware

[c] Closed in 2021

APPENDIX A-III.I. Current Programs and Meeting Needs

When interviewed, PG&E program staff stated customer feedback indicated that customers largely want PG&E to leave them alone and make it easy to save energy. The majority of PG&E's current programs targeting residential customers are free to participate. PG&E ran three EE RA programs in 2021 but they are largely sunsetting or have already ramped down for a multitude of reasons.

- The Residential Energy Efficiency Program, also known as their local Plug Load and Appliances Program incentivizing smart thermostats and water heaters, is sunsetting in favor of the new Statewide PLA program, also known as the Golden State Rebate Program.
- The Residential Pay for Performance Program, also known as the Comfortable Home Rebate Program incentivizing whole home upgrades and behavior changes through metered energy savings post-project, started under High Opportunity Energy Efficiency Programs or Projects (HOPPs) Program and is sunsetting this year due to data challenges associated with calculating energy savings from Normalized Metered Energy Consumption (NMEC) programs as well as COVID challenges. PG&E is searching for a new pathway to these services for customers, but customers can be served currently through the statewide Energy Smart Homes Program, which is primarily for new construction but can serve retrofit as well. This program does cost money for customers and is more conducive to customers with higher incomes who can pay the partial cost of deep home energy retrofits.
- The Mobile and Manufactured Homes Program was also closed in 2021 due to cost-effectiveness issues. PG&E shifted this program to the equity segment.

PG&E also offers the Water Saver Program, which has EE benefits but is largely geared toward shifting water-heating use to reduce peak load.

PG&E staff mentioned that going into customers' homes and upgrading them has not proven to be a cost-effective approach within the current cost-effectiveness framework. Beyond the three programs mentioned, PG&E is largely serving residential customer energy needs through a number of educational platforms that are free to the customer.

- Home Energy Report: PG&E reaches 3.05M households out of 5M in its territory and provides energy information and tips on how to reduce usage. Customers save 1%–2% of energy use, on average.
- Energy Action Guide: This is a new online marketplace. In PG&E's experience, customers do not like the name marketplace and do not like being sold products. However, they do want help figuring out the best next step or action they should take to save energy. This is a free website where customers can look for products and rebates. Future phases of the Guide will cater resources to specific zip codes and income level.
- Home Intel: A free program to customers where they can release their consumption data via a website and receive personalized disaggregated reports of their energy use. High energy users receive a live person/coach to virtually walk through the home, assess, and give tips on how to save energy (e.g., how to change their water heater set point or finding gas leaks). On average, these customers save 10% on energy at home and savings are claimed through NMEC methods. Given the NMEC method, mobile/manufactured homes are eligible to participate but only if they have their own dedicated meter.
- Home Energy Check-Up: This program is free and available to customers virtually via an online survey that takes about 5 minutes to complete and provides tips to reduce energy use. This program reaches approximately 200,000 customers per year.

SCE is currently running three residential EE programs:

- The Plug Load and Appliances Program operated as a downstream model but is now sunsetting in favor of the Statewide PLA program that SDG&E will administer.
- The Residential DI Program is largely focused on specific climate zones and targets customers who do not qualify for low-income programs but may still struggle with the means needed for EE upgrades.
- The Comprehensive Manufactured Homes Program is similar to the direct install program described above but targets mobile and manufactured homes specifically.

SDG&E is currently running three residential EE programs as well as a multifamily program that currently includes mobile/manufactured homes:

- The Statewide Plug Load and Appliances Program implemented by CLEAResult is largely a midstream program focused on market actors but has an end user educational component.
- The Statewide HVAC Program, also implemented by CLEAResult is largely an upstream/midstream program working with manufacturers, distributors, and retailers to drive down the cost of upgrades.
- The Statewide Residential Single-Family Program implemented by Synergy is a downstream program that provides direct install measures to customers who own or rent a single-family residence. This program is expected to launch by early 2023.
- The Multifamily Family Program (aka Residential Zero Net Energy Transformation [RZNET]) is a downstream program that provides direct install measures to customers living in multifamily properties or mobile/manufactured homes.

APPENDIX A-III.II. Which Residential Customer Segments, if Any, Are Not Being Served by Current Residential EE Programs?

It appears that the single-family market is being served by the current residential EE programs. Two PAs with overlapping service areas, SCE and SCG, are serving manufactured and mobile homes specifically through a third-party program implementer. The SCG program is considered an equity program rather than a resource acquisition program.

Given these existing programs, new programs will need to identify customer segments or subsegments not currently participating in existing programs. Once identified, customer adoption in these differentiated segments may require more innovative methods for marketing and outreach rather than expanding the technologies offered.

Reach of Current EE Programs

Given that the landscape analysis was conducted by Opinion Dynamis in 2022, the table below compiles relevant information from nine different impact evaluations spanning 2018–2020 to get an overall understanding of the extent to which customers have been served by current EE programs. To answer the types of questions raised by the CPUC, PAs, and stakeholder groups, the implementers need systems in place to track program activity, customer eligibility, and marketing data. For example, did the program reach the savings target it estimated? Did program implementation go as planned or were adjustments needed along the way? Who participated, who did not participate and why? What are the lessons learned for the next iteration?

Table 45. Summary of Recent Impact Evaluation Results Available by Program or Measure Grouping (2018-2020)

Evaluation	Measure	Program Channel	PY / Budget	Measures Installed	Participants	PAs Offering	Savings	Other Metrics
Impact Evaluation of Residential HVAC Measures [a]	HVAC measures including smart thermostat, fan motor replacements, fan controls, duct testing and sealing	Direct install (66%) and rebate delivery (34%)	PY2020 $37M [k]	58,000 residential HVAC installations [b]	29,991 Direct install (electric) 25,129 rebates (electric) 32,592 Direct install (gas) 24,182 rebates (gas)	MCE, PG&E, SCE, SCG, SDG&E	16.85 GWh (gross claimed) [b] 4.56 GWh (evaluated gross) [b] 3.1 GWh (net) [b]	GRR: 27% [b] NTGRs: 50% (smart thermostats); 89% (fan motor); 86% (fan motor controls); 79% duct testing and sealing
Upstream and Residential Downstream Lighting Impact Evaluation Report [c]	LED reflector light bulbs, LED candelabra light bulbs, LED globe light bulbs	The largest program for each PA was upstream, providing incentives to manufacturers. Downstream programs where residents received rebates was a relatively small percentage.	PY2019 $194M [l]	~26 million Mostly from upstream (~25 million Residential and 1 million Non-residential) [d]	N/A	PG&E, SCE, SDG&E	272 GWh (gross) 46 GWh (net)	GRR: 94% (includes non-residential) NRR: 23% (includes non-residential)
Impact Evaluation of Smart Thermostats [e]	Smart thermostats	Direct install, rebate	PY2019 $6.4M [l]	160,000 [f]	Delivered through 21 different programs at low or no costs to customers	MCE, PG&E, SCE, SCG, SDG&E	19 million kWh savings from direct install (70%) and 8.7 million kWh from rebates (30%) 55.8 kWh (SF unit savings) 77.7 kWh (mobile home unit savings)	GRR: 23% NTGR: 79%
Impact Evaluation of Water Heating Measures [g]	Water Heaters, central natural-gas storage and tankless water heaters, individual natural-gas storage and tankless water heaters, heat	Downstream rebates, direct install, midstream rebates	PY2019 $84M [l]	Over 8,000 gas and 800 electric savings water-heating measures (60% from small natural gas tankless)	8,000 occupants and 1,000 multifamily properties, delivered through 15 programs	MCE, PG&E, SCE, SCG, SDG&E	1,487,173 kWh 1,015,009 therms (first-year gross)	GRR: 100% NTGRs: 48.1% (HPWH); 35.8% (Tankless WH); 100% (Recirculation Pump)

Evaluation	Measure	Program Channel	PY / Budget	Measures Installed	Participants	PAs Offering	Savings	Other Metrics
	pumps and water controllers							
Impact Evaluation Report Pool Pumps Residential PY2018 [h]	Pool Pumps	Downstream rebates, point-of-sale	PY2018 $7M – PY2019 $24M [m]	11,455 pool pump measures [i]	N/A	PG&E, SCE	Gross Savings: 2,952,192 kWh (PG&E); 7,621,333 (SCE) Net Savings: 1,771,315 kWh (PG&E); 4,572,800 kWh (SCE)	89% of savings and 85% of measures from single-family residential pool pump measures
PG&E ENERGY STAR Retail Products Platform Program Pilot Early Evaluation [j]	Air Cleaners, Air Conditioners, Dryers, Freezers, Refrigerators, Soundbars, Washers	Incentives, Partnership with participating retailers (Best Buy, The Home Depot, Sears/Kmart, Nationwide, Lowe's)	PY2016–2018 $7M [n]	N/A	participating retailers (Best Buy, The Home Depot, Sears/Kmart, Nationwide, Lowe's)	PG&E	Savings not estimated as part of this pilot evaluation	Based on statistical modeling of retailer sales data, short-term sales increases for dryers, freezers, refrigerators, and soundbars.

a. Group A Residential PY2020 RES HVAC Final Report for PDA
b. The 58,000 HVAC installations and associated savings include single-family, multifamily, and mobile homes.
c. CPUC Upstream and Residential Lighting Impact Evaluation Report Lighting Sector PY2019
d. The 26 million units are the combined total light bulbs that were shipped from manufacturers to retail stores.
e. Impact Evaluation of Smart Thermostats Residential Sector PY2019
f. The 160,000 smart thermostats and associated savings include residential customers in single-family, multifamily, and mobile homes.
g. Impact Evaluation of Water Heating Measures Residential Sector PY2019
h. Impact Evaluation Report Pool Pumps – Residential Program Year 2018
i. The number of measures is for SDG&E, SCE, and PG&E single-family residential measures.
j. PG&E ENERGY STAR Retail Products Platform (ESRPP) Pilot Early Evaluation
k. 2020 BDFR_2020_20191118
l. 2019 BDFR_2019_20190123 water heater budget not delineated from broader res EE program
m. 2018–2019 CEDARS PGE=210011, SCE = 2018_000944 and 2018_001092
n. 2016–2018 Part of Plug Load and Appliance program budget

APPENDIX A-III.III. Which types of customers are not participating in EE programs and why?

Based on the PAs 2024–2031 Portfolio and Business Plans, the types of customers who are not participating in EE programs are often renters, HTR customers, LMI customers, and customers who live in DACs. For these customers, the barriers described above are even more pronounced making it challenging to participate in EE programs.

- **Hard-to-Reach**: Commission staff developed specific criteria to classify residential customers as hard-to- reach. These are customers who do not have easy access to program information or generally do not participate in energy efficiency programs due to
  - a language,
  - income,
  - housing type,
  - geographic, or
  - home ownership (split incentives) barrier. [115]

The Commission later clarified that hard-to-reach definition in Resolution G-3497.[116] It clarifies that if a "customer does not meet the geographic criterion (i.e., they are not located in one of the identified metropolitan statistical areas), they must meet a total of three criteria to be considered hard-to-reach; and if a customer meets the geographic criterion, they must meet one other criterion to be considered hard-to-reach.

- **Disadvantaged Community Customers**: "Disadvantaged Communities are in the most environmentally burdened California census tracts, as determined by the top 25 percent highest scores when using CalEPA's CalEnviroScreen tool.[117] These communities experience high unemployment, lower incomes, suffer a disproportionate impact from one or more environmental hazards, and are likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities."[118]
- **Low to Moderate Income**: These customers may not qualify for statewide Energy Savings Assistance (ESA)[119] programs and services (due to source of income for example) but have significant financial constraints to adopting EE. The income limits vary by county. Low-income customers have an annual household income of less than 50% of the HUD area median income. Moderate-income customers have an annual household income between 50% and 80% of the HUD area median income.

For example, according to HUD guidelines in 2022 a four-person household in San Diego County is considered low-income with an annual income of $65,050 or less. In Fresno County, the same household is considered low-income with an annual income of $38,950 or less.[120]

- According to the National Conference of State Legislatures, LMI customers are a desirable population for assistance because they face a greater "energy burden" than other demographics. This group uses approximately 7.2% of their

[115] SDG&E EE 3P Solicitation Advice Letter for Statewide Upstream and Midstream HVAC, November 2020, p. 8
[116] D.18-05-041 Page 43
[117] https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40
[118] Source: SDG&E EE 3P Solicitation Advice Letter for Statewide Upstream and Midstream HVAC, November 2020, p. 8
[119] Currently the California statewide ESA income limit for a family of 4 is $69,375. This limit is effective July 1, 2022, to May 30, 2023, https://www.cpuc.ca.gov/consumer-support/financial-assistance-savings-and-discounts/energy-savings-assistance
[120] HUD FY-2022 Income Limits Documentation System, https://www.huduser.gov/portal/datasets/il/il2022/select_Geography.odn

income for energy needs. This is over twice the amount used by median income households (3.5%).[121] Barriers for this (often multifamily dwelling) group include,

- Large upfront capital requirements.
- Reduced access to desirable financing.
- Customers' low credit scores.
- Lack of homeownership.
- Inability to access tax incentives.
- Residence in multifamily housing.
- Residence in inefficient manufactured housing.
- Lack of roof access.

Further, a recent study of residential customers living one of CA's largest DACs, the San Joaquin Valley, surveyed 2,660 residential customers living in the region in 2021.[122] The study explored the customers' awareness of EE programs and self-reported recall of participation in any EE program. Overall, half of the customers (51%) were aware of EE programs but only 15% participated. Homeowners were more likely than renters to be aware and have participated. Among non-low-income customers living in this DAC, 60% were aware of EE programs but only 18%–19% had participated.

Table 46. San Joaquin Valley Program Awareness and Participation

	n	Aware of SJV Proceeding	Aware of EE Programs	Participated in any EE Program
Overall	2,660	16%	51%	15%
Natural Gas Access				
No Natural Gas (a)	1,391	16%	53%	14%
Natural Gas (b)	1,269	16%	51%	15%
Community Size				
Small, No Natural Gas (c)	458	20%d	56%e	13%
Medium/Large, No Natural Gas (d)	933	16%	53%	14%
Small, Natural Gas (e)	229	20%f	48%	11%
Medium/Large, Natural Gas (f)	1,040	16%	51%	15%e
Home Ownership				
Owner, No Natural Gas (g)	1,082	14%	55%h	16%h
Renter, No Natural Gas (h)	309	21%gi	46%	10%
Owner, Natural Gas (i)	815	17%gi	55%j	19%gi
Renter, Natural Gas (j)	454	14%	44%	9%
CARE Eligible				
CARE Eligible, No Natural Gas (k)	571	19%l	47%	11%
CARE Ineligible, No Natural Gas (l)	560	15%	60%k	19%k
CARE Eligible, Natural Gas (m)	582	17%	43%	11%
CARE Ineligible, Natural Gas (n)	469	14%	60%m	18%m

a/b/c/d/e/f/g/h/i/j/k/l/m/n Indicates significant differences at a 90% confidence level between the following tests: ab,cd,ce,df,ef,gh,gi,hj,ij,kl,km,ln,mn

[121] https://www.aceee.org/press/2016/04/report-energy-burden-low-income

[122] Opinion Dynamics, SJV DAC Data Gathering Plan Findings Report, August 2021.

APPENDIX A-IV.Future EE Programs for Residential Customers

The California IOUs have set eight-year plans outlining how they intend to capture energy savings through their individual and statewide programs. The proposed 2024 statewide program budgets and savings targets are presented in the table below. These proposals are subject to CPUC approval.[123]

This table is limited to the programs that fall within the scope of this pulse check research (i.e., RA programs offered to single-family, mobile, or manufactured home residential customers). The PA plans include several behavior programs (home audits, customer energy monitoring, HERS). Only home audits are classified as RA programs and those programs also are listed in below.

Table 47. Proposed 2024 Statewide Programs, Budgets and Electric Savings

Program	PA	Budget	Gross kWh	Gross Therms
Emerging Technology Programs - Electric	SCE	$17,819,947	0	0
Emerging Technology Programs - Gas	SCG	$3,000,000	0	0
New Construction - Residential - All Electric	PG&E	$8,647,763	8,026,485	405,331
New Construction - Residential - Mixed Fuel	PG&E	$3,093,053	15,784,606	28,833
SW HVAC QI/QM Program	SDG&E	$6,900,000	9,365,542	201,769
SW HVAC Upstream Residential	SDG&E	$3,697,140	31,605	834,725
SW Plug Load and Appliances	SDG&E	$17,762,607	44,133,056	581,709
Workforce Education and Training - Career Connections	PG&E	$1,000,000	0	0
Workforce Education and Training - Career & Workforce Readiness	PG&E	$2,000,000	0	0
Crossover between Behavioral and Energy Efficiency				
Universal Audit Tool	PG&E	$2,552,640	14,259,983	219,226
Continuous Energy Feedback Program	PG&E	$18,243,661	185,900,000	6,206,300
IDSM Local Residential Behavioral Program (EE)	SDG&E	$3,005,868	45,261,075	1,123,712
Residential Behavioral Program	SCE	$4,115,226	38,515,727	0
RES-Residential Behavioral Program	SCG	$4,925,951	0	12,218,935

According to the 2024–2031 EE Business and Portfolio plans from SDG&E, PG&E, SCE, and MCE they forecast a combined 7,621 GWh of energy savings potential from residential programs for the next eight years. The table below shows the individual breakdown by PA of potential residential energy savings for 2024–2031.

[123] The values in this section and all values referenced from the 2024–2031 EE Business and Portfolio Plans are subject to change in October 2023 with upcoming tariff unit advice letter submissions with the CPUC.

Table 48. 2024–2031 EE Electric Savings Market Potential

PA [a]	Residential EE Electric Energy Savings (GWh) Market Potential 2024–2031 (Total)	Residential EE Electric Energy Savings (GWh) Market Potential 2024–2031 (Annual Avg)
SDG&E [b]	563	70
PG&E [c]	1,059 [d]	265
SCE [e]	5,807 [f]	726
MCE [g]	192 [h]	24
TOTAL	**7,620,933**	**952,616**

[a] While SCG administers residential programs that serve electric customers, they are a gas utility and are therefore not included.

[b] SDG&E EE Business Plan Testimony (2024–2031) – Exhibit, 1 p.10

[c] PG&E 2024–2031 EE Portfolio Plan Testimony – Exhibit 2, p. 1–5

[d] 2024–2027 forecasted cumulative first-year net GWh for the PG&E Residential sector

[e] SCE EE Business Plan Testimony (2024–2031) – Exhibit 1, p.2

[f] SCE's expected outcome for the overall portfolio which can include non-residential sectors

[g] MCE EE Business Plan Testimony (2024–2031) – Exhibit 1, p. 2-2

[h] Net GWh for MCE's portfolio and can include non-residential sectors

The table below lists the resource acquisition programs the PAs have proposed in their 2024–2031 EE Business and Portfolio Plans. Many of these programs have demand response and load shifting components in addition to EE.

Two of the proposed programs will be offered Statewide, if approved by the CPUC. One program for HVAC and another for plug load and appliances. Further EE programs will be offered in specific PA territories. All PAs plan to offer additional EE programs to residential single-family customers, with the exception of PG&E which is mainly planning behavioral programs. SCE and SCG are the only PAs with plans to offer an EE program entirely focused on manufactured and mobile homes.

MCE offers marketplace programs for single-family customers that incentivize individual customers or aggregators to deliver energy savings (FLEXmarket and Peak FLEXmarket). MCE is focused on maximizing equity and TSB, so their programs are aimed at lowering customer bills and reducing electric peak load.

The MCE marketplace program is very different from the Enervee Marketplace third-party resource program contracted by SCE. Where the MCE marketplace targets single-family homes and aggregators, the Enervee Marketplace taps into natural replacement cycles and eliminates barriers to energy-efficient one-off appliance purchases made at retail by both homeowners and renters. Enervee's program relies primarily on Eco Financing to eliminate financial barriers but integrates point-of-sale instant heat pump water heater incentives provided by the TECH/SGIP programs. As a result, the program is demonstrating its ability to reach underserved customer segments, as evidenced by GoGreen Home reporting.

Table 49. Proposed Resource Acquisition Residential Single-Family Programs 2024–2031

Jurisdiction	Program Name & 2024 Budget[124]	Target Market	Program Description	Savings Type / First-Year GWh
Statewide (SDGE Lead)	SW Residential HVAC (Existing) $516,121	Single-Family Upstream	An upstream/midstream program that offers a variety of HVAC products for residential sectors. The program engages HVAC distributors, manufacturers, and retailers to offer incentives for energy-efficient heating and air conditioning equipment that delivers cost-effective and reliable energy savings for California residents and businesses. The program also offers training and marketing support to participating distributors and their contractors and offers education and training materials to end use customers. The program seeks to have more direct end user contact to provide opportunities for education. Lastly, the program aims to actively target residential customers who reside in a DAC or are considered HTR, to increase high-efficiency HVAC equipment in these markets.	EE / 0.0
Statewide (SDGE Lead)	SW Plug Load and Appliances $2,479,660	Single-Family Midstream	A program that seeks to offer a comprehensive, innovative, and cost-effective turn-key energy efficiency resource program for residential applications. The program intends to offer incentives to key market actors and end user customers. Additionally, the program will seek to educate these key market actors along with customers on various energy efficiency opportunities.	EE / 6.8
SDGE	Residential Single Family $1,947,013	Single-Family Downstream	A program that provides a direct installation solution to customers and cost-effective energy savings. This solution directly addresses the needs of most Residential Single-Family customers who either own or rent a single-family dwelling. In addition to providing a path to decarbonization and ZNE143 for these customers, SDG&E plans to provide a comprehensive approach that may include home energy audits and evaluations, bill neutral energy efficiency financing, training and education regarding energy efficient appliances, and Integrated Demand Side Management (IDSM).	EE / 1.0
SCE	Residential Direct Install $14,092,953	Single-Family, Low- to Medium-Income in DACs/HTR	Direct installation of comprehensive EE measures to residential single-family (SF) customers at no cost, targeting 19 specific geographic areas to alleviate energy hardship, electric system constraints, and to assist low- to medium-income population not eligible for income assistance programs. The program is designed to enhance the EE knowledge and program participation of the targeted residential SF market segment to motivate them to undertake deeper EE activities and retrofits.	EE / 15.2

[124] Budget Filing Detail Report via CEDARS, https://cedars.sound-data.com/filings/list/2022/?include_c_n_s=true&include_cca_rens=true

Jurisdiction	Program Name & 2024 Budget[124]	Target Market	Program Description	Savings Type / First-Year GWh
SCE	Comprehensive Manufactured Homes $4,279,388	Manufactured, Mobile	A direct install program that provides comprehensive energy-efficient measures to manufactured/mobile home residents in collaboration with manufactured/mobile home parks and park managers. The program offers direct installation of energy-efficient products and services in manufactured/mobile home dwellings, and common areas of manufactured/mobile home parks, at no cost to the customer.	EE / 8.9
SCE	Fuel Substitution Midstream Program $15,537,944	Single-Family	The program will provide midstream incentives for HVAC fuel substitution measures that are not covered by the Statewide HVAC programs. The program will also create incentives for contractors and other tradespeople to evangelize and sell the benefits of electrification, focusing specifically on HVAC opportunities initially.	EE[a] / 53.9
SCE	Enervee Marketplace $2,569,284	Single-Family	The program achieves savings by driving in-market shoppers to an online marketplace (featuring Choice Engine technology and Eco Financing) that eliminates market, cognitive/ psychological, and financial barriers, empowering them to choose and buy energy-efficient products for their homes.	EE / 28.4
SCG	Residential Energy Efficiency $1,677,8143	Single- and Multifamily	Downstream gas measure rebate program that offers incentives to single- and multifamily customers, as well as to new construction residential projects	EE / -0.2
SCG	Energy Efficiency Kit Delivery $200,656	Single- and Multifamily	Home delivery of three faucet aerators and a low-flow showerhead to help you save energy and water.	EE / 0.0
SCG	Pasadena Water & Power Home Upgrade $530,213	Single-Family	No cost in-home evaluation and installations to save water and power.	EE / 0.0
SCG	Burbank Water & Power Home Upgrade $404,704	Single-Family	No cost in-home evaluation and installations to save water and power.	EE / 0.0
SCG	Residential Advanced Clean Energy $2,777,809	Single-Family	Third-party program provides eligible customers a complimentary energy assessment and the installation of energy technologies, including no-cost furnace and water heating optimization measures.	EE / 0.2
MCE	Res Marketplace $2,901,225	Single-Family	The program will leverage a P4P and incentivizes aggregators to deliver high value EE savings through a combination of long-term energy efficiency and peak-period focused savings	EE / 5.3

[a] The focus is on fuel substitution; specifically, switching from gas to electric appliances like water heaters and ovens/stovetops.

APPENDIX A-V. Residential Customer Engagement Strategies and Preferences

This section summarizes the current state of knowledge surrounding the most effective ways to engage and communicate with residential customers regarding energy efficiency programs and offerings. This includes, which distribution channels have been most successful in reaching residential customers, what communication methods tend to result in the highest customer participation and what types of program and offerings customers are most interested in.

APPENDIX A-V.I. Most Effective Ways to Engage with Residential Customers

PG&E staff discussed their experience with the most effective ways to engage with residential customers, which included the following:

- **Direct to Consumer Approaches**: A mix of digital and online marketing is the best way to reach a large audience with information and resources. Large mass-educational platforms, such as auto-enrolling customers in free behavior platforms, allow PG&E to reach a large proportion of its customer base, in addition to a monthly newsletter that reaches over two million customers.
    - A direct-to-consumer approach is the most effective way to reach mobile and manufactured homes, HTR customers, or customers residing in DACs. In particular, knocking on customer doors and canvassing neighborhoods has been most effective. However, PG&E has been challenged with deploying this method of engagement while meeting cost-effectiveness requirements for programs. This "face-to-face" approach also can be adversely affected by external events such natural disasters and pandemics.
- **Contractors**: Contractors are also an effective way to engage customers as they often make recommendations and when they promote, EE it helps increase customer interest in EE.
- **Opportunity to Try Products**: When customers have an opportunity to receive something in hand, such as an LED bulb or a smart thermostat, it can be an effective way to engage them in EE and other ways to save. Customers tend to like it when they get something in hand, but those strategies do not always yield the most savings.

SCE largely focuses on downstream models. They consider this to be the most effective way to reach lower-income families who do not qualify for low-income programs but may still face significant cost barriers to EE. Engagement strategies include the following:

- **Education**: Conducting an assessment of the home and then installing equipment that is needed.
- **Gateway measures**: Giving smart thermostats to customers for free and then following up with additional EE and DR opportunities.

In terms of marketing, SCE employs the follow tactics:

- When marketing the PLA program, SCE sent email blasts to all customers, bill inserts, links at the bottom of electronic bills, and ENERGY STAR website links to their programs. SCE found email blasts were the most effective as they could see a direct uptick in participation following these blasts.
- When marketing the Comprehensive Manufactured Homes and Residential Direct Install, SCE staff mentioned that door-to-door canvassing has been the most effective form of marketing.

For SDG&E, the most effective marketing for driving participation has included the following:

- Residential direct install, SDG&E door-to-door canvassing has been the most effective form of marketing, noting that face-to-face interactions seem to work best.
- For the PLA program, the most interest generated is through the website and "click-thru" from digital streaming such as advertisements in podcasts and on music streaming services. In their experience, email blasts do not tend to generate much interest as they are mostly sent to spam folders.

APPENDIX A-V.II. Midstream versus Downstream Channels

PG&E and SCE are largely focused on downstream strategies, which they consider the most effective way to engage customers in EE. SDG&E's local programs also employ downstream strategies, which they have found an effective way to reach lower income customers, rental customers, and those living in mobile/manufactured homes. The downside is that downstream programs are much more costly to run and therefore, harder to gain participation in large volumes.

The two Statewide programs targeting Plug Load and Appliances and HVAC upgrades largely employ a midstream strategy. The strength of the midstream approach is that there are cost-efficiencies, volume benefits, program operational efficiencies, simplicity for the customer to participate, and consistent branding statewide. The weakness of the midstream approach is that it can lose some personalization, particularly a connection between the utility and the customer and possibly the opportunity to educate the customer. This may, or may not, be important as part of a positioning strategy.

Further challenges with the midstream approach were noted in the recent PY2020 HVAC Fuel Substitution Impact Evaluation related to data collection and management challenges.[125] The report noted that "the breadth of the program documentation data was good, but quality and the addition of documentation linking program data to the utility customer database information are areas of improvement that would benefit the certainty of evaluated savings."

APPENDIX A-V.III.Communication Preferences

A program's approach to communicating with its targeted participant can make or break the success of that program. The appropriate communication channel can increase program awareness, drive participation, and impact a customers' likelihood to pursue additional EE opportunities in the future.

There were no research findings in the literature review related to the communication methods that result in the highest customer participation by customer type. There were, however, several findings worth consideration when designing and implementing communication strategies for a given program based on its target customer and the measures being offered.

The 2020 HVAC Fuel Substitution Impact Evaluation explored the resources that program participants used to inform their purchase decision. Contractors were cited as the most common resource. The study found that, "… the majority of both groups (66% and 55% for those with central and ductless heat pumps, respectively) reported contractors as being the main source of influence." The report concluded that, "The recommendations that contractors provided could have contributed to the high level of satisfaction respondents reported with contractors. Other top resources that respondents used to inform their purchase decisions included brand reputation and web searches. Utility programming and marketing had limited influence in this regard."

[125] DNV, Group A Impact Evaluation 2020 HVAC Fuel Substitution Impact Evaluation, CPUC, May 2022

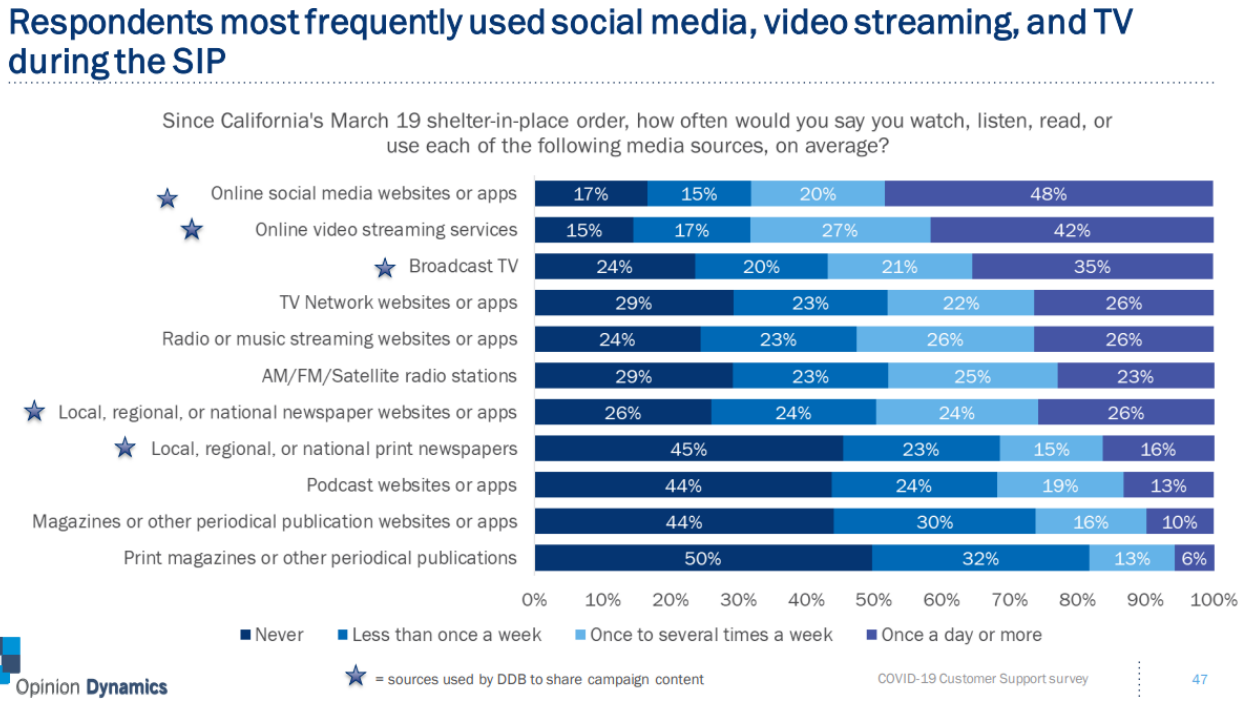
Table 50. Sources of Information for Purchase Decisions

Characteristics	PY 2020 Central Heat Pump Participants (n=171)	PY 2020 Ductless Heat Pump Participants (n=394)
Resources Used to Inform Purchase Decision		
Contractor	*66%	55%
Brand or reputation of manufacturer	*41%	31%
Web search	*42%	29%
Manufacturer website	*24%	18%
Friend / family	*15%	37%
Utility program/marketing	11%	11%
Prior experience	*9%	11%

* Statistically significantly different from ductless installation responses, at least at the 90% confidence level

Since California's shelter-in-place order (March 19, 2020), the media sources residents most frequently watched, listened to, or read are social media, video streaming, and broadcast TV.[126]

Figure 39. Frequency of Consumption by Media Source



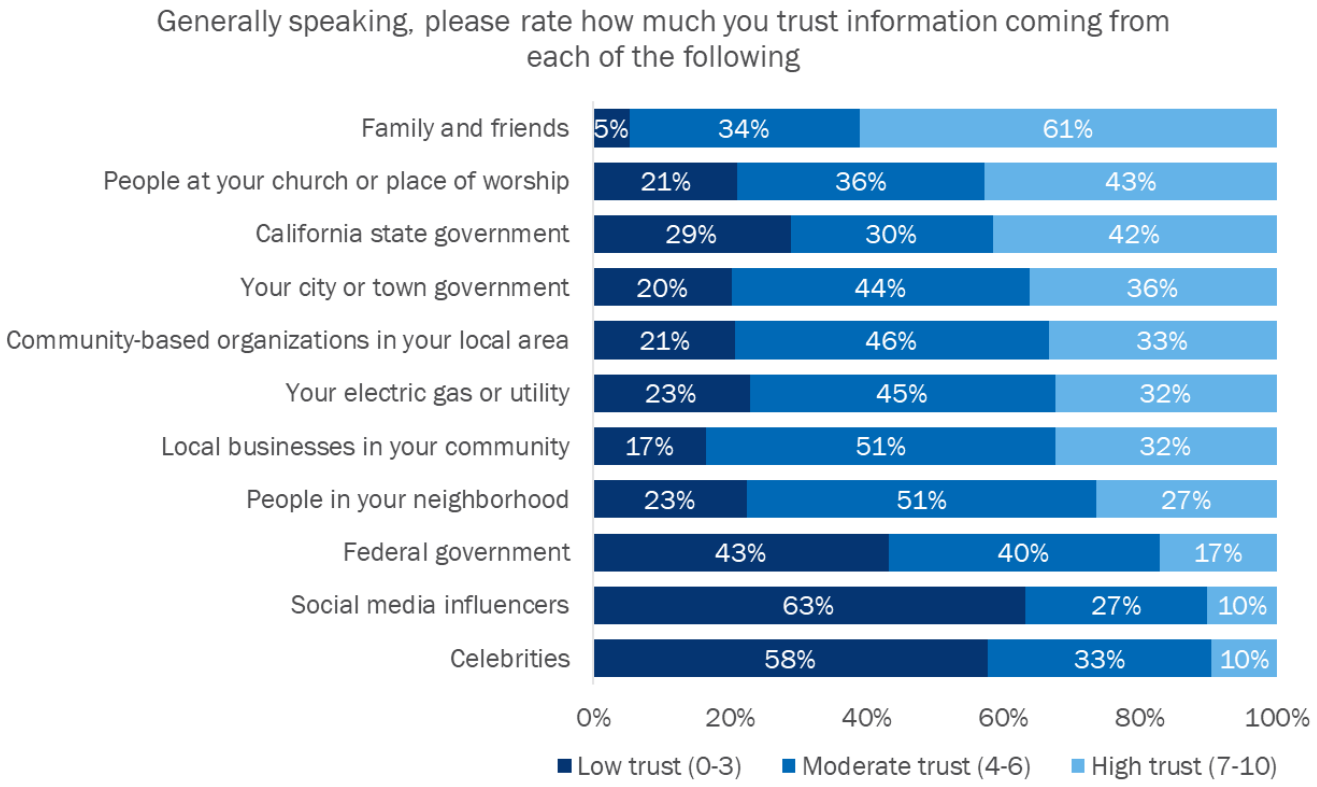
The results from analyzing Energy Upgrade California's Flex Alert campaign also showed that most people see or hear about energy upgrades from the internet or social media and interact with these methods of communication at least once a day.[127]

Although residents mostly watch, listen, or use these types of media sources, they might not trust them. Californians have the highest level of trust in friends, family, and people at church, with a much lower level of trust in celebrities and social media influencers. This demonstrates the importance of word-of-mouth referrals and actively engaging with

[126] COVID-19 Customer Support Presentation, slide 47
[127] Ibid, slide 17

community leaders when promoting energy efficiency programs to garner higher participation. The following figure shows the overall ranking of trust levels of information coming from different sources.

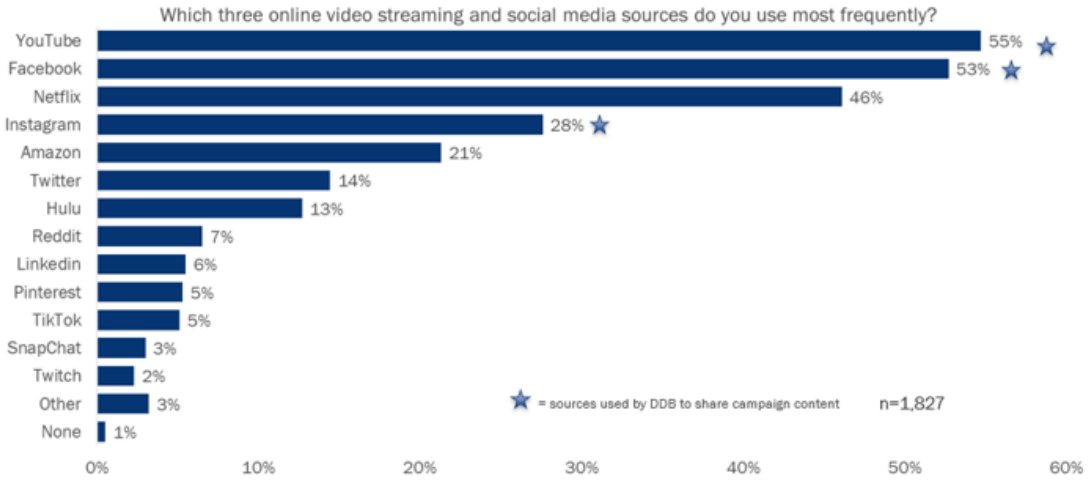
Figure 40. Ranking of Trust Levels



Note: Question asked on a 0–10 scale. Responses were binned into low, moderate, and high trust.
Source: COVID-19 Customer Support Campaign Gen Pop Survey Report, slide 49

Further, knowing where customers spend their time online can help programs focus their digital marketing. The COVID-19 ME&O Survey found online video streaming and social media sources customers most frequently visit were YouTube, Facebook, and Netflix.

Figure 41. Online Video Streaming and Social Media Sources



Source: COVID-19 Customer Support Campaign General Population Survey Report

Additionally, customer research consistently shows that an effective way to engage with residents is by establishing one-on-one connections. For this reason, programs often include energy advisors or single points-of-contact to help connect customers with the right information. One example of this type of program-specific personalized communication is MCE's Single-Family Program which "operates and maintains a customer-facing phone line and e-mail address to provide customers with an understanding of Program offerings and receive and respond to customer inquiries and feedback using standardized email and templates and talking points."[128]

The PAs also provide their planned market strategies for approaching the residential marketplace with opportunities to save energy.

Table 51. PA Residential Market Strategies in 2024–2031 EE Portfolio and Business Plans

IOU	Market Strategy
SDG&E[a]	▪ Development of an online platform to engage and educate residential customers, provide direct links to home energy checkups, finance opportunities and track their progress ▪ Onsite ads directed to potential building tenants that may include building benchmark score to educate and promote renting in more environmentally friendly and efficient buildings ▪ Communication displays of standard consumption statistics for seasonal changes to new tenants ▪ Real estate professionals as a delivery channel for promoting the value and benefits of EE programs ▪ Simplifying participation, creating awareness, and encouraging engagement ▪ Moving from primarily rebate driven programs to single comprehensive programs
PG&E[b]	▪ Engage customers through multiple channels and provide easy access and clear pathways to EE services ▪ Meet customers "where they are" ▪ Enhanced digital strategy and personalized customer journeys ▪ Customer targeting ▪ Utilizing Community-Based Organizations (CBO) and other third-party partners to drive awareness of EE programs ▪ Designing multi-channel and multi-touch marketing campaigns ▪ Residential monthly newsletters ▪ Customer emails to notify of EE opportunities
SCE[c]	▪ Simplify programs and offerings ▪ Focus on increasing adoption of fuel substitution measures ▪ Targeting hotter climate zones
SCG[d]	▪ Partnering ▪ Customer targeting with propensity modeling ▪ Single point of contact ▪ Energy audits ▪ Online platform/marketplace ▪ Intelligent Outreach using advanced metering infrastructure (AMI)
MCE[e]	▪ Analyze customer data to determine high saving customers ▪ Carry out diversity, equity, and inclusion (DEI) initiatives and stakeholder outreach

a. SDG&E EE Business Plan Testimony (2024–2032) – Exhibit 1 and 2
b. PG&E 2024-2031 EE Business Plan Testimony – Exhibit 1 and 2
c. SCE EE Business Plan Testimony (2024–2032) – Exhibit 1 and 2
d. SCG EE Business Plan Testimony (2024–2032) – Exhibit 1 and 2
e. MCE EE Business Plan Testimony (2024–2032) – Exhibit 1 and 2

[128] MCE Single Family Direct Install Program Implementation Plan PY2021, p.7

APPENDIX A-VI.Market Barriers and Opportunities

This section identifies barriers and opportunities for new measures or services, the challenges customers face in reducing, monitoring, and controlling their energy use, and the behavioral, decision, and market barriers customers face.

APPENDIX A-VI.I. Challenges to Reducing, Monitoring, and Controlling Energy Use

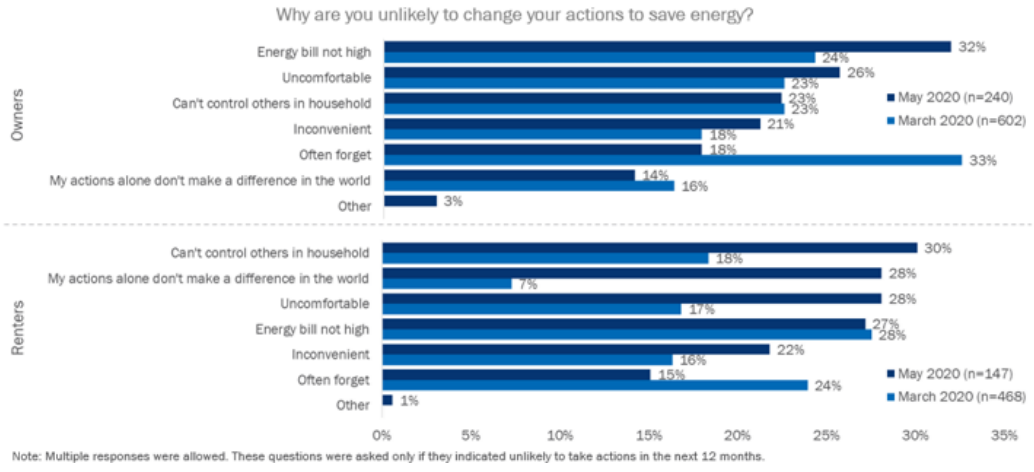
Program administrators and implementers had similar views regarding hurdles to customer participation in various programs. They also agreed on challenges customers face when reducing, monitoring, and controlling their energy use. These were common across regions and segments.

- Challenges found were largely around monitoring and controlling energy use.
  - Customers don't know how and when they use energy.
  - Most customers do not have the equipment necessary to monitor energy use in real time.
  - Customers are not interested in engaging with the monitoring resources available to them (e.g., PG&E has found that asking customers to log-in to their account to see their energy use is a barrier).
  - Customer schedules and equipment in the home impact their ability to control use.
  - Customer schedules may not be in their control.
  - Customer habits, as many have set days for activities such as laundry.
  - Customers may lack the equipment needed to control their energy use (e.g., if a customer does not have a smart thermostat, they cannot set it to pre-cool their home easily).

Across research studies, a few sources touch upon the challenges in this area.

The COVID-19 Customer Support ME&O General Population Study in 2020 explored why customers were unlikely to take actions to save, or reduce, energy. Five months into the pandemic, homeowners and renters most commonly reported that (1) they often would forget, (2) their energy bill wasn't high enough to warrant it, (3) they didn't want to be uncomfortable in the home, or (4) they lacked control over others in the household.

Figure 42. Barriers to Changing Actions to Save Energy



Note: Multiple responses were allowed. These questions were asked only if they indicated unlikely to take actions in the next 12 months.

Source: COVID-19 Customer Support Campaign Gen Pop Survey Report

The California EE Market Adoption Characteristics Study[129] explored awareness and participation for single-family residential customers in DR programs for smart thermostats.

> "Among the 598 residential single-family non-low-income customer respondents, 62% do not own a smart thermostat. Awareness is a key barrier to participating in DR programs. Hesitancy over their utility adjusting their thermostat settings during high demand events is another key barrier to controlling their energy use."

Table 52. Awareness and Participation in Demand Response Programs for Smart Thermostats

Awareness/Participation	Percent
Owns a smart thermostat (n=154)	
Never heard of a DR program	36%
Heard of a DR program but never participated	34%
Currently participating in a DR program	17%
Participated in a DR program before but not currently	13%
Does not own a smart thermostat (n=182)	
Aware of a DR program	27%
Unaware of DR program	73%

Note: Surveyed customers with a smart thermostat were asked about their awareness and participation in DR programs while surveyed customers without a smart thermostat were only asked about their DR program awareness.

Source: California Energy Efficiency Market Adoption Characteristics Study; Opinion Dynamics Analysis

Table 53. Reported Average Importance of Barriers to Participating in DR Smart Thermostat Programs

Participation Barriers	Owns a Smart Thermostat (n=138) [a]	Does Not Own a Smart Thermostat (n=182)	Total (n=320)
Allowing your utility to adjust the thermostat(s) during high demand events	3.6	3.6	3.6
Making changes to the temperature settings in your home during high demand events	3.1	3.2	3.1
Sharing thermostat data with your utility	3.0	3.2	3.1
Your level of familiarity or experience with a DR program	2.2	2.8	2.6
Your level of familiarity or experience with a smart thermostat	2.0	2.7	2.4

Note: Average importance of barriers measured on a 1 to 5 scale where 1 means 'not at a barrier,' 2 means 'minor barrier,' 3 means 'moderate barrier,' 4 means 'considerable barrier,' and 5 means 'major barrier.'

[a] Surveyed customers who reported currently participating in the DR program at the time of the survey were excluded from this analysis.

Source: California Energy Efficiency Market Adoption Characteristics Study; Opinion Dynamics Analysis

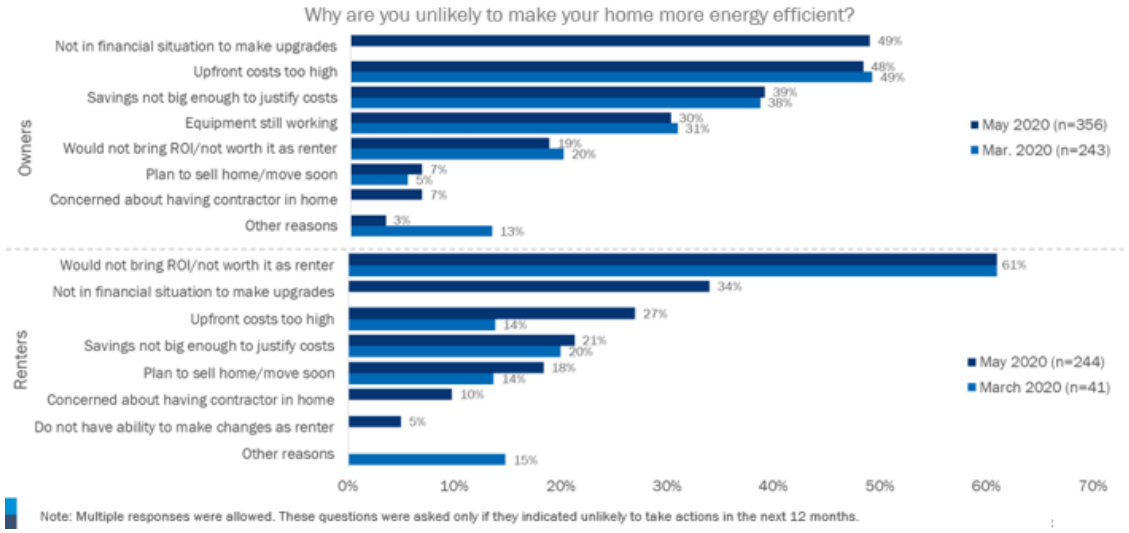
APPENDIX A-VI.II.Behavioral, Decision, and Market barriers

[129] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021.

There are myriad behavioral, decision, and market barriers that a residential customer may confront when deciding whether to pursue EE opportunities. The customer barriers derived from the PA's business plans are summarized below, most of which are decisions or market barriers.

- **Lack of knowledge about EE, program offering and services**: Some customers do not have the expertise needed to implement a project nor an understanding of the economic value associated with investing in EE. Further, some customers are unaware of program offerings and services.
- **Uncertainty**: Customers may be bogged down with uncertainty over what actions they should take to save energy.
- **Performance uncertainty of EE activities**: Customers have varying levels of knowledge and experience with EE, and many do not understand how their behavior influences their home's energy consumption.
- **Misperception of EE value**: Some customers do not recognize the benefits of EE, resulting in lower priority of investment.
- **Hassle and search costs**: Customers are largely unaware of the benefits of energy-saving measures, specifically non-energy benefits. They have limited time and resources to search for EE solutions. The hassle factor increases when customers seek more comprehensive upgrades to their homes. Customers who need comprehensive energy efficiency improvements often need to obtain technical or financial information from multiple sources to bring energy efficiency improvements together for their properties.
- **Program complexities**: There are multiple program options available to customers and some programs have multiple steps involved in the participation processes, which can be portrayed as too complex to participate. Customers can have difficulty identifying eligibility and can misunderstand what a program offers.
- **Financial limitations**: Some customers lack the capital needed to invest or are unaware of financing options. Financial constraints are the largest reasons customers cite for not being able to incorporate the most EE measures into their homes. Deeper, more comprehensive EE solutions are too costly for customers, and customer cost-effectiveness is difficult to attain due to the high first cost. The incremental cost of efficient products and the lack of access to (affordable) capital are both common barriers amongst residential customers. The COVID ME&O Study conducted back in 2020 largely found that financing barriers continued to be the main reason why owners and renters are unlikely to make home upgrades.

Figure 43. Barriers to Making Homes More Energy Efficient



Source: COVID-19 Customer Support Campaign General Population Survey Report

- **Split incentives between landlords and tenants**: Neither tenants nor landlords are motivated to make EE investments, as the tenant does not own the building and the landlord does not pay the energy bill. The split incentives problem creates a challenge for renters to adopt traditional EE measures. Because renters make up about 42% of California residential customers, this creates a major barrier to achieving energy savings.
- **Communication between customers and market actors**: Communication barriers exist between retailers/contractors and customers leading to information on energy efficiency programs and products not being presented effectively to customers.
- **Timing of projects and decision-making:** Homeowners often only complete projects when equipment breaks or is no longer able to operate and consequently, have limited time to find an EE solution. The compressed decision process is typically exacerbated when customers need a water heater, furnace in the winter, or air conditioner in the summer.

There are a few interrelated challenges within the Residential single-family and manufactured homes sectors: lack of capital, lack of knowledge, and lack of awareness. According to SCE's 2024–2031 EE Portfolio and Business Plan, many low- to middle-income customers lack the capital needed to invest in EE improvements, and also tend to lack knowledge of EE. For this demographic, EE generally is not a priority but paying their utility bill is. This ties in with the lack of awareness; customers who are not knowledgeable in EE and lack the capital to invest in it are generally not aware of the existence of EE programs. Customers face additional challenges where fuel substitution is an option. This includes finding knowledgeable and affordable contractors and understanding the benefits of electric fuel switching options.

APPENDIX A-VI.III. Barriers to EE Program Participation

Program administrators and implementers had similar views regarding hurdles to customer participation in various programs.

- **Ease and simplicity**: Customers do not want to be bothered and want something simple and easy. Customers often do not want to spend the time and resources needed to educate themselves on all options and benefits of EE.
- **Financial**: The cost of the energy-efficient upgrades is a barrier and is even more pronounced among the mobile and manufactured home customer segment. Some electrification measures require that customers upgrade their electric panel, which is then an added cost barrier. For many upgrades, such as a new heat pump water heater, multiple costs can add up for the customer (e.g., panel upgrade costs, equipment costs, and contractor installation costs). In addition, incentives and rebates are not always enough for customers to overcome the upfront cost barrier. Current price increases and general inflation seem to be leading customers to think twice about upgrades.
- **Time**: Deep retrofits are time consuming and can take a lot of energy and resources that customers may not have.
- **Structural**: The quality of construction, age of the home, quality of materials used to construct the home, and the ability to add or adjust existing structures are all variables that can be barriers for customers.
- **Level of trust**: This barrier applied to the IOU, vendor, and technology. If a customer is already familiar with a product and knows it performs well, it can be difficult to convince them to try something new. Lack of trust and interest are more pronounced barriers among customers targeted for the Residential Direct Install and Comprehensive Manufactured Homes Programs. According to SCE Program Staff, "Customers are cautious that it is a scam when implementers are doing door-to door-marketing."
- **Program eligibility rules:** For example, the Pay-for-Performance Program required one year of consumption data from the home so new tenants or owners were not eligible.
- **Availability:** Are products readily available in the marketplace, or is there a delay in availability?

- **Split incentives**: Staff noted they see this barrier often in the mobile/manufactured home market where the tenant does not own the property and the decision-making falls on the property owner or manager.

Contractors who promote and install equipment based on heat pump technology expressed more specific barriers.[130] This includes heating and cooling units, clothes dryers, and water heaters. Additional barriers to participation they cited are below:

- Statewide HVAC permitting processes and associated costs (Financial)
- Potential costly electrical panel upgrades (Time and Financial)
- Noisy operation (Structural)
- Unit Aesthetics—especially for indoor components (Structural)
- Performance relative to climate conditions (Level of trust)

APPENDIX A-VII. What Opportunities Exist for New Measures That Address Unmet Needs of Residential Customers?

When asked what opportunities exist for new measures in future RA EE programs, all IOU staff and the implementer named the lack of measures they can offer currently in programs and still be cost-effective. While customers may have many needs and wants related to energy, the PAs can only offer programs that meet the cost-effective threshold required by regulators and this limits their ability to expand offerings. Staff feel there are very few measures they can offer within the current cost-effectiveness framework in California. For example, when asked how current RA program offerings and services could be tailored to meet the needs of customers:

- PG&E staff mentioned if they offer any programs that require actually doing the energy upgrades for customers, then the program must be targeted to a very finite segment in order for it to pass the cost-effectiveness threshold, otherwise they need to push those programs into the equity or market support areas.
- SCE staff mentioned they would like to bring back measures that were very popular, (e.g., pool pumps and appliance recycling) but cannot do so under the current cost-effectiveness framework and baseline assumptions.
- SDG&E staff and implementers in particular, noted they would like to be able to offer packages of measures that cater to the needs of each customer, but they cannot do so with the current cost-effectiveness framework.
- When asked where EE programs might be modified moving forward:
    - Program and implementation staff largely focused on electrification and pairing EE with load management.

Opportunities to increase offerings can be grouped into three categories: Emerging Technologies, Access to Capital, and Other. These groupings are discussed in detail in subsequent sections.

APPENDIX A-VII.I. Emerging Technologies

California maintains the Emerging Technologies Coordinating Council (ETCC) to facilitate collaborations on emerging technologies projects. Charter members include all four California IOUs, Sacramento Municipal Utility District (SMUD), Los Angeles Department of Water and Power (LADWP), and the California Energy Commission.

[130] California Heat Pump Residential Market Characterization and Baseline Study, ODC, May 13, 2022, p 84

Additionally, the IOUs fund two emerging technology programs to distill this broader research into useful documentation for program implementers. These include the IOUs and are open to program implementers, manufacturers, and others interested in bringing new technologies to the market. Currently, activities among the Emerging Technologies Programs corroborate PA and implementer staff impressions that the focus is on electrification and pairing EE with load management moving forward. All completed, ongoing, and proposed research is available on each collaborative's website. Research agenda information is also available in the eTRM.

Electric Emerging Technologies: CalNEXT is a statewide collaborative initiative focused on electric emerging technologies. It is implemented by Energy Solutions and includes technical experts from other organizations and firms.[131] CalNEXT claims to be "a great opportunity for programs to see their full potential, to get the evaluation and implementation support they need, and for good ideas to come to life and make major impacts to support California's decarbonized future."[132] Technologies investigated by CalNEXT may be directed toward the eTRM for inclusion. According to CalNEXT, high priority emerging technologies include the following:

- **Water Heaters**. "The transition of both residential and commercial water heating from natural gas to electric heat pump will lead a vast decarbonization of this end use, and intelligent controls and load-shifting strategies are essential to create the demand flexibility needed to avoid grid constraints."[133]
- **HVAC.** The opportunity for savings is in two areas: increased savings from improved technologies and expansion of existing markets. "For matured products such as high efficiency air-to-air packaged heat pumps, we expect to focus on market deployment. For less developed product markets like air-to-water heat pumps, CalNEXT expects continued field demonstrations and early-stage research."[134]

These opportunities for EE programs may be offset; however, since "… air conditioners & heat pumps will see new standards, test procedures, and metrics in 2023 as well as new low-Global Warming Potential (GWP) requirements driven by CARB." These GWP requirements apply to refrigerants. Research being conducted in the Low GWP Alternative Refrigerants Evaluation Program (Low-GWP AREP), is being led by the Air-Conditioning, Heating, and Refrigeration Institute.[135]

Gas Emerging Technologies: The California Statewide Gas Emerging Technologies Program (GET), implemented by ICF.[136] is similar to CalNEXT but focuses on gas technologies. Technologies investigated by GET may be directed toward the eTRM for inclusion.

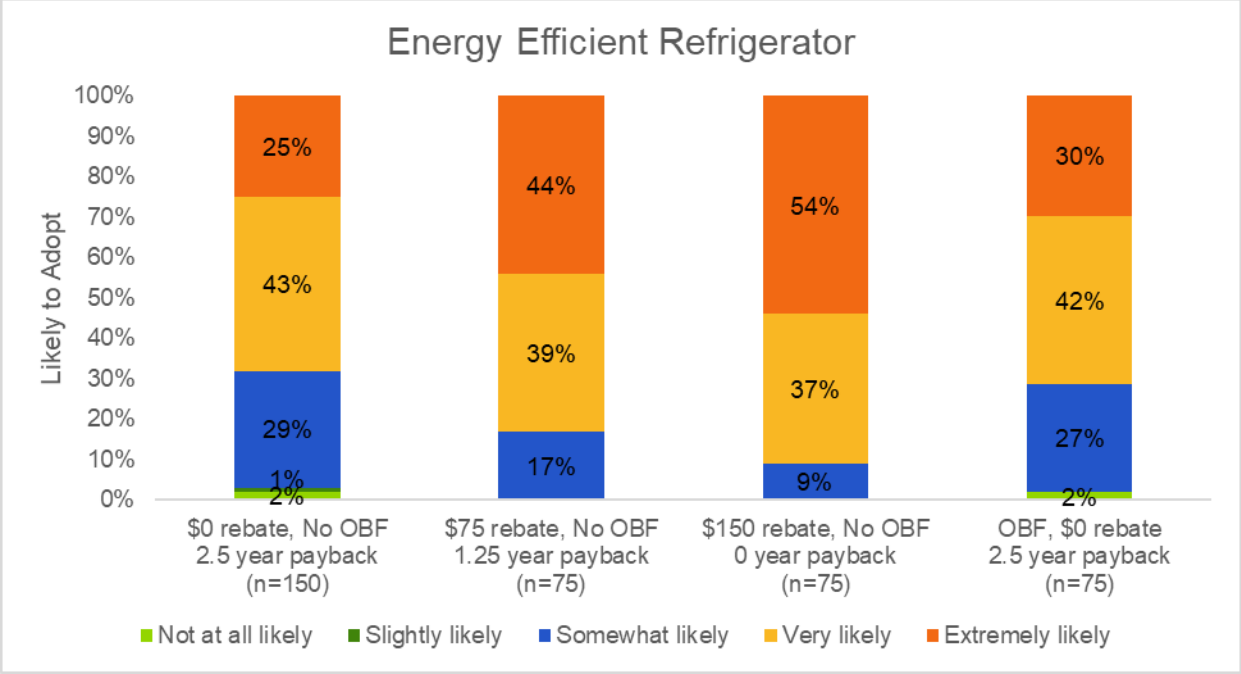
- GET is currently researching condensing tankless water heaters. The market for this technology is growing, but the units are still prohibitively costly to saturate the mass market. GET also is preparing a report, due in Q4, 2022,[137] that includes the market potential for
  - Solar thermal water heating systems,
  - Boilers for multifamily applications, and
  - High efficiency pool heaters.

APPENDIX A-VII.II. Access to Capital

[131] The statewide Emerging Technologies Program (administered by SCE) was outsourced and branded as CalNEXT, https://ca-etp.com/
[132], https://calnext.com/about/
[133] Myers, David, and Tim Miniezaki, "Technology Priority Maps: Whole Buildings, Water Heating, and HVAC", p22, September 20, 2022, CalNEXT
[134] Ibid, page 27
[135] https://www.ahrinet.org/analytics/research/ahri-low-gwp-alternative-refrigerants-evaluation-program
[136] The statewide Emerging Technologies Program (administered by SCG) was outsourced and branded as GET, https://ca-etp.com
[137] https://cagastech.com/sites/default/files/GET%20Project%20Summary%201_Water%20Heating%20Market.pdf

Most programs do offer some form of financial incentive to address financing constraints in the market. On-bill financing (OBF) is a new service that was explored in the recent California EE Market Adoption Characteristics Study. Rebate incentives and on-bill financing can address some barriers such as financial limitations. The California EE Market Adoption Characteristics Study explored willingness to adopt various EE and DR technologies under different scenarios for low-touch and high-touch EE technologies and DR opportunities.[138] Results from each scenario are presented in the following figures.

Figure 44. Willingness to Adopt EE Refrigerator Under Various Cost Scenarios

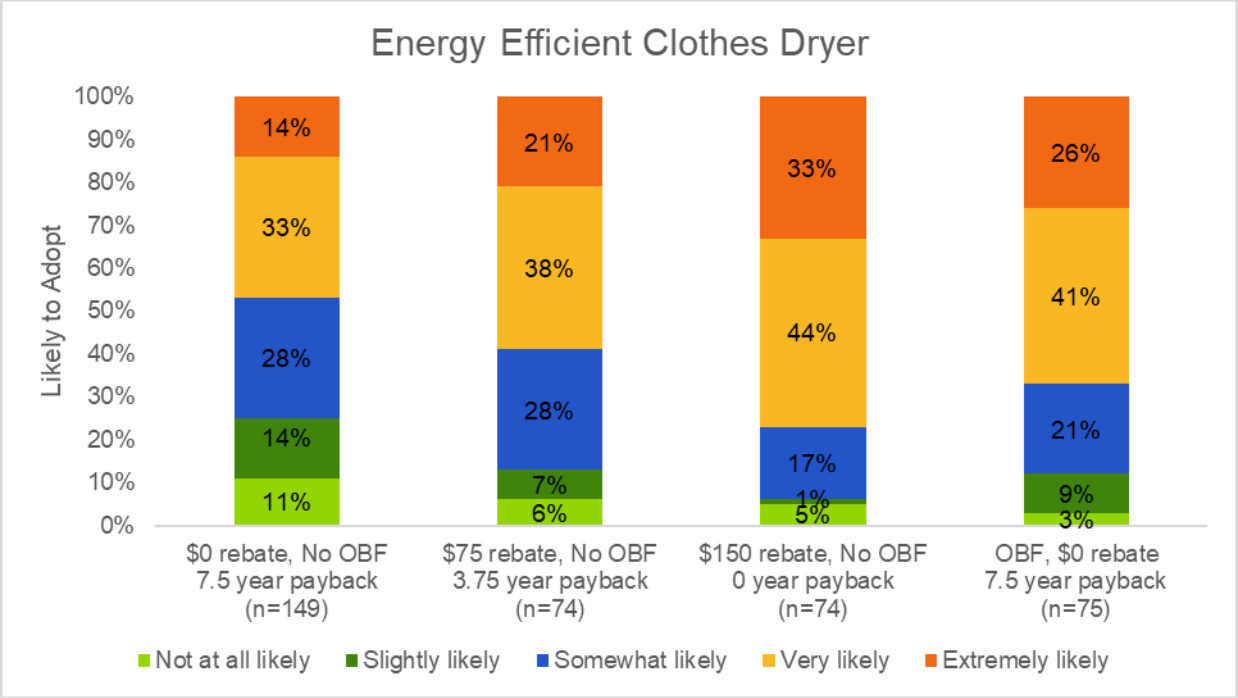


"Note: Surveyed customers were asked to consider needing to replace their refrigerator and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first, baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized refrigerators in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

[138] Guidehouse, California Energy Efficiency Market Adoption Characteristics Study, CPUC, April 2021. Pages C-4 to C-17.

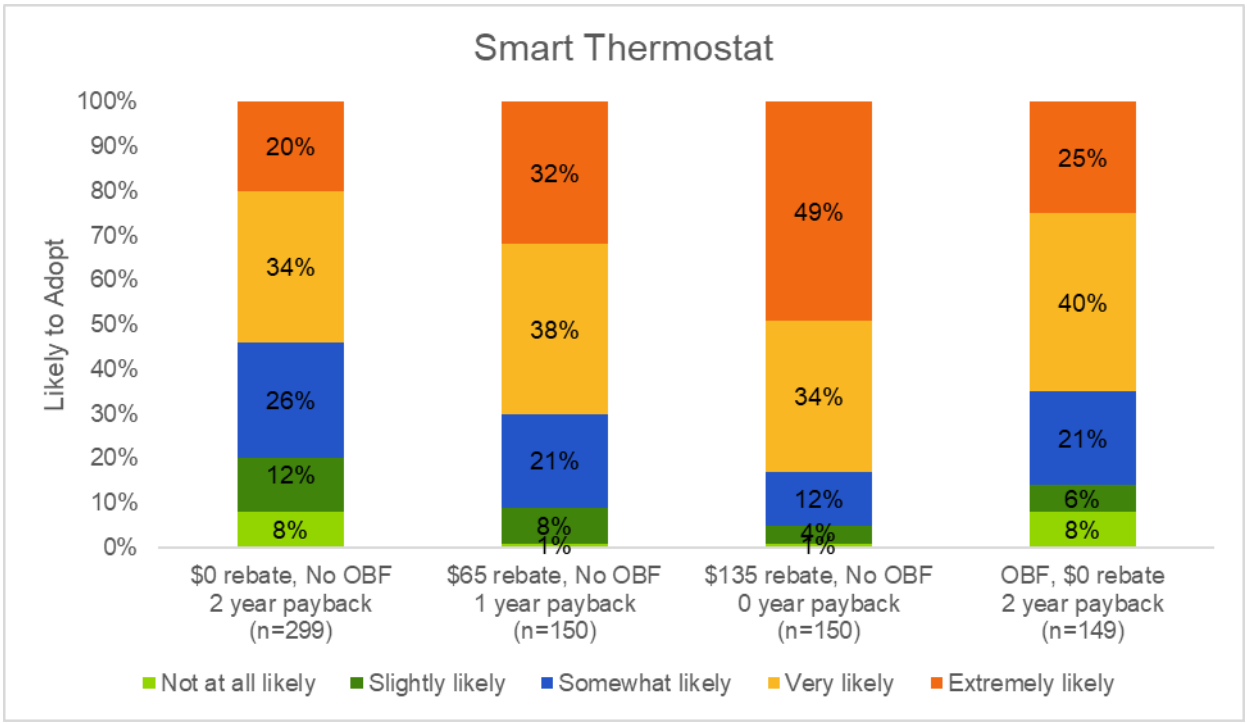
Figure 45. Willingness to Adopt EE Clothes Dryer Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider needing to replace their clothes dryer and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized clothes dryers in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

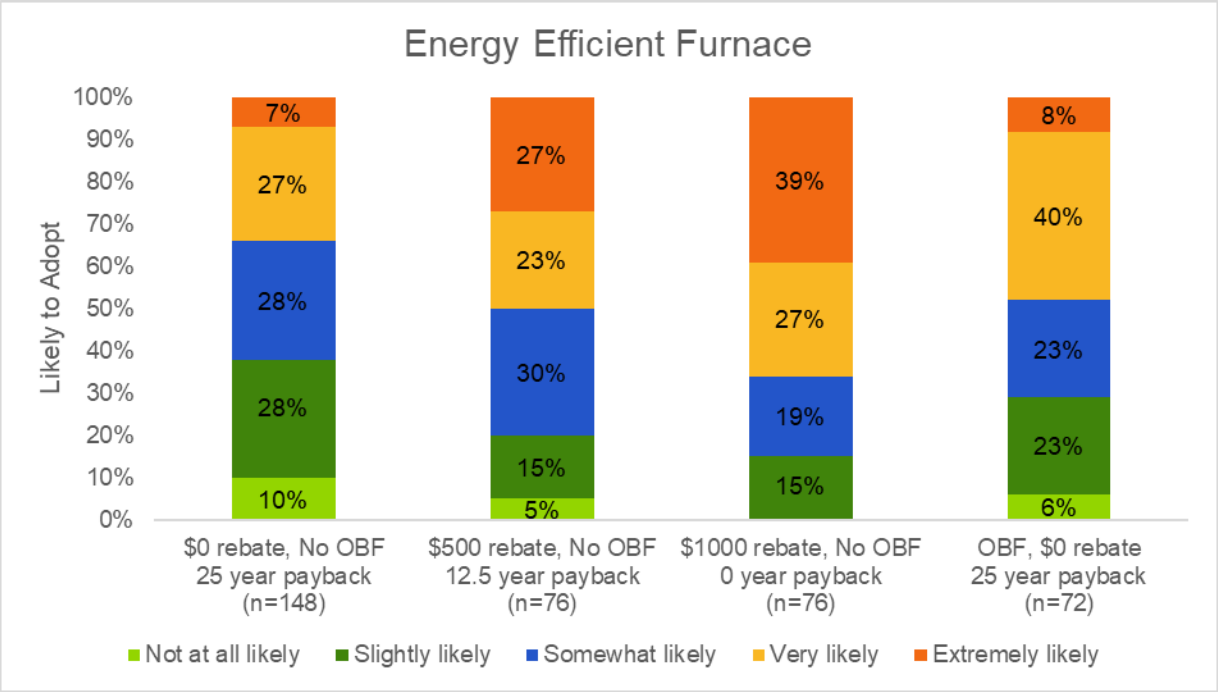
Figure 46. Willingness to Adopt EE Smart Thermostat Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider needing to replace their clothes dryer and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for smart thermostats in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

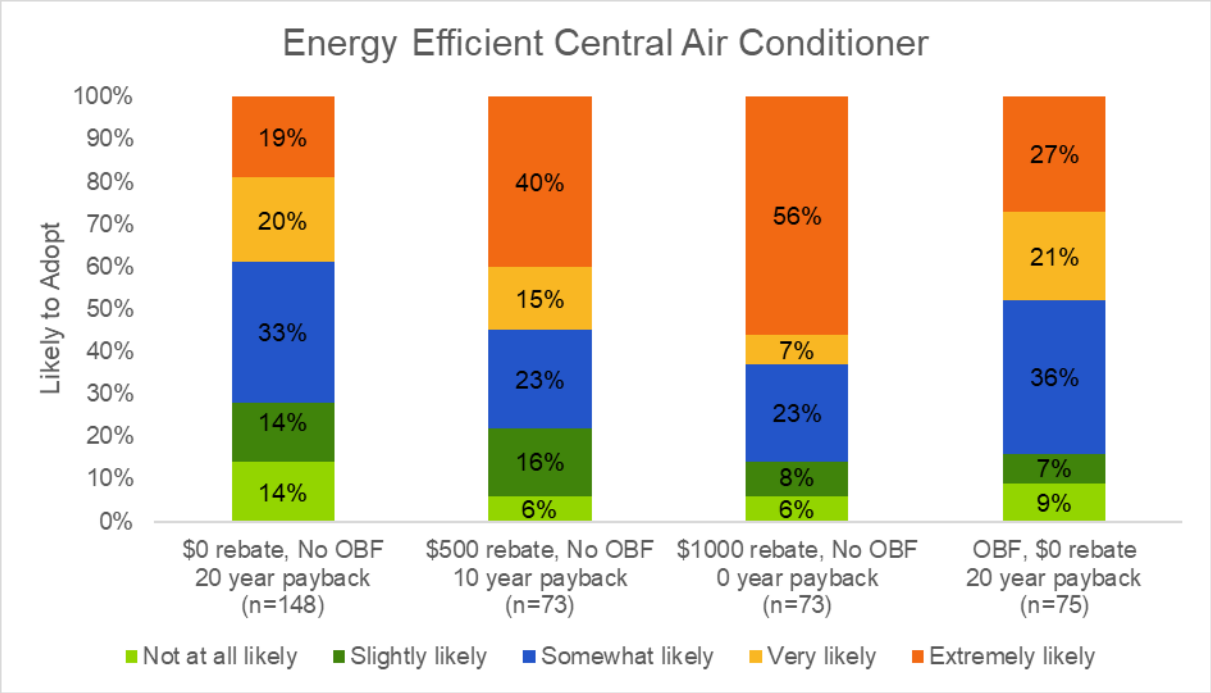
Figure 47. Willingness to Adopt EE Furnace Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider needing to replace their furnace and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized furnaces in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

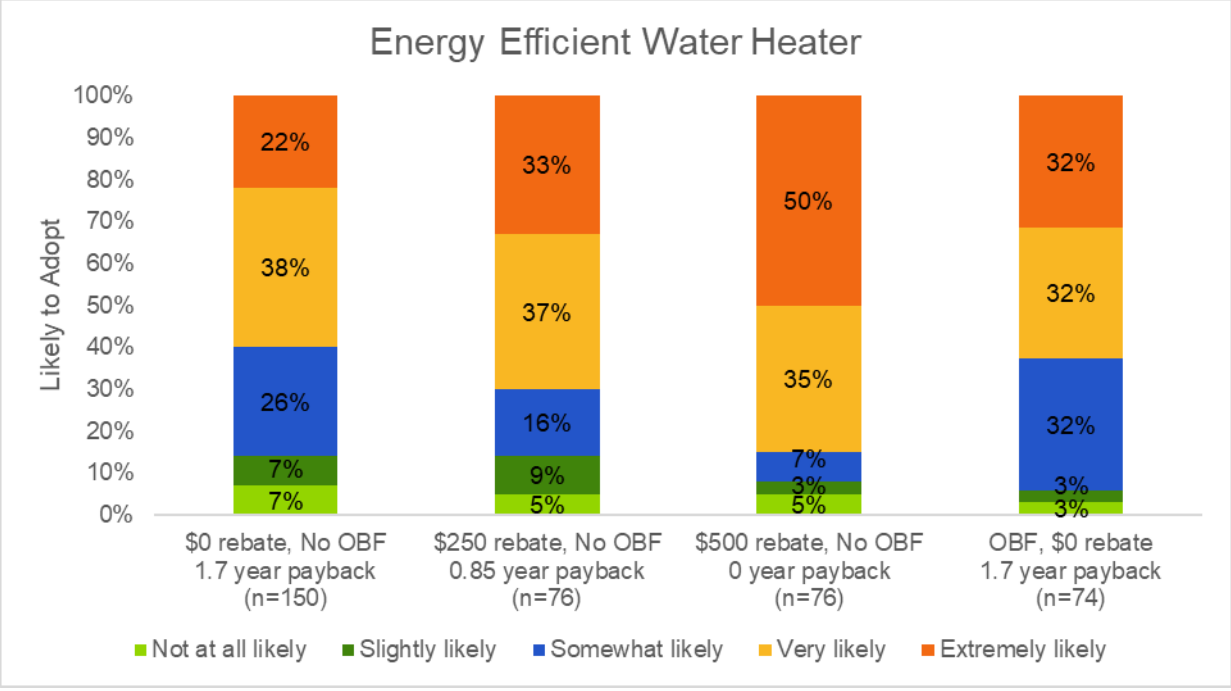
Figure 48. Willingness to Adopt EE Central Air Conditioner Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider needing to replace their CAC and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized CACs in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

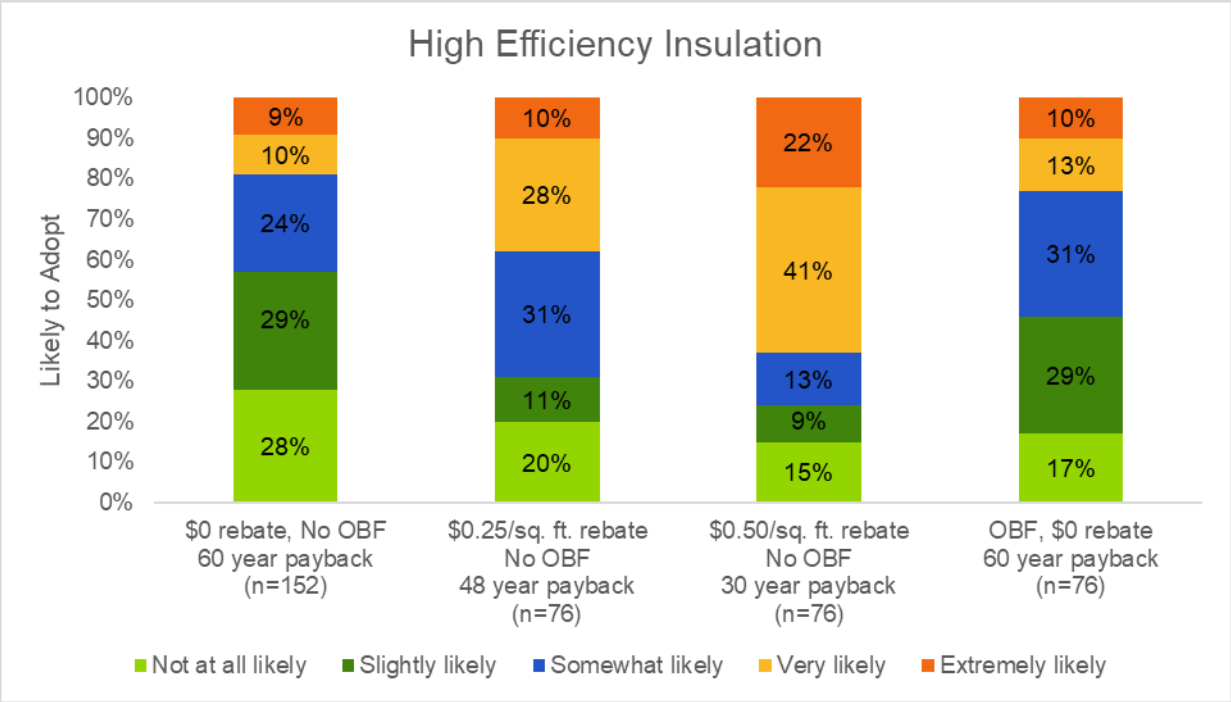
Figure 49. Willingness to Adopt EE Water Heater Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider needing to replace their water heater and their willingness to adopt the EE model (vs. a standard efficiency model) under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized residential water heaters in California. A payback period is the amount of time for the average energy savings from the EE technology to equal the difference in cost between the EE and standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

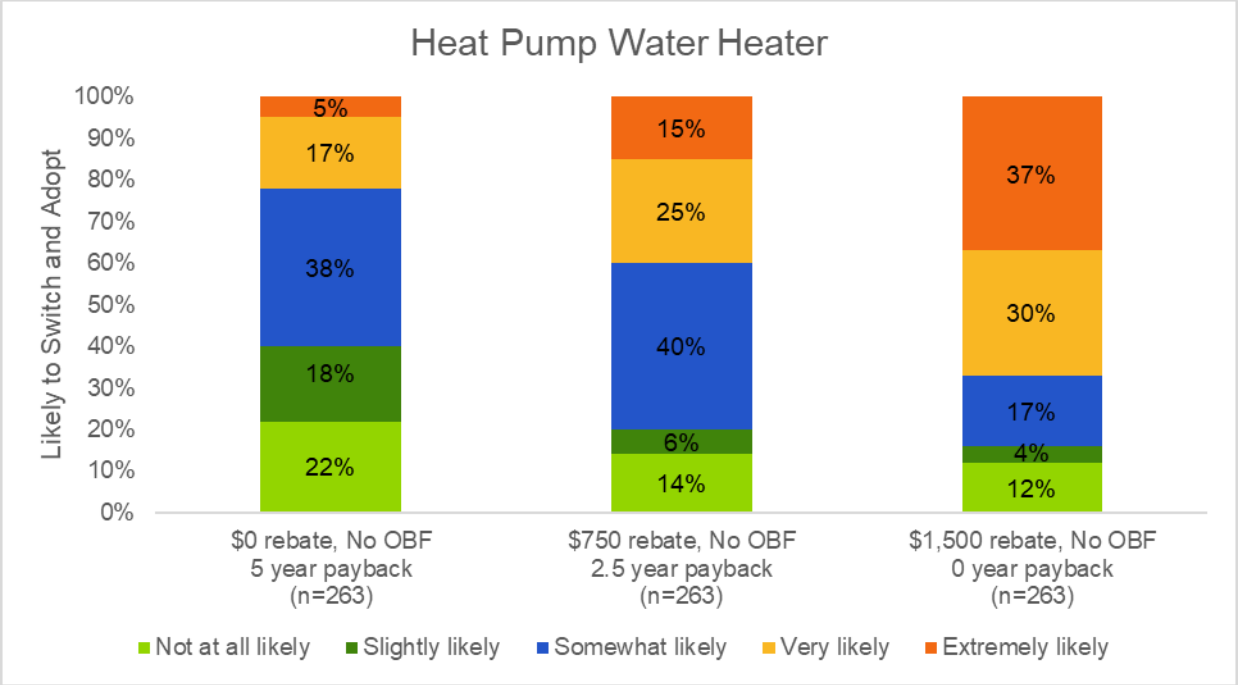
Figure 50. Willingness to Adopt EE Insulation Under Various Cost Scenarios



"[a] Surveyed customers were asked to consider adding or upgrading insulation in their attic or ceiling and their willingness to do so under different payback scenarios. All respondents were asked the first baseline scenario without a rebate or OBF, and about half were then asked the two follow-up rebate scenarios and about half were asked the follow-up OBF scenario. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for high efficiency attic insulation in California. The payback period is the amount of time for the average energy savings from the high efficiency insulation to equal the difference in cost between adopting and not adopting the insulation."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

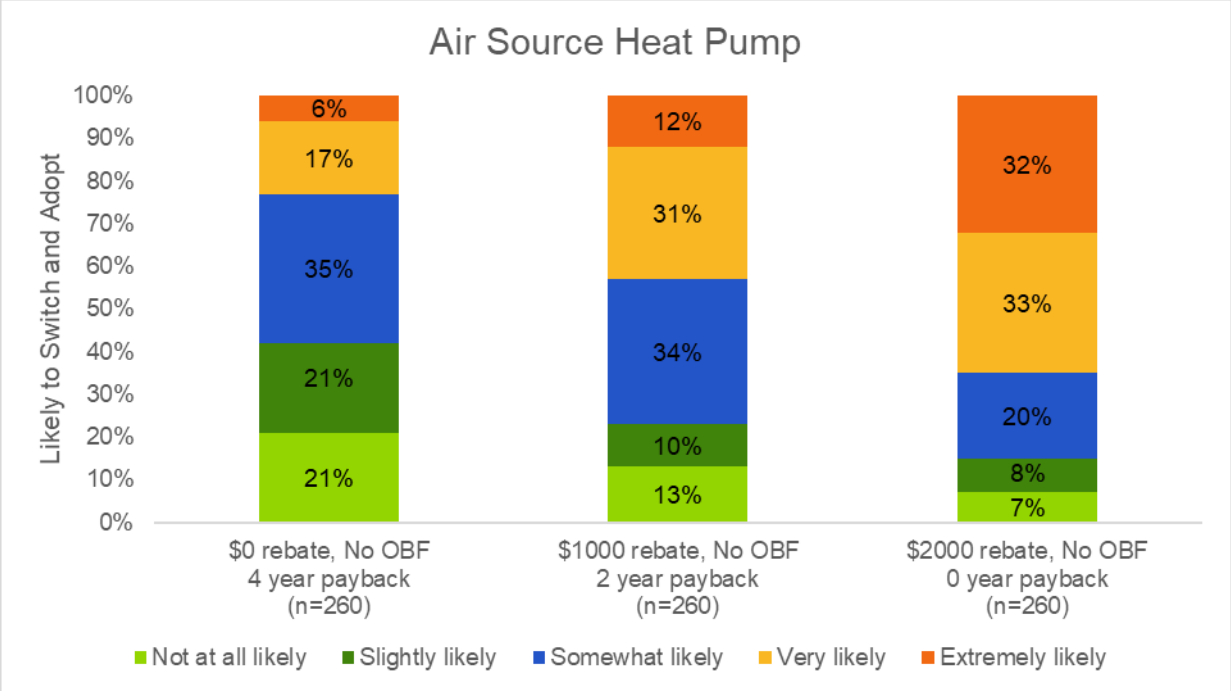
Figure 51. Willingness to Adopt EE Heat Pump Water Heater Under Various Cost Scenarios



"[a] Surveyed customers with a gas water heater were asked to consider needing to replace it and their willingness to switch to electricity and adopt the electric EE heat pump model (vs. a gas standard efficiency water heater) under different payback scenarios. Respondents were asked the baseline first scenario without a rebate and were then asked the two follow-up rebate scenarios. Respondents were not presented with an OBF scenario for this measure. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized residential heat pump water heaters in California. A payback period is the amount of time for the average energy savings from the electric EE technology to equal the difference in cost between the electric EE and gas standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

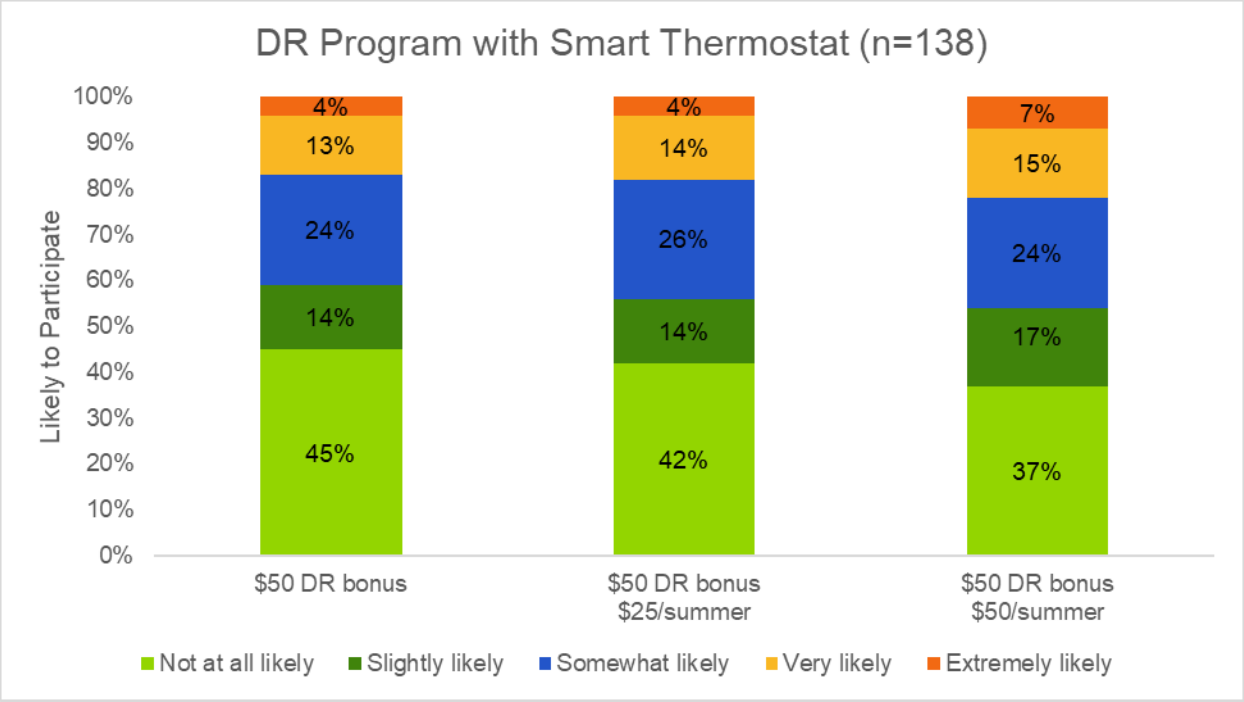
Figure 52. Willingness to Adopt EE Fuel Switch Under Various Cost Scenarios



"[a] Surveyed customers with a gas furnace were asked to consider needing to replace it and their willingness to switch to electricity and adopt the electric EE air source heat pump (vs. a gas standard efficiency furnace) under different payback scenarios. Respondents were asked the first baseline scenario without a rebate and were then asked the two follow-up rebate scenarios. Respondents were not presented with an OBF scenario for this measure. Respondents who reported they were 'extremely likely' to adopt in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt in a follow-up scenario than they reported in a previous scenario. Costs and payback periods are from market and engineering estimates for average-sized residential heat pump water heaters in California. A payback period is the amount of time for the average energy savings from the electric EE technology to equal the difference in cost between the electric EE and gas standard efficiency models."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

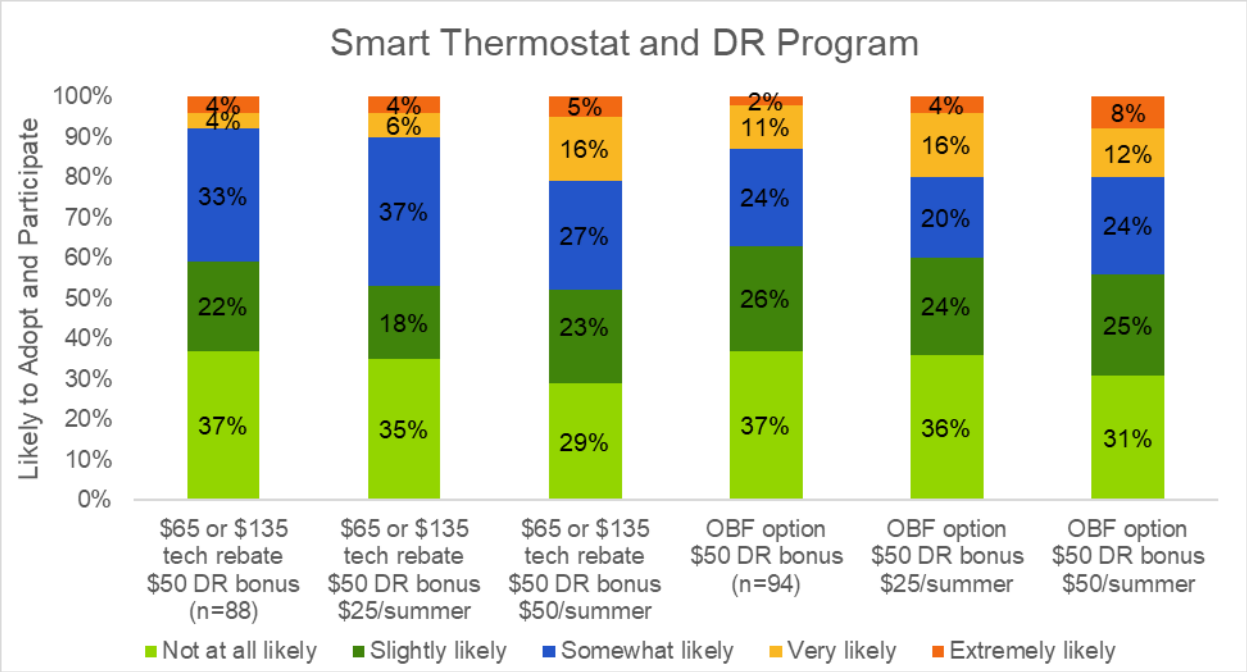
Figure 53. Willingness To Participate in Demand Response Under Various Cost Scenarios



"[a] Surveyed customers with a smart thermostat and who were not currently participating in a DR program were asked about their willingness participate in a DR program with their smart thermostat under different incentive scenarios. Respondents were asked the first baseline scenario with just a DR sign-up bonus and were then asked about two follow-up scenarios that also included different amounts of a summer DR participation incentive. Respondents who reported they were 'extremely likely' to participate in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to participate in a follow-up scenario than they reported in a previous scenario."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

Figure 54. Willingness to Adopt EE and DR Under Various Cost Scenarios



"[a] Surveyed customers without a smart thermostat were asked about their willingness to adopt a smart thermostat and participate in a smart thermostat DR program under different incentive scenarios. Some respondents were asked about a first baseline scenario with a technology rebate and a DR sign-up bonus and were then asked about two follow-up scenarios that also included different amounts of a summer DR participation incentive. Other respondents were asked about the first baseline scenario with an OBF option for the thermostat and a DR sign-up bonus and were then asked about two follow-up scenarios that also included the summer DR participation incentives. Respondents who reported they were 'extremely likely' to adopt and participate in one scenario were not asked but were included as 'extremely likely' in the follow-up scenarios. Respondents also could not report a lower willingness to adopt and participate in a follow-up scenario than they reported in a previous scenario.

[b] All the respondents in this analysis also answered questions about their willingness to purchase a smart thermostat with a rebate (and no DR program) earlier in the survey. Some respondents reported they were "extremely likely" to adopt a smart thermostat with a $65 rebate (that reduced payback period by half) and others did so with a $135 rebate (that reduced payback period to zero). When presented with the DR program scenario, respondents were reminded of the tech rebate amount they preferred earlier in the survey. The respondents with different tech rebate preferences are combined in this analysis because separating them produces smaller counts with less statistical confidence/precision, and their reported willingness to participate in the DR program did not differ significantly by the rebate amount. This is the reason for '$65 or $135 tech rebate' criteria in the figure."

Source: California EE Market Adoption Characteristics Study; Opinion Dynamics Analysis

APPENDIX A-VII.III. Other Opportunities

Program implementers had a few ideas on customer wants and needs, but these were not strictly about resource acquisition programs. The HVAC program manager noted contractors and customers were becoming more aware of, and asking about, thermal storage paired with a heat pump. This is optimal for homes in climate zones with higher heating than cooling requirements. Customers can reduce their energy bill through demand response and by shifting load away from peak hours. Currently no workpapers are available for residential thermal storage. Another option offered as promising, but currently not offered, was ducted mini-split systems. Finally, another program implementer suggested offering whole house fans. These fans reduce customer air conditioning loads and improve indoor air quality. Like thermal storage however, they are considered as demand response or load shifting equipment and are not offered through resource acquisition programs.

- One program implementer mentioned building virtual power plants using smart thermostats and potentially other "smart" equipment. A virtual power plant is a collection of energy resources that can be interconnected and

operated together to save energy and manage grid reliability. The SCE "Smart Energy Program" is similar to a virtual power plant concept.

- Another theme that emerged from discussions with implementers was delivering energy savings and GHG reductions to all customers in a region. The idea was that there could be a joint responsibility or cost-sharing arrangement with municipality and other non-IOU service areas rather than being limited to IOU service areas. This is more of a factor in the southern part of the state than in the northern part.

APPENDIX A-VIII. Conclusion

This landscape analysis documents what we know based on existing research and data in light of the study research objectives and questions. The customer survey supplements what we already know. The landscape analysis covers several research questions well while others are covered or expanded upon in the customer survey effort.

APPENDIX B. Pulse Check Survey Demographics

Regarding household occupancy, respondents averaged between two and three occupants (2.6). Occupancy did not vary by utility or income but did vary by housing type with single family respondents averaging closer to 3 occupants (2.7) and mobile home respondents averaging closer to two occupants (2.2).

Overall, 91% of respondents were homeowners and 9% were renters. Home ownership varied by utility, housing type, and IOU-sponsored program participation but not income. Specifically, SDG&E and PG&E respondents were significantly more likely than SCE respondents to be renters. Single family respondents and participants were significantly more likely to be homeowners than mobile home respondents and non-participants, respectively.

Table 54. Breakdown of Respondent Home Ownership

	n	Owner	Renter
Overall	965	91%	9%
Utility*			
SDG&E (a)	321	86%	14%[C]
PG&E (b)	321	87%	13%[C]
SCE (c)	323	98%	2%
Housing Type†			
Single family (d)	865	90%	10%[E]
Mobile home (e)	100	97%[D]	3%
Program Participation‡			
Participant (p)	245	95%[Q]	5%
Non-participant (q)	720	89%	11%[P]

Note: a/b/c/d/e/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, pq; A/B/C/D/E/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, PQ

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.12 (df=4)

† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.08 (df=2)

‡ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.08 (df=2)

Pulse Check Survey Question: Including yourself, how many people live in your household? (Open-ended)

The average respondent age was 60; however, it varied significantly by utility, housing type, income, and IOU-sponsored program participation. SCE respondents had the highest average age of 64 and on average were significantly older than both PG&E and SDGE respondents. PG&E respondent's average age (59) was also significantly higher than SDG&E respondents average age (54). Across the other subsegments, single family, moderate income, and participant respondents had a higher average age than mobile home, market rate, non-participant respondents respectively.

Table 55. Respondent Age

	n	Age	
		Mean	Standard Deviation
Overall	802	60	15.4
Utility*			
SDG&E (a)	270	54	14.5
PG&E (b)	253	59[A]	15.8
SCE (c)	279	64[AB]	14.5
Housing Type†			
Single family (d)	708	59	15.4
Mobile home (e)	94	67[D]	14.1
Income‡			
Moderate income (h)	274	64[I]	15.0
Market rate (i)	405	56	14.7
Program Participation§			
Participant (p)	211	62[q]	15.1
Non-participant (q)	591	59	15.5

Note: a/b/c/d/e/h/i/p/q indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi, pq; A/B/C/D/E/H/I/P/Q indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI, PQ

* An ANOVA with eta squared revealed a significant relationship between this subsegment and survey question with an effect size of 0.03 (df=2)

† An ANOVA with eta squared revealed a significant relationship between this subsegment and survey question with an effect size of 0.03 (df=1)

‡ An ANOVA with eta squared revealed a significant relationship between this subsegment and survey question with an effect size of 0.06 (df=1)

§ An ANOVA with eta squared revealed a significant relationship between this subsegment and survey question with an effect size of 0.01 (df=1)

Pulse Check Survey Question: In what year were you born? (Open-ended)

All respondents who indicated they were renters indicated they paid their electric bill separately from their monthly rent (100%). Results were similar across all subsegments.

Most respondents either had a graduate or professional degree (37%) and/or bachelor's degree (36%). Approximately 20% of respondents completed some college with no degree (11%), or completed a technical/trade school program or earned an associate's degree (9%). Level of education varied by utility, housing type, and income status, but not participation status. The table below provides the distribution across subsegments. Single family homeowners were significantly more likely to have a graduate or professional degree or a bachelor's degree compared to mobile/manufactured homeowners. Inversely, mobile/manufactured homeowners were significantly more likely to have some college/no degree, an associate's degree, or a high school graduate or equivalent compared to single family homeowners. In addition, market rate respondents were significantly more likely than moderate income respondents to have a graduate or professional degree.

Table 56. Level of Education

	Overall	Utility*			Housing Type†		Income‡	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)	Moderate Income (h)	Market Rate (i)
n	965	321	321	323	865	100	331	445
Graduate or professional degree, e.g., J.D., MBA, MD, Ph.D.	37%	37%C	41%C	30%	39%E	16%	28%	44%H
Bachelor's degree	36%	38%	37%	33%	37%E	23%	39%	37%
Some college, no degree	11%	10%	9%	14%ab	9%	23%D	13%	9%
Technical/trade school program or Associate's degree	9%	8%	7%	13%aB	8%	20%D	12%i	7%
High school graduate or equivalent (e.g., GED)	4%	3%	2%	6%b	3%	12%D	5%	3%
Less than high school	1%	<1%	1%	1%	1%	2%	1%	<1%
Prefer not to say	3%	4%	2%	3%	3%	5%	2%	<1%

Note: a/b/c/d/e/h/i indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de, hi; A/B/C/D/E/H/I indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE, HI

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.12 (df=12)

† A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.28 (df=6)

‡ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.20 (df=6)

Pulse Check Survey Question: What is the highest level of education that you have completed so far? (Single response permitted)

The average income across respondents was $172,498.[139] Results were similar across all subsegments.

Table 57. Average Annual Household Income

	n	2022 annual household income before taxes	
		Mean	Standard Deviation
Overall	776	172,498	163,044
Utility+			
SDG&E (a)	267	166,994	125,768
PG&E (b)	260	195,785	188,770
SCE (c)	249	135,975	113,766
Housing Type†			
Single family (d)	700	182,346	169,063
Mobile home (e)	76	87,612	36,796
Program Participation‡			
Participant (p)	198	201,274	217,057
Non-participant (q)	578	162,769	139,056

Pulse Check Survey Question: Please estimate your annual household income before taxes in 2022. (Open-ended)

Most respondents selected English as the primary language spoken in their home (95%). Results were similar across utility and participation status but varied across housing type.

[139] This study targeted non-low-income residential customers. We defined the moderate-income and market-rate customer segments using area median income (by customer).

Most respondents were White or Caucasian (63%). Results were similar across subsegments except for utility and housing type.

Table 58. Respondent Race

	Overall	Utility			Housing Type	
		SDG&E (a)	PG&E (b)	SCE (c)	Single family (d)	Mobile home (e)
n	960	319	320	321	860	100
Other	4%	4%	4%	5%	4%	4%
American Indian or Alaskan Native	1%	1%	1%	0%	0%	1%
Asian	13%	9%	16%^{Ac}	10%	15%^{E}	2%
Black or African American	2%	1%	1%	3%^{ab}	2%	3%
Pacific Islander	<1%	2%^{bc}	<1%	<1%	1%^{e}	0%
White or Caucasian	63%	64%	62%	65%	62%	73%^{d}
Prefer not to say	16%	19%	16%	16%	16%	17%

Note: a/b/c/d/e indicates significant differences at a 90% confidence level and 0.10 alpha between the following tests: abc, de; A/B/C/D/E indicates significant differences at a 90% confidence level and 0.01 alpha between the following tests: ABC, DE

* A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.10 (df=12)

ǂ A chi-squared with Cramer's V revealed a significant relationship between this subsegment and survey question with an effect size of 0.13 (df=6)

Pulse Check Survey Question: Which of the following best describes your race? (Single response permitted)

APPENDIX C. Customer Survey Instrument

Opinion Dynamics submitted the survey instrument as a separate Word document to the IOUs.

APPENDIX D. Customer Survey Analysis Workbook

Opinion Dynamics submitted the survey analysis workbook as a separate Excel document to the IOUs.

Opinion **Dynamics**

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