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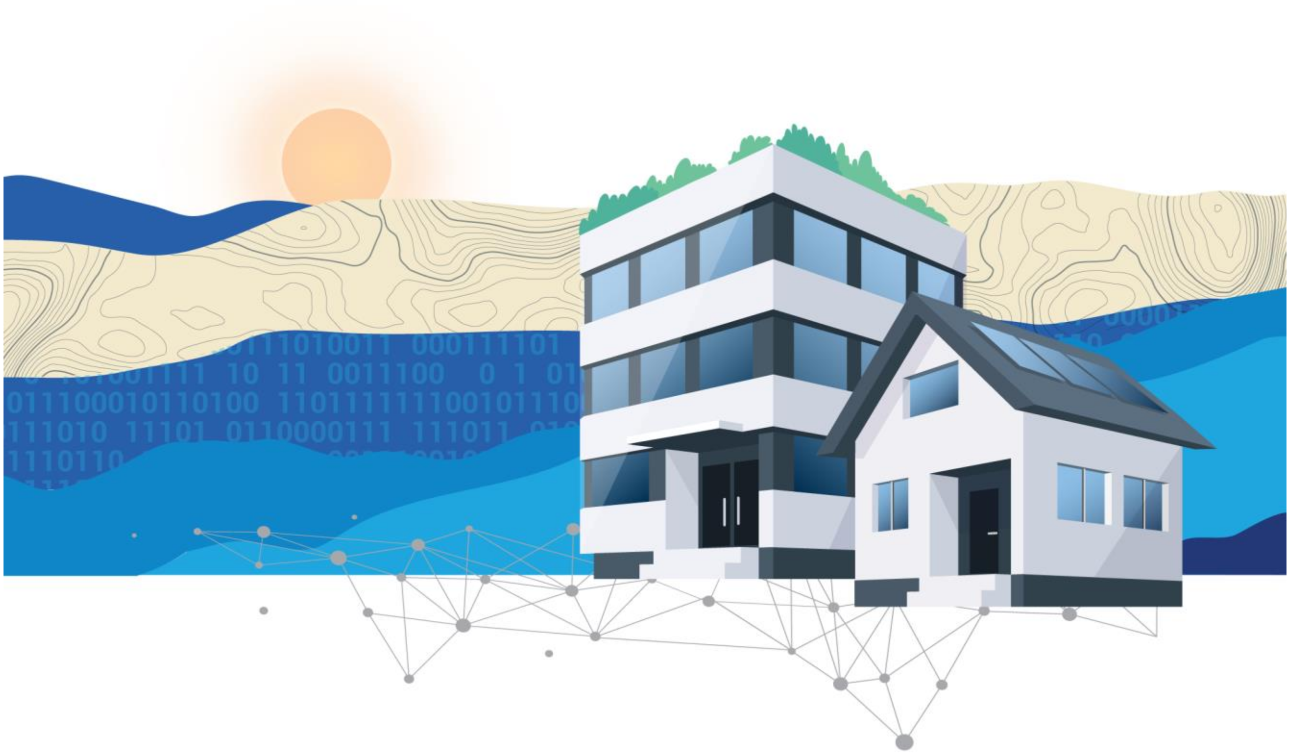

Building Initiative for Low-Emissions Development (BUILD) Program

Baseline Market Assessment

January 19, 2023

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1. Executive Summary

The Building Initiative for Low-Emissions Development (BUILD) Program is intended to encourage the design and construction of all-electric, energy-efficient buildings by providing incentives for the construction of all-electric low-income residential housing and offering technical assistance to support project planning and educate new construction professionals including, builders, developers, architects, and engineers (collectively "stakeholders") about electric technologies and all-electric building design.[1] The primary goal is to engage with new construction market actors to raise awareness of building decarbonization technologies and encourage the design, development, and construction of all-electric residential housing.

The primary objectives of this study were to assess existing market conditions and establish a baseline for the BUILD Program based on primary and secondary research. Data informing this report has been garnered from a variety of sources including a survey of market actors active in the California residential new construction market and a review of secondary data resources.

This report provides an overview of market size, summarizes market perceptions of all-electric design and electrification equipment, and characterizes the key cost, technical assistance, and training considerations related to the future of low-emission residential new construction in California.

1.1 Key Findings and Recommendations

Based on our research, we offer several key findings and recommendations to ensure the BUILD Program is effective in increasing low-income all-electric new construction in California.

- **Finding: The market for all-electric new construction is still relatively nascent in California.** California added, on average, almost 100,000 housing units per year between 2012 and 2021, but only an estimated 0.5% to 1.5% of single family homes and 7% to 13% of multifamily homes are all-electric.
- **Finding: Affordable housing stakeholders reported having more experience building all-electric buildings compared to market rate stakeholders.** Stakeholder experience with all-electric new construction is comparatively high (66% of respondents overall, n=116), especially in the multifamily affordable housing market (75%, n=48). While most stakeholders reported being at least moderately knowledgeable about all-electric design and construction, less than half reported attending formal training in all-electric design.
  - **Recommendation:** Given that a large percentage of multifamily affordable housing stakeholders already have experience building all-electric, CEC may want to consider adding a second New Adopter Awards that is focused on high efficiency all-electric buildings.
- **Finding: Multifamily stakeholders are generally familiar with high efficiency all-electric design and technologies and see limited technical barriers to their installation.** Most multifamily affordable housing stakeholders felt that building all-electric is practical within this market (57%, n=46). Yet, many stakeholders reported never recommending electric technologies in their projects. Respondents in the multifamily sector who indicated high efficiency all-electric design and technologies were impractical today generally cited concerns about the ability of the electric grid to support additional load (5 of 12), the high upfront costs to build all-electric including costs to build and equipment costs

[1] In the first phase of BUILD, the program is focused on affordable housing. Current program guidelines restrict participation to builders and developers of properties that meet one of three criteria, designed to focus BUILD Program funds on low-income developments. In future iterations of the program, eligibility could be expanded.

(3 of 12), limitations of electric water heating systems in multifamily applications (3 of 12), and costs of utility bills to residents in all-electric buildings (3 of 12).

- **Recommendation:** The CEC should address these topics in technical assistance.

- **Finding**: **Stakeholders surveyed reported that recent supply chain issues, including labor and material shortages, have heavily impacted their new construction projects by increasing project costs and delaying projects.** Affordable housing projects also may be coordinating with a variety of other statewide incentive and rebate programs. One key finding from the Terner Center Report on the Costs of Affordable Housing Production[2] was that developers reported delayed project timelines due to utility delays. Low Income Housing Tax Credit (LIHTC)-imposed deadlines were the main driving factors that increased their costs on LIHTC-funded projects. Construction delays often caused developers to pay contractors overtime to meet these deadlines.
- **Finding**: **The majority of stakeholders surveyed felt building high efficiency all-electric housing was more expensive than building dual-fuel housing, but the incidence of this sentiment was lower among stakeholders with experience building all-electric.** Most stakeholders also agreed that high efficiency all-electric homes often qualify for incentives and rebates.
  - **Recommendation:** Stakeholders suggested technical assistance should focus on comparative cost analyses for all-electric equipment choices as well as sharing sources of incentives, financing, and other funding opportunities.
- **Finding**: **Few respondents have received training on all-electric or reach codes, and respondents also express interest in technical assistance focused on code compliance and permitting.** Few respondents received training on this topic but showed a preference for receiving this type of technical assistance through utility-sponsored programs and local government or building departments.
  - **Recommendation:** The CEC should consider leveraging the relationships with local governments they are cultivating through their education and outreach. Local governments are trusted sources of information on building codes and the program could leverage their existing relationships with market actors to increase participation in code-related trainings and technical assistance.
- **Finding**: **Stakeholders were overwhelmingly interested in receiving technical assistance,** although a significant portion were only interested if the technical assistance is free. The lack of awareness of where to access technical assistance is the largest barrier (51% of those interested in technical assistance, n=88) to stakeholders taking advantage of such resources.
  - **Recommendation:** BUILD E&O should focus on the availability of free technical assistance to help increase participation.

[2] Carolina Reid, Adrian Napolitano, and Beatriz Stambuk-Torres, "The Costs of Affordable Housing Production: Insights from California's 9% Low-Income Housing Tax Credit Program," 2020, 32.

2. Introduction

The BUILD Program is an $80 million program that aims to put California on a path to zero emission homes. The BUILD Program is intended to encourage the design and construction of all-electric buildings. The BUILD Program provides incentives for the construction of all-electric new residential housing using near-zero emission building technologies for the purpose of significantly reducing greenhouse gas (GHG) emissions beyond what would be expected to result from a code-compliant mixed-fuel building. Eligible applicants[3] must demonstrate that their project will result in at least a five percent reduction of residents' utility bills compared to mixed-fuel homes. The BUILD Program also offers technical assistance to support project planning and educate developers, architects, builders, contractors and other stakeholders about new technologies and all-electric building design. The primary goal is to engage with new construction market actors to raise awareness of building decarbonization technologies and encourage them to design, develop, and build all-electric new construction. All program funding will be directed toward new low-income housing for the first two years of the program.

The BUILD Program offers the following incentives:

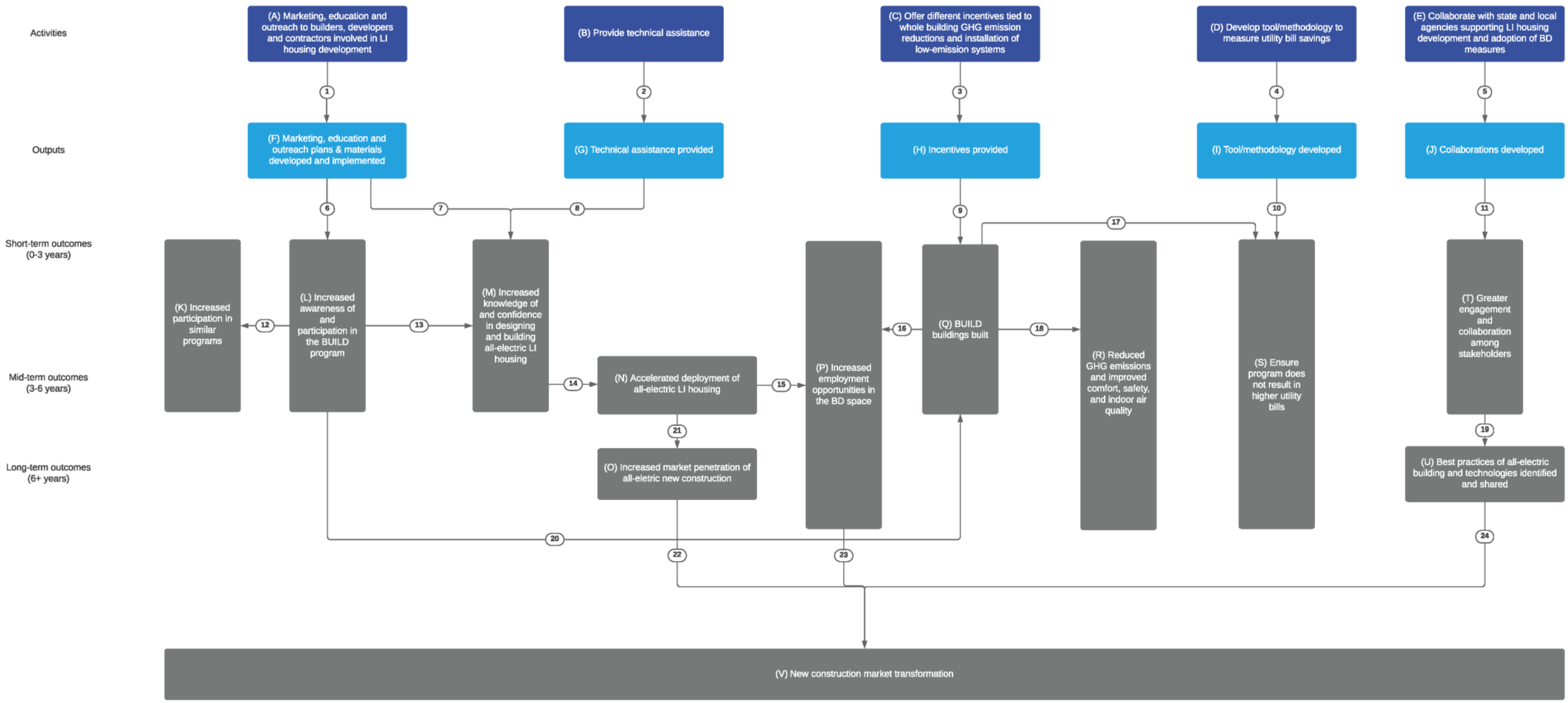
- **Base GHG incentive** – Base electrification incentive calculated as $150 per metric ton of avoided GHG emissions.
- **Building Efficiency incentive** – Projects built to achieve efficiency beyond the applicable energy code, using the performance method as specified by the Residential and Nonresidential Alternative Calculation Method Reference Manuals[4], will receive an additional incentive of up to $1,000 per bedroom.
- **Incremental PV incentive** – An incentive per watt of additional photovoltaic (PV) installed beyond what is required by the applicable energy code. This incentive will not be provided for PV installed to meet code or for additional PV beyond what is required to meet the modeled resident energy cost requirement. This incentive is also capped at the cost of the PV system.
- **Kicker Incentives** – The program provides kicker incentives for specific high-efficiency technologies, including smart thermostats, JA-13 compliant[5] heat pump water heaters (HPWHs), use of equipment with low global warming potential (GWP) refrigerants, induction cooktops, heat pump clothes dryers (HPCDs), on-site energy storage, and electric vehicle supply equipment (EVSE).

Opinion Dynamics, with subcontractors Guidehouse and Mitchell Analytics (collectively the "Evaluation Team"), are serving as the embedded evaluator for the BUILD Program. One of our first evaluation activities was to work with the prime program implementer, California Energy Commission (CEC), to create a Program Theory Logic Model (PTLM) that explains the BUILD Program's activities, outputs and intended market and program outcomes. We also developed key program and market metrics that, when measured, can demonstrate whether the intended outcomes are achieved. The market metrics align with the PTLM and tie directly to the market barriers that the BUILD Program is attempting to address (Figure 1).

[3] The BUILD Program Guidelines define an eligible applicant as a "private, nonprofit, tribal government, California tribal organization, or public owner developer of an eligible residential building."
[4] Accessible at https://www.energy.ca.gov/publications/2019/2019-nonresidental-alternative-calculation-method-reference-manual
[5] JA-13 compliant heat pump water heater is certified by the CEC as a heat pump water heater demand management system.

Figure 1. BUILD PTLM

Key market barriers:
Low interest and awareness of BD measures
Low perceived customer value of going all electric
Low perceived builder/developer/designer value of going all electric
Limited availability of trained workforce
Limited understanding of code compliance modeling techniques
Lack of financing solutions to help customers manage upfront costs



When evaluating a market transformation program, it is integral to understand the natural market baseline to accurately assess the impacts of the intervention. For the BUILD Program, the baseline is a counterfactual, or what would have occurred in the market absent program intervention, all other variables remaining equal. The counterfactual takes into account current practices, impending policy changes and known code updates to equipment standards or building energy codes. In this report, we establish a snapshot of the residential new construction market by estimating relevant market metrics drawn from the PTLM and supplement with additional quantitative and qualitative evidence from a baseline survey we conducted with residential new construction market actors in California. After program implementation, we will be able to conduct an analogous study to establish a snapshot of the market in the future and understand specific market changes the BUILD Program may have influenced.

This report provides an overview of market size, summarizes market perceptions of all-electric design and electrification equipment, and characterizes the key cost, technical assistance, and training considerations related to the future of low-emission residential new construction in California.

2.1 Study Objectives

The primary objectives of this study were to assess existing market conditions and establish a baseline for the BUILD Program based on primary and secondary research. Data informing this report has been garnered from a variety of sources including a survey of market actors active in the California residential new construction market and a review of secondary data resources, which are listed in section 2.2.2. Specific objectives of this baseline report include the following:

- Understand the annual market size/share of market rate and low-income new residential housing that is all-electric
- Ascertain the number of existing all-electric buildings in California
- Determine the number of trade allies with appropriate licenses to construct or alter structures in California, and/or install, service, and maintain low-emission technologies in total and by climate zones, zip code, and Disadvantaged Communities (DACs)[6]
- Assess stakeholders' existing knowledge of all-electric building value propositions and acceptance of all-electric technologies
- Assess stakeholders' existing knowledge of specific all-electric housing technologies and their implementation
- Identify any barriers to receiving technical assistance
- Assess stakeholders' existing knowledge about local governments' all-electric building permit requirements specified in relevant laws, ordinances, regulations, standards, and all-electric building Reach Codes
- Assess stakeholders' knowledge about all-electric funding opportunities and financing requirements as well as the number of stakeholders who have already taken advantage of funding opportunities
- Determine BUILD Program awareness among new construction stakeholders in California

[6] For this report, we define a DAC as a census tract in the top 25% of census tracts most burdened by pollution per the CalEnviroScreen 4.0 scoring tool. California Public Utility Commission, "Disadvantaged Communities," accessed August 16, 2022, https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/disadvantaged-communities.

- Ascertain number of available positions within the new construction industry by climate zones, zip codes, and DACs (as available)
- Ascertain number of workers employed within the new construction industry by climate zones, zip codes, and DACs (as available)

2.2 Methods

The Evaluation Team relied on a survey of new construction stakeholders and a variety of secondary sources to complete this baseline assessment. Each are described below.

2.2.1 New Construction Stakeholder Survey

The Evaluation Team fielded a survey with builders, contractors, designers, and developers involved in residential new construction in California. In addition to BUILD-qualified applicants (i.e., builders and developers), the survey sought to understand the sentiments of architects and engineers who play a pivotal role in the design and technology selection for single family and multifamily new construction projects. The goal of the survey was to understand stakeholders' familiarity with and sentiments towards high efficiency, all-electric residential new construction. The data collection instrument is provided in Appendix B.

We created a purposive sample of market actors through independent research, previous Opinion Dynamics work, and contacts provided by the program implementation team. Many stakeholders identified as potentially eligible respondents from previous Opinion Dynamics work had participated in other California energy efficiency programs which may present potential biases in responses towards all-electric construction. Stakeholders were contacted via email, up to four times each. Given that all implementation funds are focused on low-income housing for the first two years of the BUILD Program's implementation, the Evaluation Team focused its sampling efforts on affordable housing developers, builders, architects, and engineers. The survey was fielded from May to July 2022. We achieved a total of 102 survey completes and 15 partial completes (Table 1).[7] Respondents received a $100 gift card as a thank you for participating in the survey.

Table 1. Number of Respondents by Stakeholder Type

Stakeholder Type	Number of Respondents	Percent of Respondents
Architect / Design Firm	57	49%
Developer / Real Estate Development	26	22%
Building / Construction Firm	20	17%
Engineering Firm	14	12%
Total	**117**	**100%**

2.2.2 Secondary Data Market Analysis

The Evaluation Team reviewed and leveraged a variety of secondary sources to help characterize the California new construction market, each of which is provided and described below:

[7] Respondents who completed over 50% of the survey were included in this research.

- **2019 California Residential Appliance Saturation Study (RASS).**[8] The RASS study is a comprehensive report that summarizes residential energy use. Managed by the CEC and conducted by DNV GL Energy Insights, this study received 39,985 homeowner responses across California when conducted in 2019. The Evaluation Team used data from the RASS study to understand the current proportion of new construction that is all-electric.
- **Southern California Edison (SCE) Home Energy Rating System (HERS) Registry Data Summary Analysis.**[9] The Evaluation Team acquired a summary of HERS Registry data from SCE. This summary analysis was generated by SCE by analyzing multiple sources of CA HERS Registry data and includes registrations from both the 2016 and 2013 Title-24 code cycles. In this analysis, all-electric construction is inferred based on registrations that have both electric water heating and space heating. HERS Registry data is comprehensive for the low-rise residential new construction market and updated in real-time, making it a valuable source for analyzing new construction building characteristics. The Evaluation Team relied on this summary to support the findings from the RASS analysis.
- **U.S. Residential Energy Conservation Survey (RECS).**[10] The U.S. RECS, conducted every five years, collects detailed information on household energy characteristics, usage patterns, and household demographics. The Evaluation Team analyzed this data to support the findings from the RASS analysis.
- **Construction Industry Research Board (CIRB) Report.**[11] The CIRB Report has published statistics on California residential, commercial, and energy-efficient building permit data since 1954. The Evaluation Team used 2013–2022 CIRB data to develop an understanding of the overall residential new construction single family and multifamily markets.
- **2020 Opinion Dynamics CPUC Group B Heat Pump Market Characterization and Baseline Study.**[12] We used findings from 30 interviews conducted with new construction developers, builders, architects, engineers, and building department staff in the market rate and low-income residential and multifamily markets to understand motivations and identify barriers to building all-electric homes. These interviews were conducted with market actors who indicated they have some familiarity working with heat pumps, so findings may not be representative of the total market.
- **California State Licensing Board (CSLB) Contractor License Data.**[13] The CLSB, under the Department of Consumer Affairs, protects California consumers by licensing and regulating the state's construction industry. The CSLB was established in 1929 and today licenses approximately 290,000 contractors in 44 different licensing classifications. The Evaluation Team relied on the CSLB data to characterize the trade ally market in California.
- **2021 United States Energy & Employment Report (USEER).**[14] The USEER report contains information regarding the US labor market as it pertains to energy-related sectors and provides a database of labor market information. USEER relies on employment data collected by the Bureau of Labor Statistics Quarterly Census of Employment and Wages in addition to a supplemental survey, which received

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[8] California Energy Commission, "2019 Residential Appliance Saturation Study," California Energy Commission (California Energy Commission, 2019), https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study.
[9] The Evaluation Team relied on the public version of the summary table. The underlying data are confidential.
[10] U.S. Energy Information Administration. Residential Energy Consumption Survey. 2020 RECS Survey Microdata. Accessed at: https://www.eia.gov/consumption/residential/
[11] Construction Industry Research Board (CIRB), "Construction Industry Research Board Annual Building Permit Summary," (California Homebuilding Foundation, 2021).
[12] Opinion Dynamics, "Opinion Dynamics CPUC Heat Pump Market Study Report" (California Public Utilities Commission, May 13, 2022).
[13] Department of Consumer Affairs (DCA), "Contractor State License Board," (State of California, 2022), https://www.cslb.ca.gov/onlineservices/dataportal/.
[14] BW Research Partnership and MG Strategy & Design, "United States Energy & Employment 2021 State Reports," (Department of Energy, 2020).

responses from over 25,000 business establishments across the country in 2021. The report is a year-over-year analysis that aims to provide "complete definitions and quantifications of energy jobs across all sectors of the economy." The database provides information regarding the difficulty of hiring, in-demand occupations, and the demographic composition of portions of the energy and energy efficiency workforce. The Evaluation Team used this report to understand the number of available positions in the energy efficiency and new construction workforces as well as the number of workers currently employed in these fields in California.

- 2022 Home Builders Institute (HBI) Construction Labor Market Report.[15] The HBI report provides an update on the status of the nation's construction labor market including information on the demand for construction workers, the demographic breakdown of the workforce, and the number of open positions available, among other metrics. The Evaluation Team used this report to understand the number of available positions in the new construction workforce as well as the number of workers currently employed in this field in California.

[15] Home Builders Institute, "Spring 2022 HBI Construction Labor Market Report," (Home Builders Institute, June 2022).

3. Market Overview

California currently faces an extremely tight housing market with demand for homes continuing to soar. New construction of single family and multifamily homes has not kept pace with the growth of California's population. Over the past decade, population growth has outpaced the growth of housing units by 220%.[16] Recently, California has committed to building 2.5 million new homes to address the growing shortage of affordable housing across the state.[17]

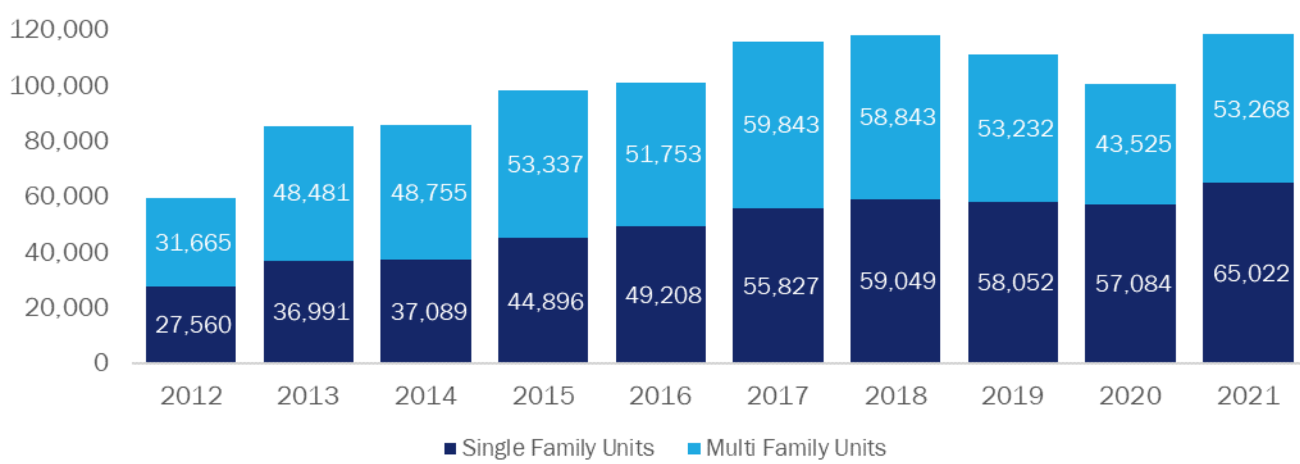
The following section outlines the current size of the new construction market in California as well as the estimated number of all-electric homes based on fuel use of central heating and cooling, water heating, and household appliances such as laundry and cooking equipment. Increasing the penetration of all-electric new construction is a key outcome of the BUILD Program.

3.1 New Construction Market Size

3.1.1 Total New Units

California's residential new construction market has been trending upward over the past decade. According to CIRB, California added an average of almost 100,000 housing units[18] a year between 2012 and 2021, with a record high of 118,290 units added in 2021 (Figure 2). Growth has been similar in single family and multifamily units. Additional information on market size by climate zone and zip code is provided in Appendix A.

Figure 2. New Housing Units Built from 2012 to 2021

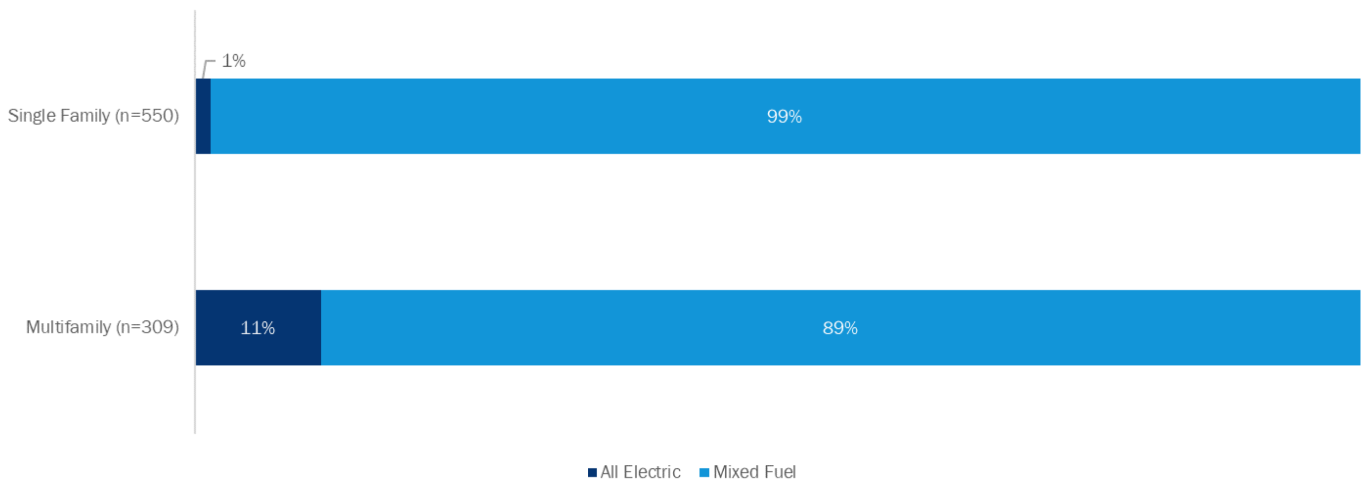


[16] Dan Walters, "California Housing Crisis Both Wide and Deep," *CalMatters*, December 7, 2021, sec. Commentary, http://calmatters.org/commentary/2021/12/california-housing-crisis-both-wide-and-deep/.
[17] State of California, "Governor Newsom Signs Legislation to Increase Affordable Housing Supply and Strengthen Accountability, Highlights Comprehensive Strategy to Tackle Housing Crisis," (California Governor, September 28, 2021), https://www.gov.ca.gov/2021/09/28/governor-newsom-signs-legislation-to-increase-affordable-housing-supply-and-strengthen-accountability-highlights-comprehensive-strategy-to-tackle-housing-crisis/.
[18] A multifamily building is composed of multiple individual housing units.

3.1.2 Penetration of All-Electric Units

New homes in California are predominately dual-fuel. [19] The majority of California residential new construction contains non-electric technologies fueled by natural gas, propane, wood, or other non-electric fuel sources. According to data from the 2019 California RASS study, only 1% of single family homes and 11% of multifamily homes constructed after 2012 were all-electric.[20] The majority of new construction in California is still predominantly mixed fuel homes with 99% of single family households and 89% of multifamily households surveyed in the RASS study reporting they use at least one non-electric fuel type (Figure 3).[21] Further, 82% of respondents residing in new homes report having natural gas lines or hooks up currently in their home.

Figure 3. Percent of New Homes that are All-Electric



This finding is generally supported by analysis of other relevant data sources, although estimates for the multifamily sector are more divergent. An analysis of recent HERS Registry data estimates all-electric penetration[22] based on registrations from both the 2013 and 2016 Title 24 code cycles of 0.48% of new single family units (n= 191,731) and 4.43% of new low-rise multifamily units (n=46,447).[23] Importantly, high-rise multifamily buildings with four or more stories are not included in historical HERS Registry data, and the data do not include registrations under the more recent 2019 code cycle. Similarly, based on analysis of the 2020 U.S RECS Survey microdata, we estimate the penetration of all-electric units to be 1.9% for single family units (n=739) and 16.1% for multifamily units (n=402). Importantly, the RECS data includes the entire building stock in California, not just new construction. Therefore, considering the vintage of the data sources and the various limitations of each, we estimate a penetration rate of all-electric new construction in the range of 0.5% to 1.5% for the single family sector and 7% to 13% for the multifamily sectors.

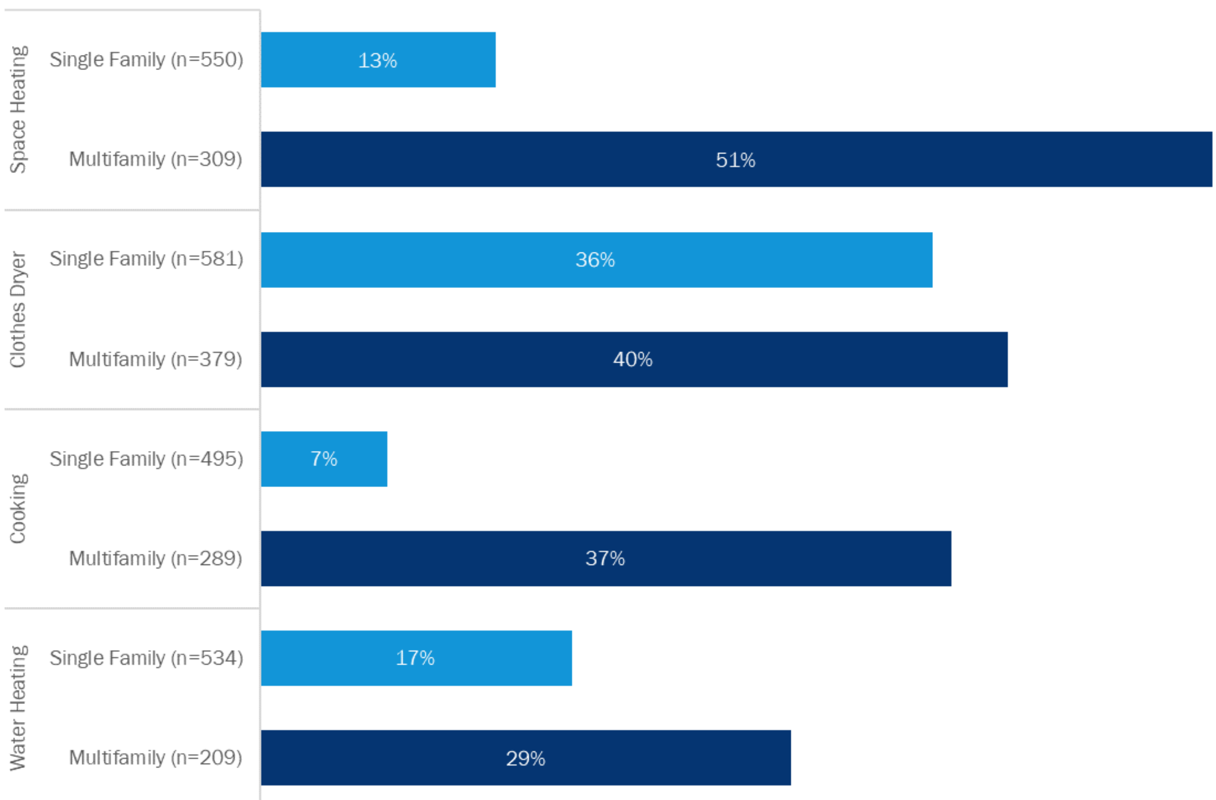
[19] The Evaluation Team refers to "new homes" several times in this section. We define "new home" or "new construction" as homes built after 2012.
[20] Based on the number of homes with electric space heating, water heating, cooktops, stoves, and dryers. These homes may still have a natural gas hookup.
[21] Other fuel types include natural gas, fuel oil, propane, wood, solar, or other miscellaneous fuels.
[22] A unit is assumed to be all-electric in this calculation if it has electric heating and electric water heating.
[23] Based on a summary of CF-2R installation certificates for new construction projects.

3.2 Equipment Types

While new all-electric homes in California are still rare, the penetration of electric technologies varies significantly by end use. According to data from the 2019 California RASS study, new multifamily homes have higher all-electric penetration rates than single family homes across all end uses. The absolute difference between penetrations rates in multifamily and single family is greatest in the space heating (51% multifamily all-electric penetration compared to 13% for single family) and cooking end uses (37% compared to 7%).

Figure 4 provides the penetration of new homes with all-electric technologies by end use.

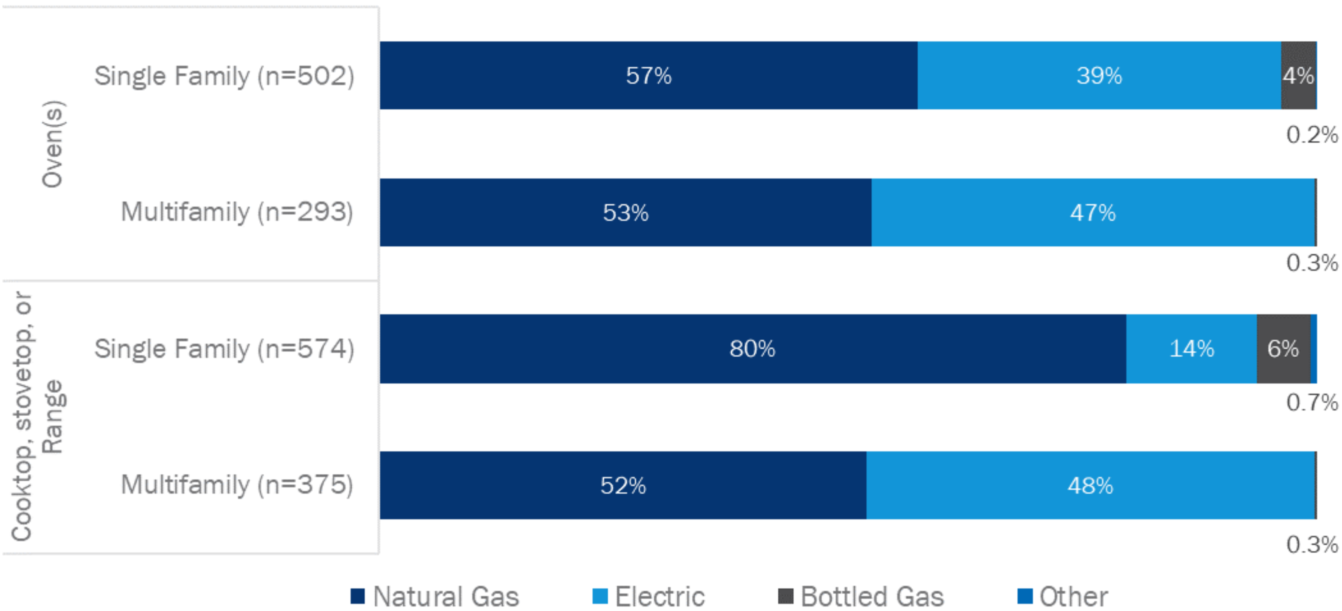
Figure 4. Penetration of Electric Only Technologies, by End Use



Ovens and cooktops in new multifamily homes are more likely to be electric, compared to single family homes. Almost half of the ovens and cooktops in new multifamily homes are electric (47% and 48%, respectively). Comparatively, 39% of ovens and just 14% of cooktops are electric in new single family homes.

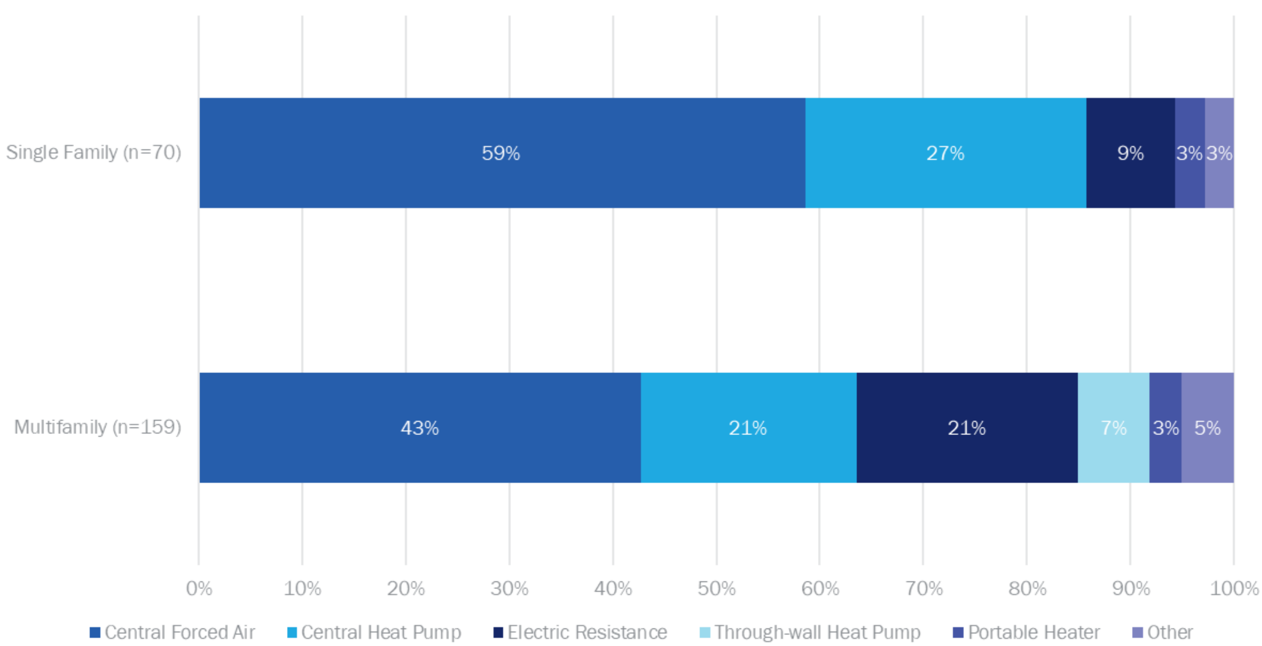
The distribution of cooking fuel for ovens and stovetops in new homes is shown in Figure 5.

Figure 5. Cooking Fuel Types by Equipment Type



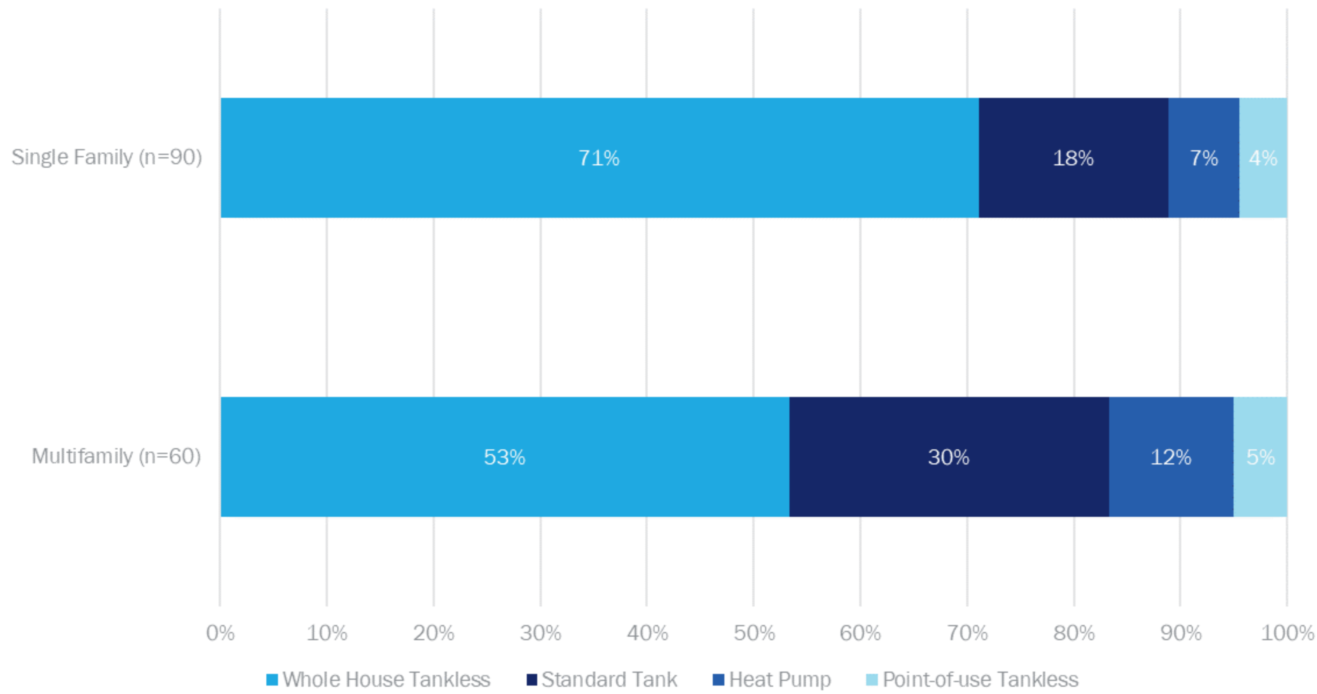
In both the single family and multifamily market types, heat pumps account for just over one-quarter of new electrically-heated homes. As shown in Figure 6, almost half of new electrically heated homes primarily use a central forced air furnace (59% of single family and 43% of multifamily) while just over one-quarter use heat pumps (30% of single family and 28% of multifamily).

Figure 6. Electric Space Heating Types



Few new homes with electric water heating have a heat pump water heater. Among homes with an electric water heating system, a whole house tankless water heater is the most common (71% of single family and 53% of multifamily) followed by a standard electric tank water heater (18% of single family and 30% of multifamily). Heat pump water heaters only comprised 7% and 12% of electric systems in new single family homes and multifamily homes, respectively (Figure 7).

Figure 7. Electric Water Heating Types



4. Stakeholder Perceptions

Increasing stakeholder's knowledge of and confidence in designing and building all-electric affordable housing is a key outcome of the BUILD Program. In order to effectively assess this outcome, the Evaluation Team conducted a baseline survey of new construction market actors to characterize stakeholder perceptions of all-electric design and technologies, including perceptions of the practicality, feasibility, costs, and other barriers to all-electric new construction. Understanding barriers to all-electric new construction will also help the implementation team increase the number of BUILD buildings that are built, which is another key outcome included in the PTLM. The following section summarizes respondent firmographics, respondent perception of all-electric design, high efficiency all-electric technologies, relevant financing and incentive programs, and the need for decarbonization technical assistance and trainings.

4.1 New Construction Stakeholder Firmographics

It is important to understand the composition of the respondent pool when interpreting the results of this survey. Certain batteries of the survey focused questions on markets—single family market rate, single family affordable housing, multifamily market rate, and multifamily affordable housing. If a respondent reported any experience in the single family new construction or multifamily new construction sectors, they were included in questions regarding single family market rate or multifamily market rate, respectively. If a respondent indicated that more than 25% of their work, by sector, was in affordable housing, they were also asked questions pertaining to affordable housing in these sectors. As a result, a respondent may be included in multiple market types.

Table 2 shows the number of respondents included in analyses specific to each market type.

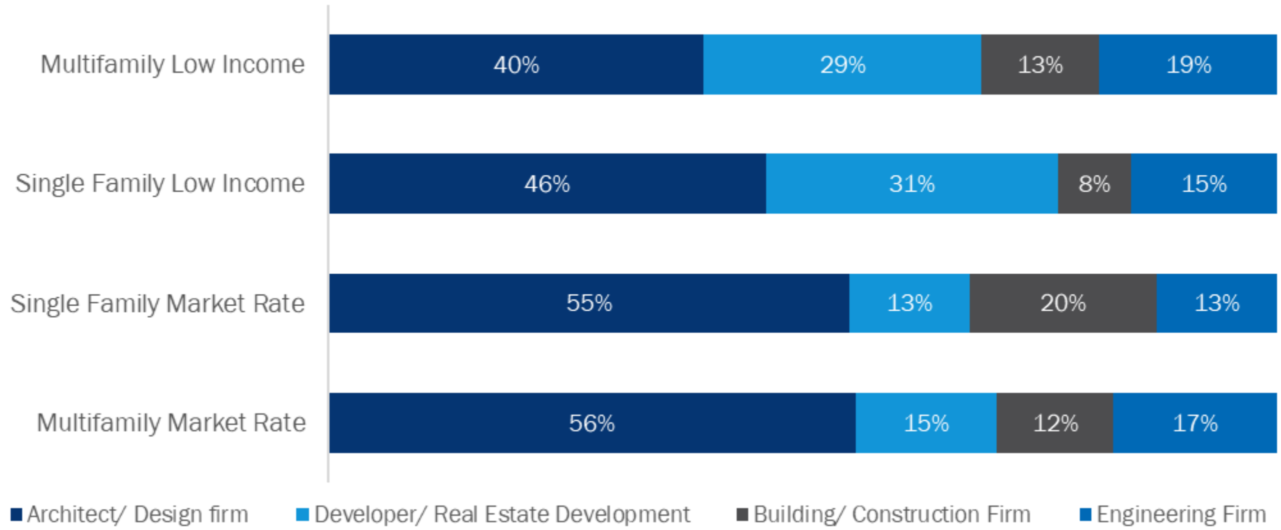
Table 2. Number of Respondents by Market Type

Market Type	Number of Respondents	Percent of Respondents [a]
Multifamily Market Rate	81	69%
Single Family Market Rate	71	61%
Multifamily Affordable Housing	48	41%
Single Family Affordable Housing	13	11%

[a] Sums to over 100% because respondents could be included in analyses for multiple market types.

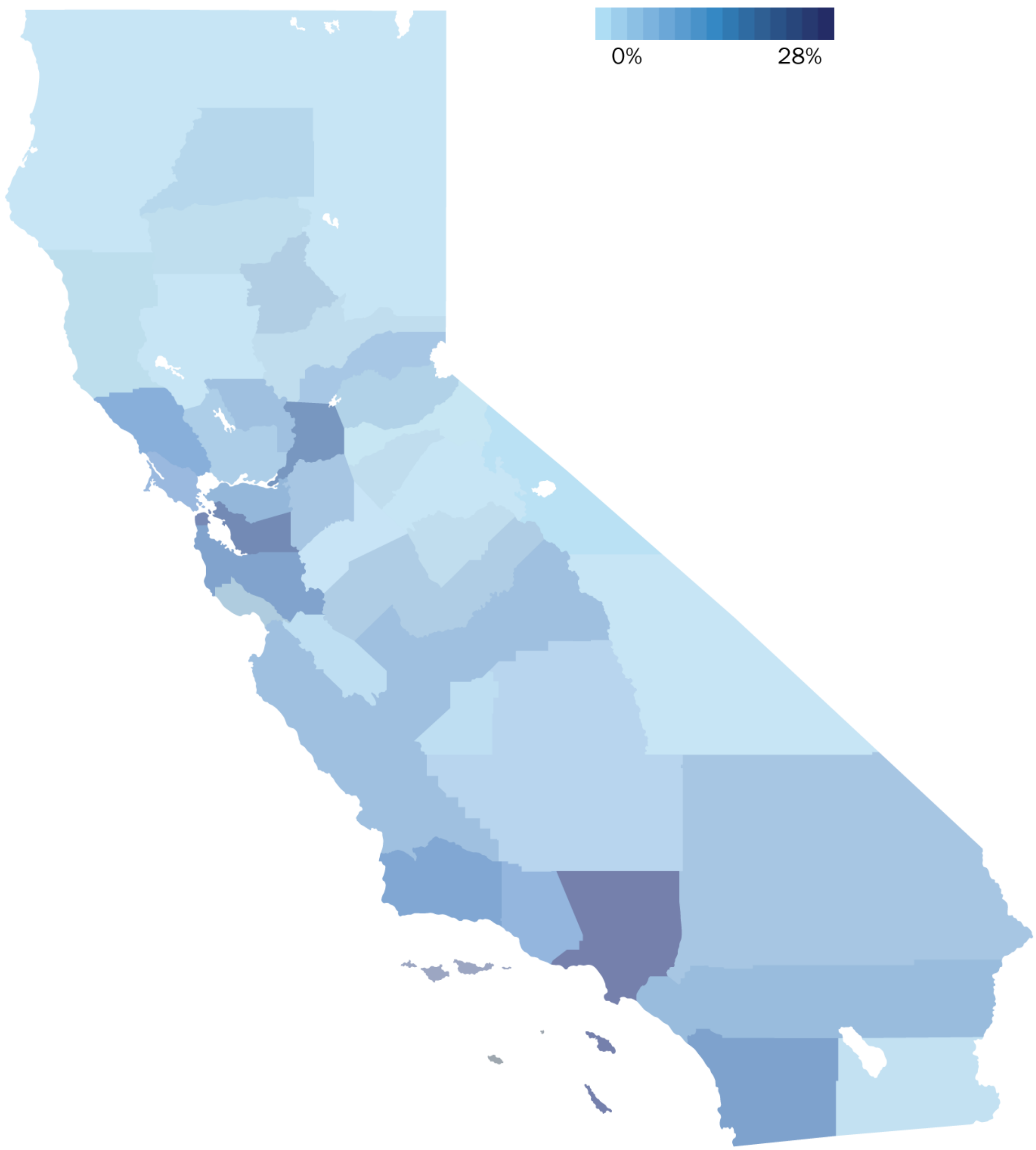
Figure 7 below shows the breakdown of stakeholder types represented within each market type. Architects were the most common stakeholder type, accounting for 40% to 56% of respondents within a market type. Developers were relatively more common in the low-income market types while builders were more common in the market rate market types.

Figure 8. Stakeholder Type by Market Type



The vast majority of stakeholders focused their work in the urban centers of Northern and Southern California. Respondents most commonly worked in Los Angeles (28%), Alameda (15%), San Francisco (15%), and Sacramento (11%). Figure 9 shows where the respondents reported working in California.

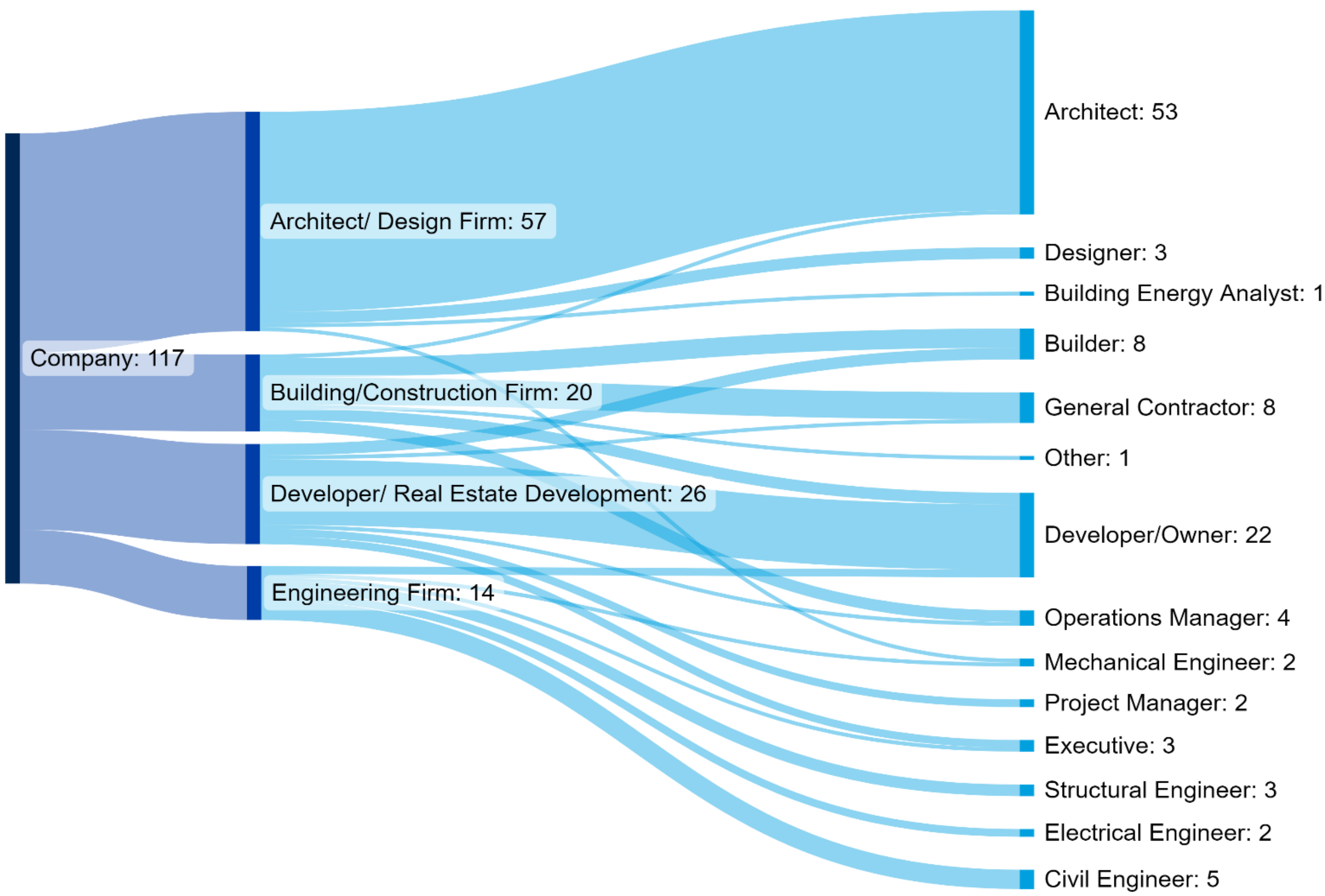
Figure 9. Location of New Construction Stakeholders



Most stakeholders we surveyed worked at architecture and design firms and had the title of architect (Figure 10)**.** Developers and builders (i.e., eligible BUILD applicants) accounted for 22% and 17% of respondents, respectively. The remaining respondents were from architecture firms (49%) and engineering firms (12%).

Respondents generally possessed job titles in line with their company's businesses segment. Figure 10 summarizes the titles of respondents based on their company types. Further, most respondents reported working for small companies, with 1-10 employees (56%) or mid-sized companies, with 11-100 employees (37%). A small minority of respondents reported working for large companies, with over 100 employees (7%).

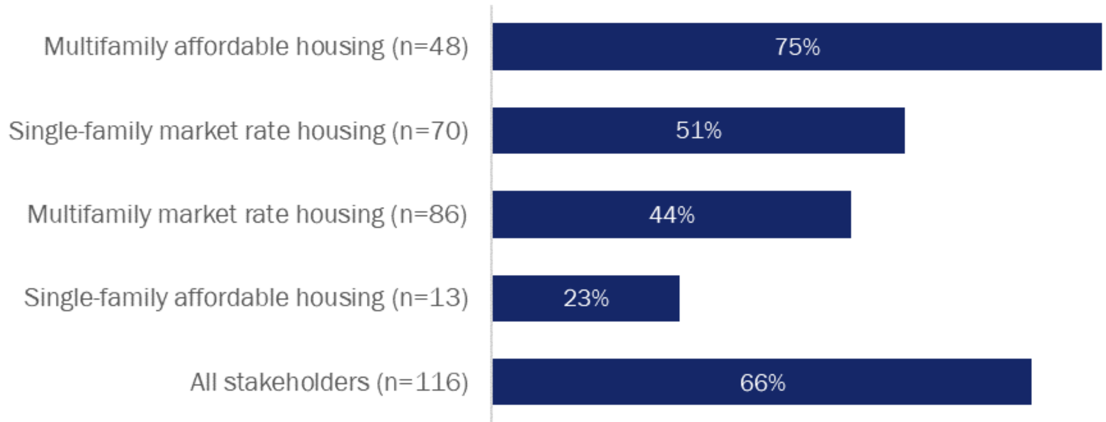
Figure 10. Summary of Stakeholders Company and Title



4.2 Overall Experience and Perceptions

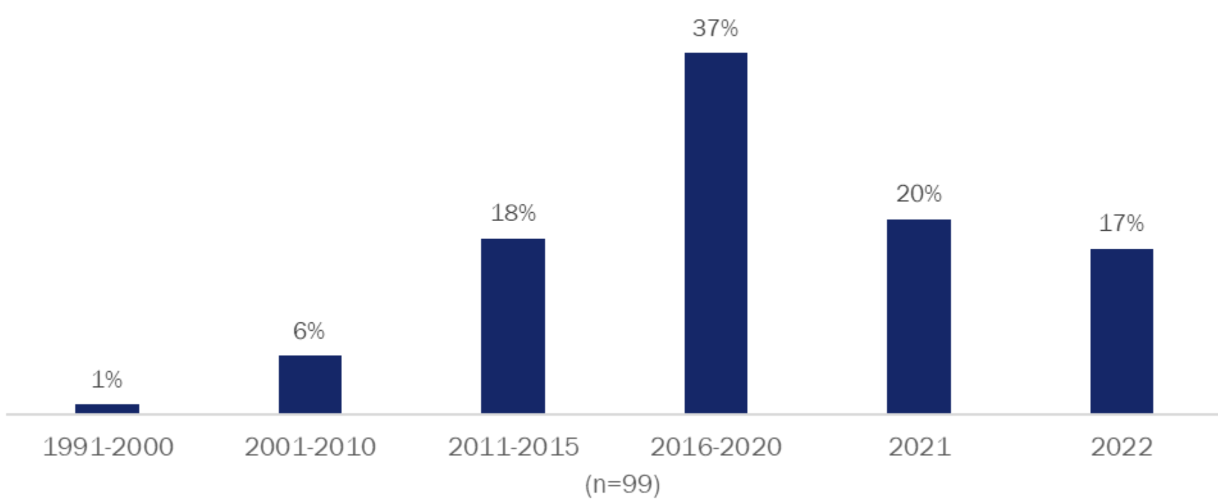
Stakeholders had varying amounts of experience working in all-electric design across each market type. Over half of stakeholders (66%) we surveyed have experience working on a team that has built or is currently building an all-electric new construction project, although this varies by market. The multifamily affordable housing market has the highest proportion of respondents with experience building all-electric (75%), compared to less than one-quarter (23%) in the single family affordable housing market. Stakeholders' all-electric experience overall and by market is outlined in Figure 11.

Figure 11. Stakeholders with Experience Working on All-Electric Residential Projects



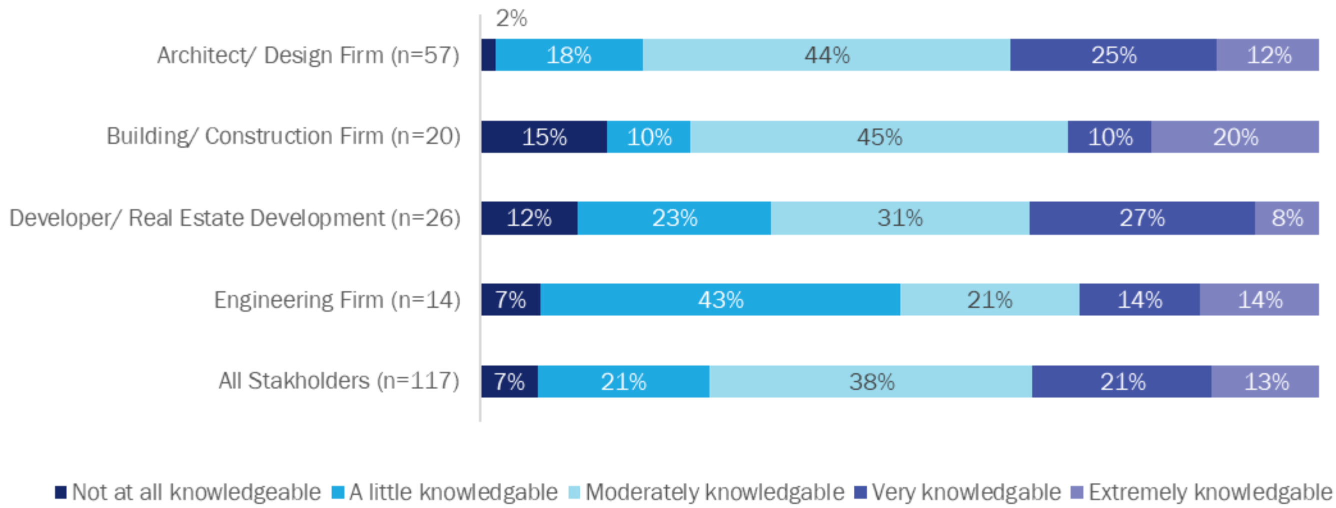
The majority of respondents with all-electric construction experience built their first all-electric home in the last six years. Almost three-quarters of stakeholders (74%) reported first working on an all-electric project in 2016 or later, while 37% of stakeholders reported it was in the last two years. Very few stakeholders (7%) reported building all-electric new construction prior to 2010 (Figure 12).

Figure 12. Timeline of Stakeholders First All-Electric New Construction Projects



Although stakeholders started building all-electric homes relatively recently, most stakeholders reported being at least "moderately knowledgeable" about all-electric residential building design. Additionally, over one-third of respondents (34%) reported being "very" or "extremely" knowledgeable about all-electric design. Architects reported being the most knowledgeable about all-electric design while engineers reported being the least knowledgeable, as shown in Figure 13.

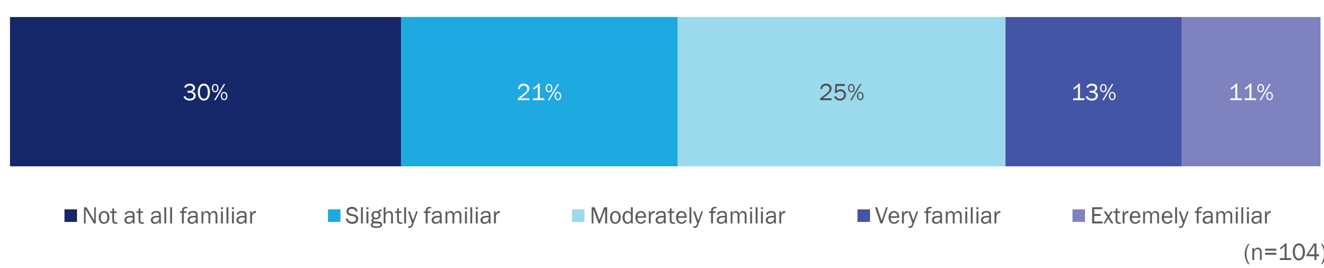
Figure 13. Stakeholders Knowledge Building All-Electric Residential Building Design



Stakeholders reported varying levels of exposure to sustainability certifications. Most commonly, stakeholders reported the majority of their projects earn a sustainability certification such as LEED, ENERGY STAR®, or GreenPoint rating,[24] or participate in a utility-sponsored new construction energy efficiency program (36%). However, one-fifth of stakeholders stated that none of their projects meet these requirements. Among stakeholders who have experience in all-electric new construction, almost half (42%) reported that over 50% of their projects receive a sustainability certification, while only and 17% reported that none of their projects receive these certifications.

Stakeholders also reported varying levels of familiarity with reach codes. Almost half of respondents reported being at least "moderately" familiar with local jurisdictional reach codes set in the counties that they work in (49%); however, 30% reported being "not at all" familiar (Figure 14).

Figure 14. Stakeholder Familiarity with Jurisdictional Reach Codes

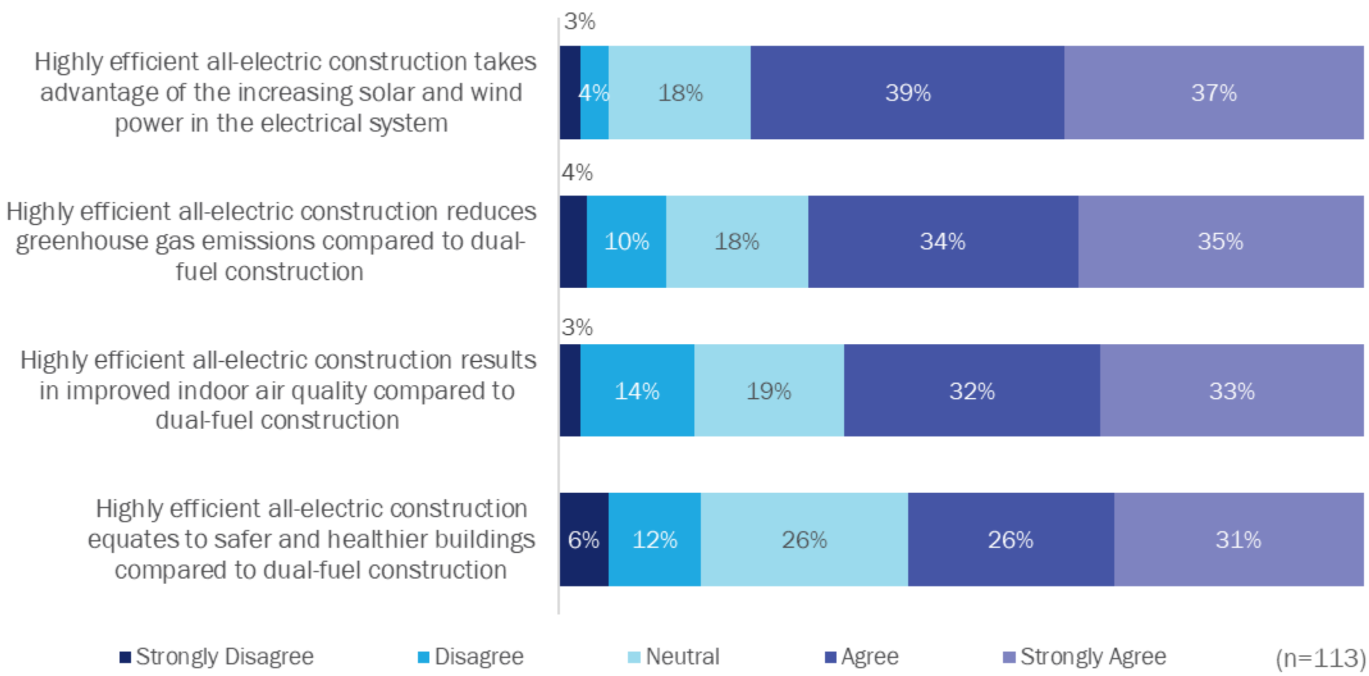


Stakeholders largely agree that high efficiency, all-electric new construction is safer, cleaner, leverages more renewable energy, and reduces GHG emissions relative to comparable dual-fuel construction. Most stakeholders (76%) "agree" or "strongly agree" that all-electric construction takes advantage of the increasing solar and wind power in the electrical system and produces less GHG emissions compared to dual-fuel

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

construction (69%). Stakeholders were less likely to agree that all-electric construction equated to safer and healthier buildings when compared to dual-fuel construction (57% of respondents agreeing or strongly agreeing). More respondents (18%) disagreed with this statement than any other statements in this question of the survey. Figure 15 summarizes respondent perception toward high efficiency all-electric new construction.

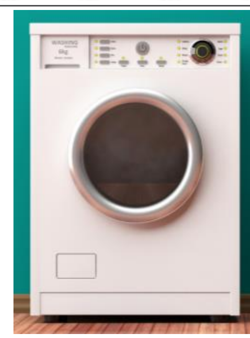
Figure 15. Stakeholders Perceptions of High Efficiency All-Electric New Construction



4.3 Technology Choices & Design

The following section outlines stakeholder sentiments about installing specific electric technologies into single family and multifamily market rate and low-income homes. We highlight findings related to technologies that are eligible for a BUILD Program kicker incentive. Each technology discussed in the following section is introduced below:

Table 3. Relevant Electric Technologies

Unit Type	Description	Example Image
Induction cooktop (Kicker)	Induction cooktops look visually similar to standard glass top electric cooktops; however, they utilize electromagnetic waves to heat cookware. These types of cooktops are highly efficient because they allow for precise heating of cookware and very little heat energy is lost in the process.	
Heat pump clothes dryer (Kicker)	HPCDs work as closed loop systems by heating the air, using it to remove moisture from the clothes, and then reusing it once the moisture is removed. The HPCD uses refrigerant to catch hot air, push it through a compressor to make it hotter than before and then push that hot air through the dryer drum to dry clothes. Rather than releasing warm, humid air through a dryer vent to the exterior of the home as a conventional dryer does, an HPCD sends it through an evaporator to remove the moisture and deposits the water in an accessible compartment.	
Electric clothes dryer	In electric dryers, an electric current is sent through a coil, which is designed to create resistance. The resistance builds up electrons and creates heat. The heat is then transferred to the surrounding air and forced throughout the dryer by a blower or fan. These types of dryers typically run on a 240V circuit and do not require professional installation. The operating costs of these units tend to be almost twice that of a traditional gas dryer, especially in locations such as California where gas is more prevalent.	

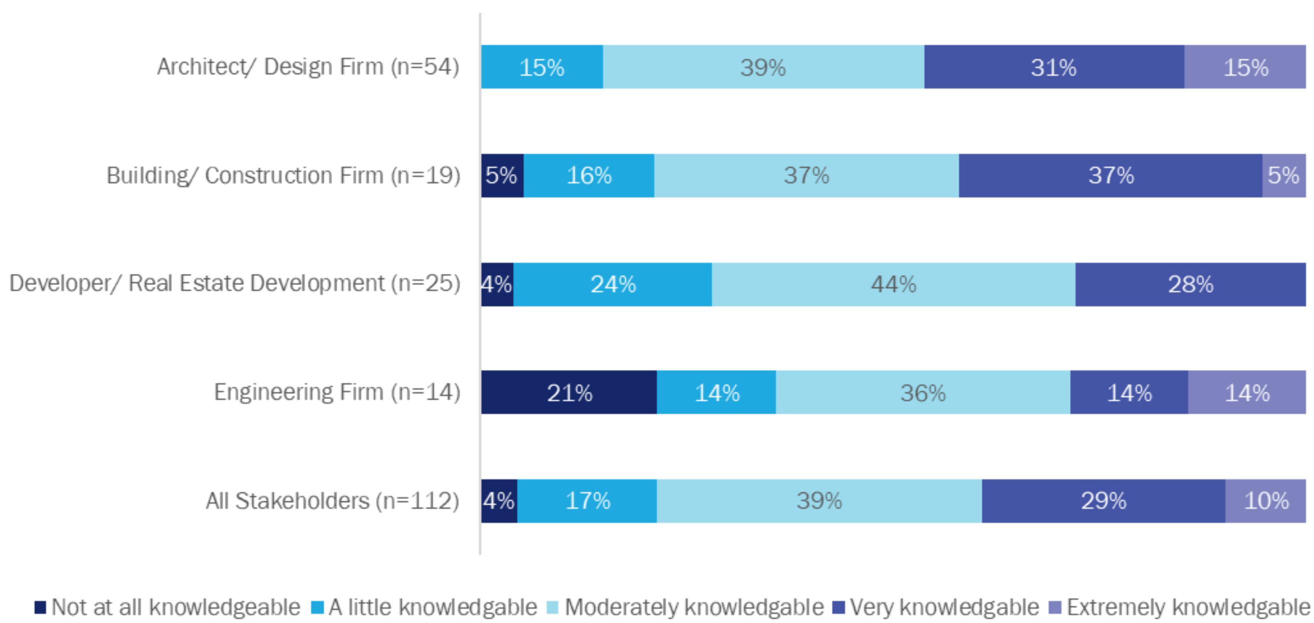
Unit Type	Description	Example Image
Heat pump water heaters (Kicker if JA13-compliant)[25]	HPWHs are all-electric, high efficiency water heaters that, unlike gas-powered water heaters and electric resistance water heaters, heat water by transferring heat from the surrounding air rather than creating new heat. A fan brings air in through an air filter and evaporator coil. The evaporator coil contains refrigerant, which absorbs heat from the air. The refrigerant is then pumped through a compressor, which increases the temperature of the refrigerant. The hot refrigerant is circulated through a closed-loop system from the compressor through a coil that wraps the tank. As the refrigerant passes through the coil, heat is transferred from the refrigerant into the water. Transferring heat rather than creating it allows HPWHs to be up to three times more efficient than gas and electric resistance water heaters, conserving power and reducing energy bills	
Electric resistance water heater	An electric resistance water heater generally consists of an insulated, glass-lined steel tank with two electric resistance elements that heat the water. Electric resistance water heaters are highly efficient; however, they depend upon the unit being well insulated. These types of water heating units can be installed in locations where a combustion gas vent may not be easily installed as well.	
Air Source Heat Pump	Air source heat pumps (ASHPs) are an efficient electric heating and cooling option for homes. When properly installed, an ASHP can deliver 1.5 to 3 times more heat energy to a home than the electrical energy it consumes. This is possible because a heat pump moves heat rather than generates heat. An ASHP extracts heat from outdoor air, even in cold weather, and uses that to heat a home. In the summer, an ASHP works in reverse transferring the inside heat to the outdoor unit. ASHP systems have the capacity for single and multi-zoning.	

[25] Certified by the CEC as a heat pump water heater demand management system.

Unit Type	Description	Example Image
Ductless Mini-Split Heat Pump	A ductless mini-split heat pump is a heating and cooling system that allows for the ability to control temperatures in individual rooms or a combination of rooms. Mini-split systems include a head unit, or multiple head units, that are mounted on an interior wall or ceiling, with an accompanying unit outside. Similar to an ASHP, a mini-split heat pump extracts heat from outdoor air, even in cold weather, and uses that to heat a home. In the summer, it works in reverse transferring the inside heat to the outdoor unit. Because they transfer rather than generate heat (or cold), mini-splits use up to 60% less energy.	

Stakeholder knowledge of all-electric residential building technologies is moderately high, but varies across stakeholder groups, indicating an opportunity for education, training, and possibly technical assistance in this space. Architects and designers reported being the most knowledgeable about all-electric technologies, with 46% reporting being "very" or "extremely" knowledgeable (n=54), followed closely by builders and constructions firms (42%, n=19). While developers reported being less knowledgeable than other stakeholders, this is unsurprising given that developers often consult with design teams to plan projects. Engineering firms reported being the least knowledgeable (21% reported being "not at all knowledgeable"). Figure 16 shows each stakeholder group's reported knowledge of all-electric technologies such as induction cooktops, heat pumps, and HPWHs.

Figure 16. Stakeholder Knowledge of All-Electric Building Technologies by Stakeholder Type



4.3.1 Multifamily All-Electric Design

Stakeholders overwhelmingly agree that installing all-electric technologies is at least somewhat technically feasible across all end uses in multifamily homes. Between 66% and 96% of stakeholders reported all-electric technologies are at least somewhat technically feasible, across equipment types and multifamily market types. The highest rated technology in terms of feasibility for both groups was the electric clothes dryer with 71% of market rate housing stakeholders and 75% of affordable housing stakeholders reporting electric clothes dryers are “very” or “extremely” technically feasible.

Stakeholders reported technologies eligible for BUILD Program kicker incentives are technically feasible in the multifamily market rate and affordable housing market types. Multifamily market rate housing stakeholders reported moderately high levels of technical feasibility for induction cooktops (60% reported being “very” or “extremely” technically feasible), central HPWHs (47%), HPCDs (42%), and individual HPWHs (40%). Multifamily affordable housing stakeholders reported moderately high levels of technical feasibility for induction cooktops (60% reported being “very” or “extremely” technically feasible), individual HPWHs (56%), central HPWHs (45%), and HPCDs (42%).

Perceptions on the technical feasibility of electric technologies in the **multifamily market rate** market are shown in Figure 17.

Perceptions on the technical feasibility of electric technologies in the **multifamily affordable housing** market are shown in Figure 18.

Figure 17. Technical Feasibility of All-Electric Technologies in Multifamily Market Rate Housing

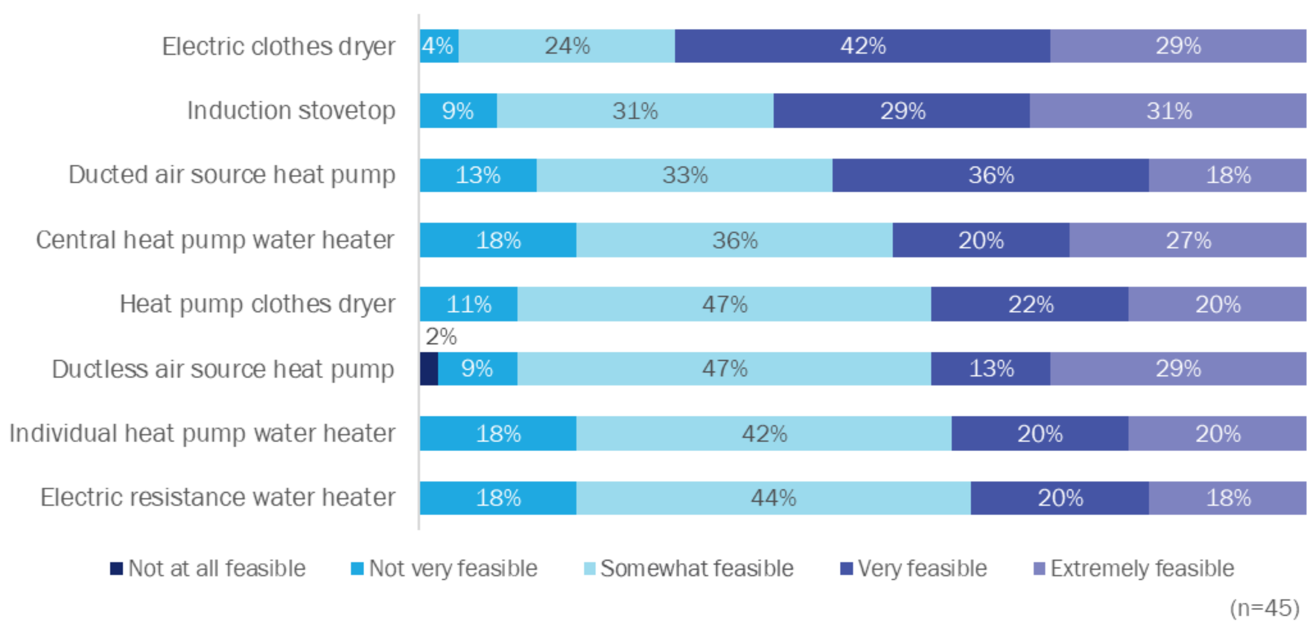
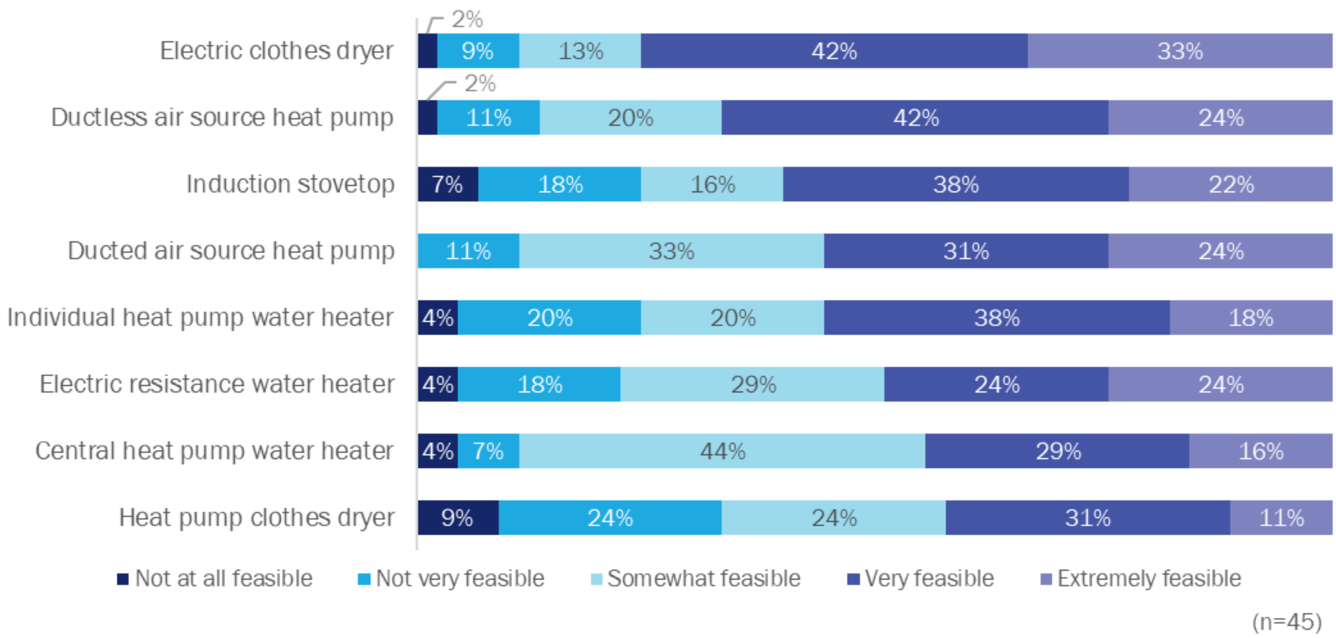


Figure 18. Technical Feasibility of All-Electric Technologies in Multifamily Affordable Housing



While respondents rate the technical feasibility of many electric technologies high, in practice, far fewer recommend electric technologies in their projects. Over half of multifamily market rate stakeholders (60%) reported that induction stovetops were "very" or "extremely" feasible to install. Conversely, 43% of multifamily market rate stakeholders said they never recommend installing them in their new construction projects. This pattern continues with the remaining technologies, as shown in Table 4.

Table 4. Percent of Market Rate Multifamily Stakeholders Who Never Recommend Electric Technologies

Technology	Rated Technology Installation Feasibility as "Very" or "Extremely" Feasible (n=45)	Never Recommend Technology in their Project (n=44)
Electric Clothes Dryer	71%	39%
Induction Stovetop	60%	43%
Ducted Air Source Heat Pump	53%	41%
Central Heat Pump Water Heater	47%	55%
Ductless Air Source Heat Pump	42%	55%
Heat Pump Clothes Dryer	42%	64%
Individual Heat Pump Water Heater	40%	55%
Electric Resistance Water Heater	38%	64%

Similar to multifamily market rate stakeholders, multifamily affordable housing stakeholders reported that all-electric technologies are often "very" or "extremely" feasible, yet there is a high proportion of stakeholders who never recommend these technologies in their projects. Over two-thirds of multifamily affordable housing stakeholders (67%) reported that ductless air source heat pumps were "very" or "extremely" feasible to install.

Conversely, 30% of multifamily affordable housing stakeholders said they never recommend installing them in their new construction projects. This indicates that technical understanding or applicability are likely not the main barriers to increased penetration of these technologies. Potential other barriers are discussed further in section 4.4 below.

Table 5. Percent of Affordable Multifamily Stakeholders Who Never Recommend Electric Technologies

Technology	Rated Technology Installation Feasibility as “Very” or “Extremely” Feasible (n=45)	Never Recommend Technology in their Project (n=43)
Electric Clothes Dryer	76%	37%
Ductless Air Source Heat Pump	67%	30%
Induction Stovetop	60%	53%
Ducted Air Source Heat Pump	56%	33%
Individual Heat Pump Water Heater	56%	42%
Electric Resistance Water Heater	49%	63%
Central Heat Pump Water Heater	44%	37%
Heat Pump Clothes Dryer	42%	65%

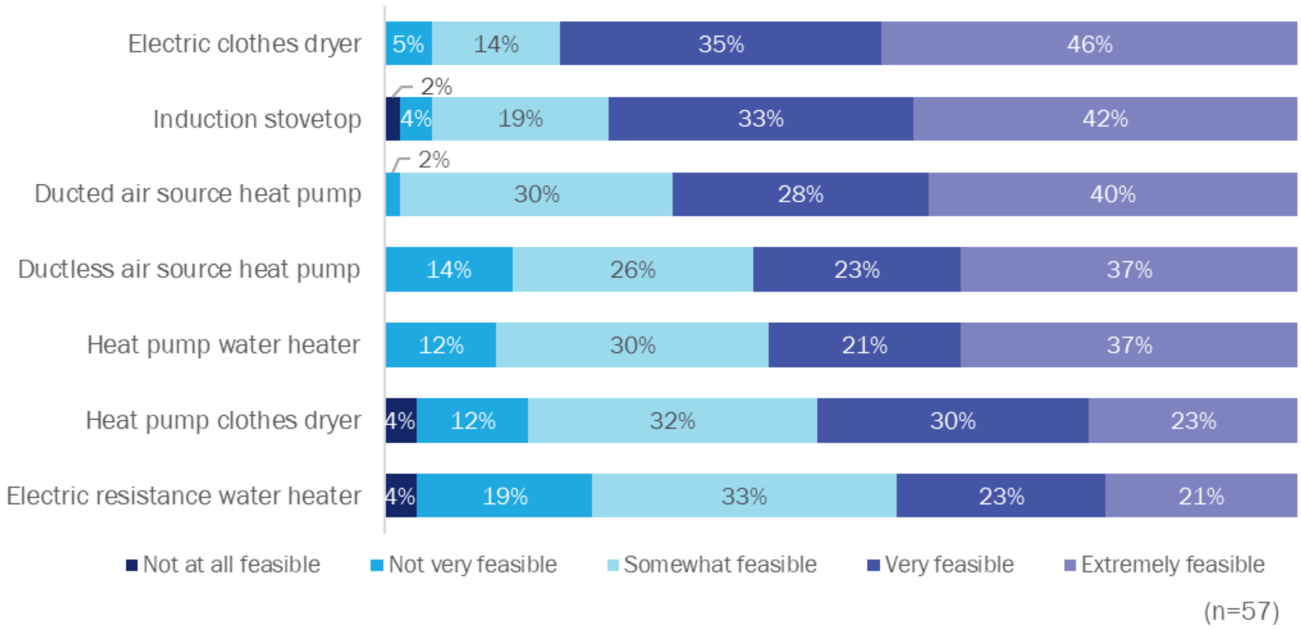
4.3.2 Single Family All-Electric Design

Stakeholders overwhelmingly agree that installing all-electric technologies is at least somewhat technically feasible across all end uses in single family market rate homes. Over 95% of stakeholders reported that installing electric clothes dryers, induction stovetops, and ducted ASHPs were all at least somewhat feasible in single family market rate homes. The least feasible technology in this market were electric resistance water heaters with 23% of stakeholders reporting that they are “not very” or “not at all” feasible to install. Figure 19 summarizes the remaining stakeholder perceptions towards the technical feasibility of various all-electric technologies in single family market rate homes.

In single family market rate housing, stakeholders reported all kicker technologies are technically feasible. Stakeholders report moderately high levels of technical feasibility for induction cooktops (75% reported being “very” or “extremely” technically feasible), HPWHs (58%), and HPCDs (53%).

Perceptions on the technical feasibility of electric technologies in the **single family market rate** market are shown in Figure 19.

Figure 19. Technical Feasibility of All-Electric Technologies in Single Family Market Rate Homes



Few stakeholders reported working in single family affordable housing (n=12); however, sentiments were generally the same when compared to single family market rate stakeholders. One key difference between the two markets is that single family affordable housing respondents felt induction cooktops were far less feasible than those who worked in market rate building. Additionally, single family affordable housing stakeholders felt installing electric resistance water heating was far more feasible than market rate with 67% of stakeholders reporting it being "very" or "extremely" feasible.

Despite reporting that technologies were technically feasible to install, few respondents reported recommending electric technologies in their projects. The starkest contrast can be seen with induction cooktops in which over 80% of respondents rated the technology as "very" or "extremely" feasible to install technically; however, 42% also said they never recommend installing them in their projects. This trend is similar among all other technologies, as shown in Table 6.

Table 6. Percent of Single Family Market Rate Stakeholders Who Never Recommend Electric Technologies

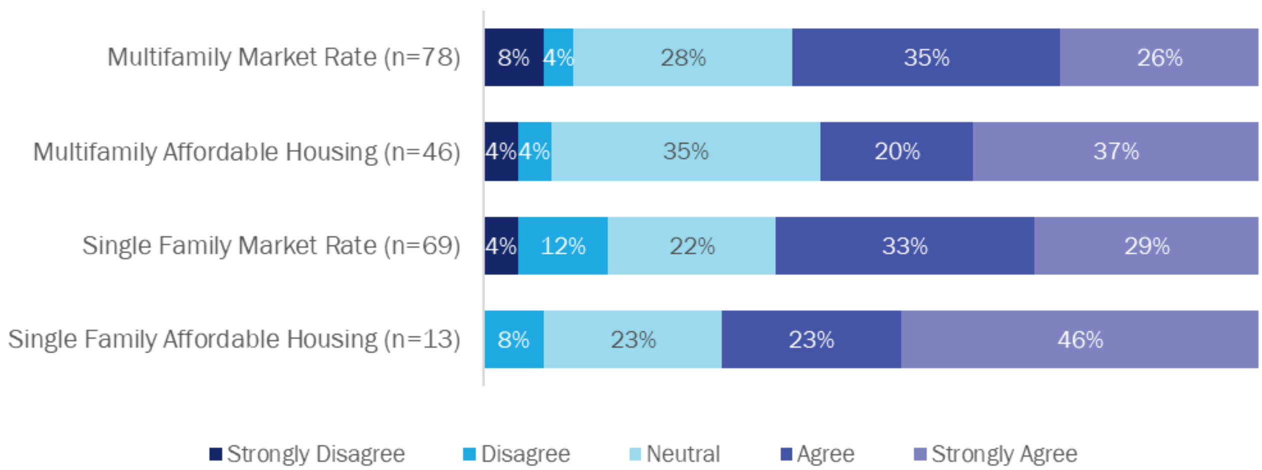
Technology	Rated Technology Installation Feasibility as "Very" or "Extremely" Feasible (n=57)	Never Recommend Technology in their Project (n=53)
Induction Stovetop	81%	42%
Electric Clothes Dryer	75%	28%
Ducted Air Source Heat Pump	68%	32%
Ductless Air Source Heat Pump	60%	42%
Heat Pump Clothes Dryer	58%	32%
Heat Pump Water Heater	53%	66%
Electric Resistance Water Heater	44%	72%

4.4 Practicality of High Efficiency All-Electric Design

Stakeholders generally agreed that the construction of high efficiency all-electric homes across each market type is practical today.

Over half of multifamily affordable housing stakeholders (57%) felt building all-electric is practical Most stakeholders in the single family affordable housing market (69%) “agree” or “strongly agree” that high efficiency all-electric design is practical in the single family market. However, more than one-fifth of respondents in each category were also neutral as to whether building all-electric was practical today, indicating there is still hesitancy among stakeholders when it comes to the practicality of building all-electric (Figure 20).

Figure 20. Practicality of All-Electric New Construction by Housing Type [a]



[a] The n sizes in this chart vary from previous charts because stakeholders were displayed response options to every market in which they reported working. In the previous section, stakeholders were only shown the market in which they primarily work (affordable or market rate).

Stakeholders indicated high efficiency all-electric new construction was least practical in the single family market rate and multifamily market rate markets. In the single family market rate market type, eleven respondents disagreed with the statement that high efficiency all-electric construction was practical. Respondents mentioned that client preference for gas, particularly for cooking (6 of 11), limitations of electric water heaters, including cost to install as well as ability to meet water use demand (4 of 11), and higher upfront cost relative to a dual-fuel home (3 of 11) as barriers that made building all-electric not practical. One quote from a single family builder on this subject is highlighted below:

> *"The main concern her[e] is electric cooking. Our homebuyers today overwhelmingly demand gas cooktops, so taking this away will be a big challenge. Also, there is definitely a cost premium to switch to electric products for HVAC, DHW, and cooking."*

In the multifamily market rate market, of the ten respondents who disagreed with the statement that high efficiency all-electric construction was practical in this market type, most mentioned higher upfront cost relative to a dual-fuel home (4 of 10), concern regarding the electrical grid's ability to handle the increased load (3 of 10), and the impact on tenants' bills (3 of 10) as barriers that made building all-electric not practical. A quote from a multifamily developer is highlighted below:

> *"The local electric grids cannot support an increase in electric demands. In addition, it substantially increases the cost of housing due to increased monthly utility cost. While an electric policy appears a great aspiration, at this point it is highly infeasible due to lack of infrastructure and the current housing affordability crisis.*

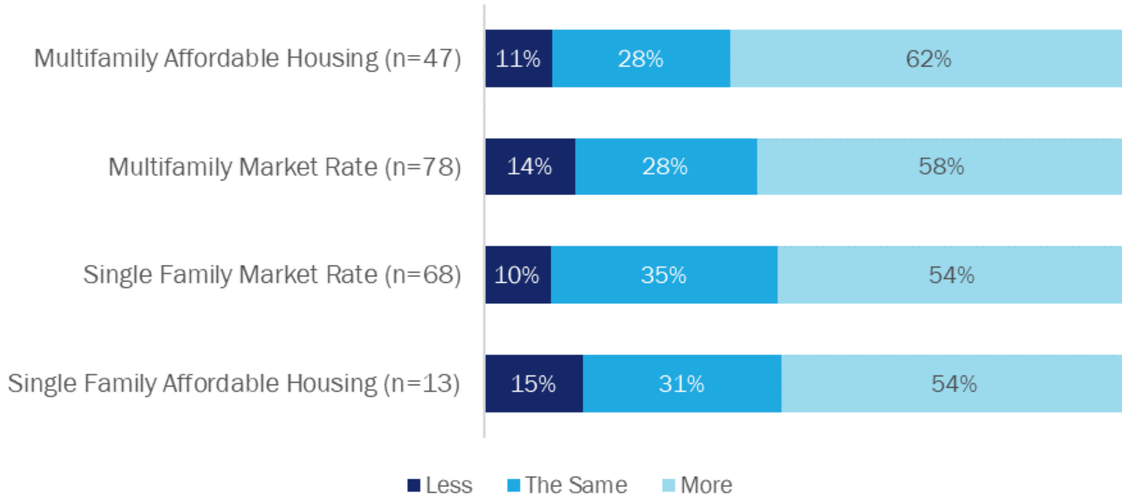
4.5 Project Costs & Incentives

In the following sections we summarize stakeholder perspective on the cost of building all-electric and their awareness and usage of available funding opportunities.

4.5.1 Project Costs

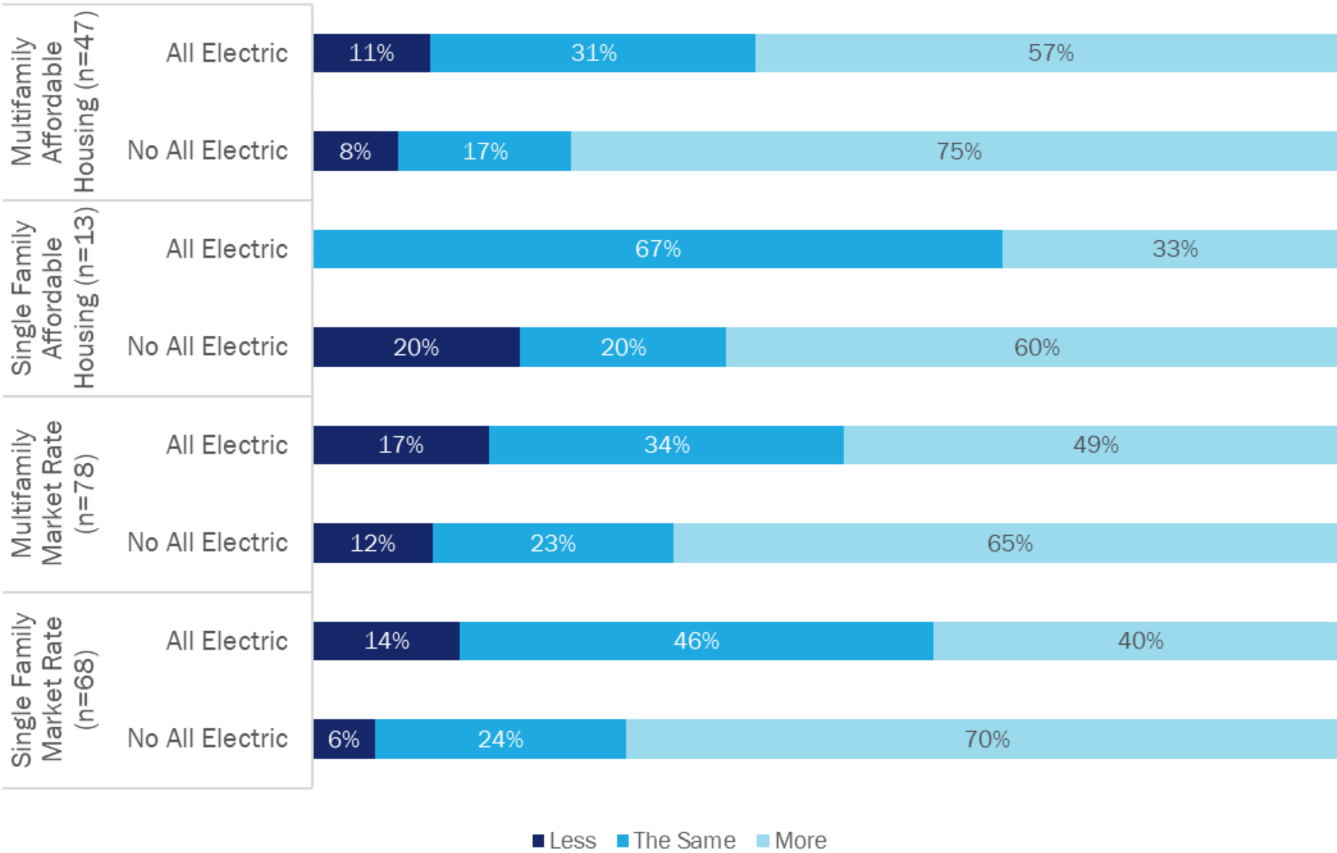
The majority of stakeholders across market types felt building high efficiency all-electric housing is more expensive than building dual-fuel housing. Within each market type, more than 50% of stakeholders claimed the construction of high efficiency all-electric buildings was more expensive than dual-fuel, ranging from 62% in the multifamily affordable housing type to 54% of the single family market rate and single family affordable housing market types (Figure 21).

Figure 21. Cost to Build High Efficiency All-Electric Compared to Dual Fuel



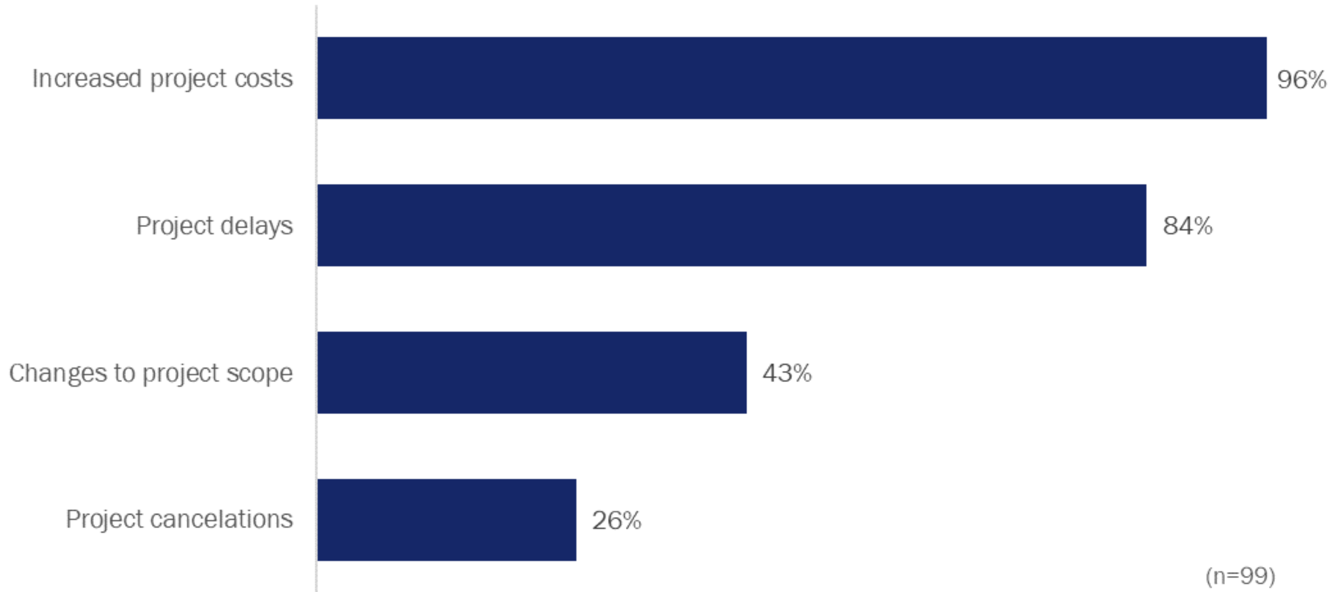
Stakeholders with experience with all-electric new construction were less likely to report high efficiency all-electric new construction is more expensive than dual-fuel construction. Within all market types, the proportion of respondents who indicated high efficiency all-electric new construction costs more than dual-fuel construction was lower among those with experience building all-electric compared to those with no experience. Figure 22 shows the breakdown of responses to this question by market type and by self-reported all-electric experience.

Figure 22. Cost to Build High Efficiency All-Electric Compared to Dual Fuel, by All-Electric Experience



Stakeholders also reported recent supply chain issues, including labor and material shortages, have heavily impacted their new construction projects by increasing costs and delaying projects. Almost three-quarters of respondents reported these impacts have affected their projects "a lot" or "a great deal" (70%, n=102). Among stakeholders who have been impacted by supply chain issues at all (n=99), almost all reported the primary impacts of supply chain shortages has been increased project costs (96%) and delays (84%) as shown in Figure 23.

Figure 23. Impacts of Supply-Side Constraints



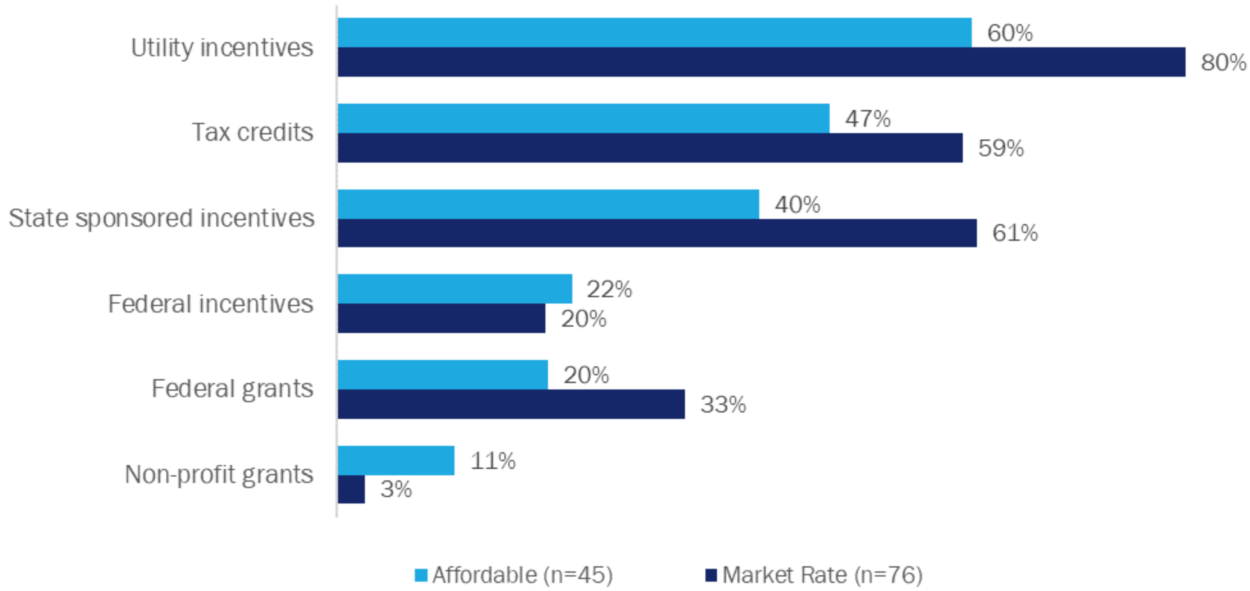
4.5.2 Incentives

Stakeholders are generally aware of incentive programs and believe all-electric buildings often qualify for incentives. Almost two-thirds of respondents (65%) were knowledgeable of at least one type of incentive program; however, 36% of respondents were unaware of any kind of incentive programs. This is consistent with the Heat Pump Market Characterization and Baseline Study which showed that majority of new construction market actors[26] (20 of 26; 77%) were aware of new construction incentive programs however far fewer were aware of incentive programs available for heat pumps specifically (4 of 26; 15%).

The most common incentive programs mentioned for all-electric new construction were utility incentives, followed by tax credits and then state-sponsored incentive programs (Figure 24).

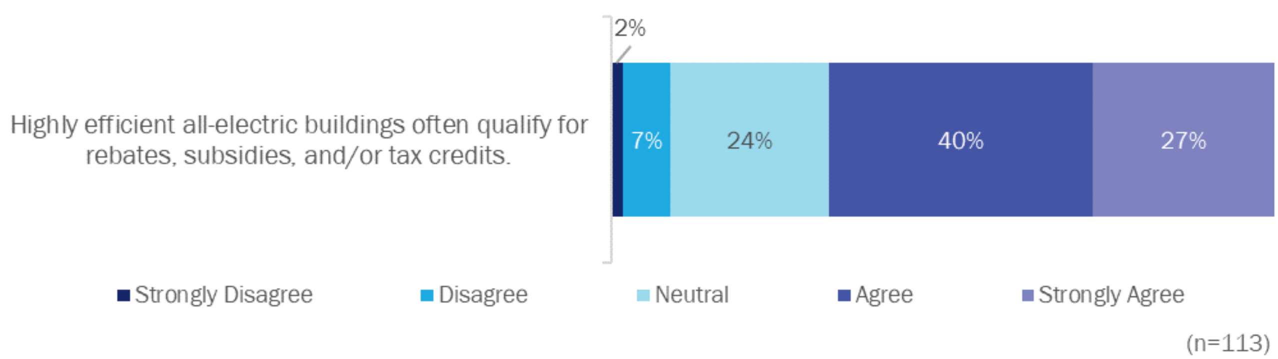
[26] In the Heat Pump Residential Market Characterization and Baseline Study Market actors included architects, engineers, builders, consultants, housing authority staff, local government staff, general contractors, and developers.

Figure 24. Stakeholder Knowledge of All-Electric New Construction Funding Opportunities



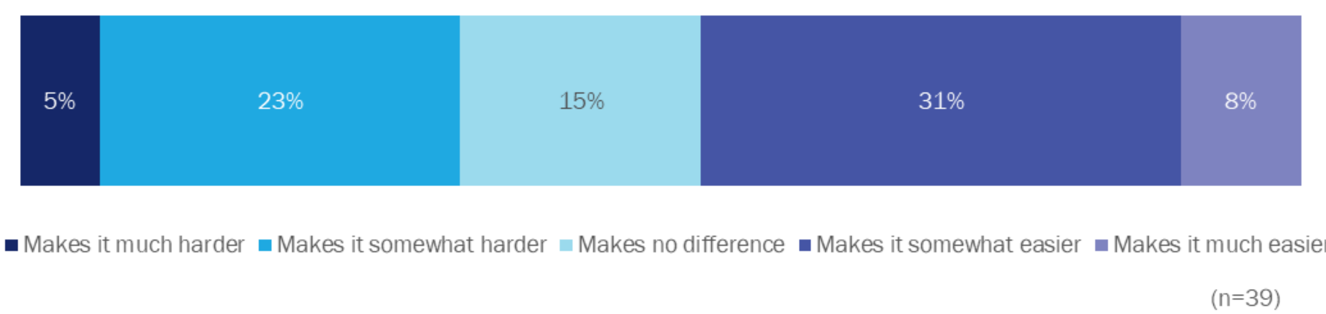
Most stakeholders agree high efficiency all-electric homes often qualify for incentives and rebates. Over two-thirds of stakeholders (67%) either "agreed" or "strongly agreed" that highly efficient all-electric buildings often qualify for rebates, subsidies, and/or tax credits, as shown in Figure 25.

Figure 25. Stakeholder Sentiments Towards All-Electric Building Incentives and Rebates



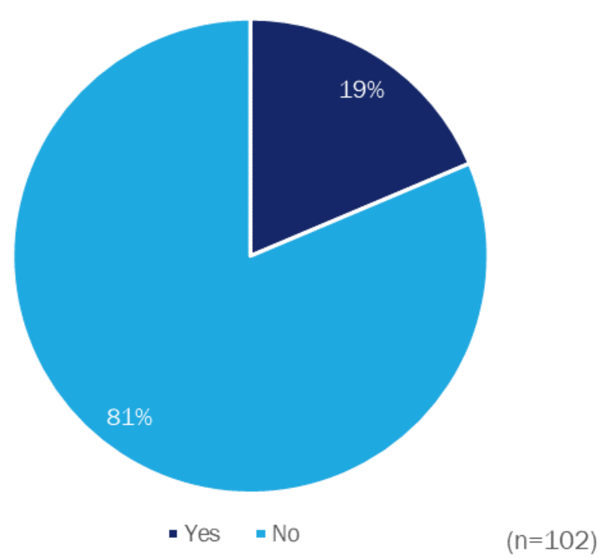
Affordable housing stakeholders had mixed views about whether building all-electric made it harder or easier to apply for affordable housing financing and tax credits. Almost two-fifths (39%) of respondents with experience in the affordable housing market reported building all-electric affordable housing makes it somewhat or much easier to receive a LIHTC, qualify for the California Tax Credit Allocation Committee (TCAC), or qualify for the California Debt Limit Allocation Committee (CDLAC). This finding is supported by the Heat Pump Market Characterization and Baseline Study, in which stakeholders reported that keeping highly efficient electric technologies in their designs allows them to qualify for low-income housing tax credits, makes their proposals more attractive. Conversely, 28% reported it would be somewhat or much harder to receive these credits when building all-electric. Stakeholders who reported building all-electric would make accessing these programs harder generally cited increased construction costs as the primary driving factor.

Figure 26. Impact of All-Electric Design on Access to Financing and Tax Credits



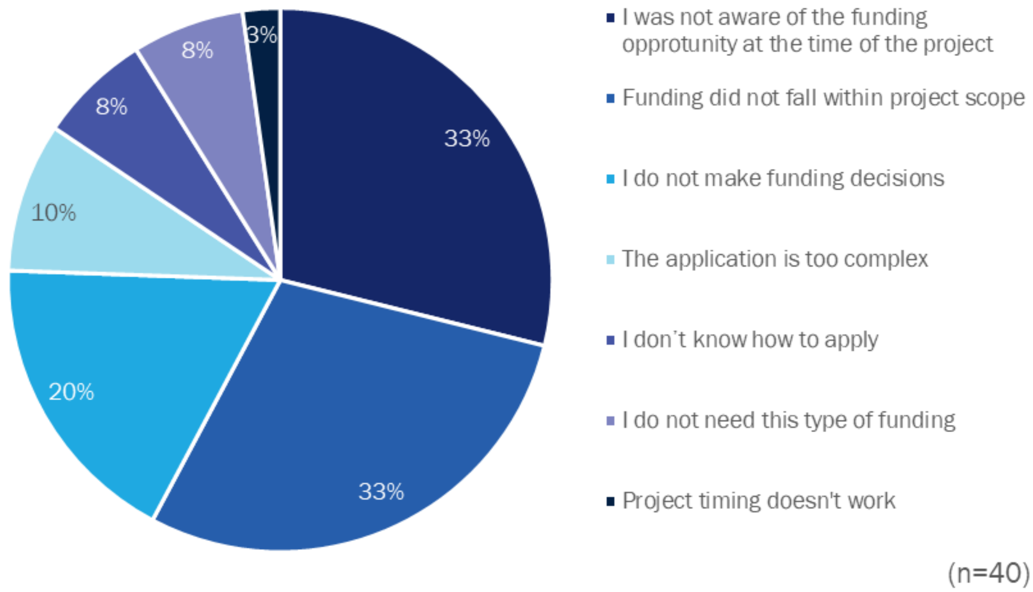
The vast majority of respondents were unaware of the BUILD Program (81%). While almost half of respondents indicated interest in participating in the BUILD Program (48%), almost one-third (29%) were unsure if they were interested in participating and one-fifth said they were not interested (20%). A very small minority reported they had already begun participating in the BUILD Program (3%).

Figure 27. Awareness of BUILD Program



Among stakeholders who reported being aware of various funding opportunities, only half reported taking advantage of them (49%). One-third of respondents who were aware of incentive programs but have not applied for any stated they have not worked on a project that would qualify. Another one-fifth of respondents mentioned they lacked decision-making authority.

Figure 28. Reasons for Not Applying to Funding Opportunities



4.6 Technical Assistance & Training

Technical assistance is a key component of the BUILD Program. The BUILD Program will "provide support to the developers, architects, engineers, energy consultants and staff of an eligible applicant prior to and throughout the BUILD participation process."[27]

In the following sections we summarize stakeholder awareness and usage of available technical assistance and training opportunities, as well as stakeholder recommendations on potential technical assistance topics.

4.6.1 Technical Assistance

The majority of stakeholders reported having prior experience with technical assistance and the vast majority would take advantage of technical assistance in the future. Almost two-thirds of respondents (64%) reported they had taken advantage of technical assistance in the past. Respondents were most likely to report they would take advantage of technical assistance depending on the cost (52%) or only if it were free (42%). Only 6% of stakeholders reported they do not need any kind of technical assistance on their projects.

Those who mentioned that they were interested in taking advantage of technical assistance reported interest in a wide array of topics (Table 7). Most commonly, respondents mentioned they would be interested in receiving technical assistance to support comparative cost analyses of all-electric equipment (69%), support

[27] BUILD Program Guidelines, First Edition. https://www.energy.ca.gov/publications/2021/building-initiative-low-emissions-development-build-program-1st-edition

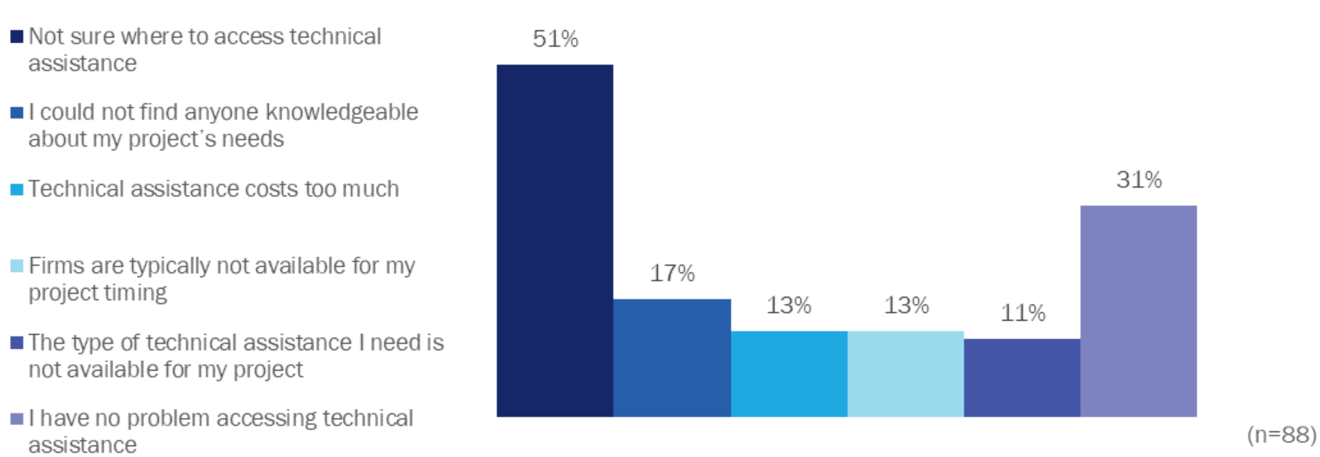
navigating incentive, financing, and other funding opportunities (68%), and support with code compliance and permitting (66%). Similarly, in the Heat Pump Market Characterization and Baseline Study, respondents commonly reported a need for additional support with heat pump system design, how to model these systems for energy code compliance, and comparative cost analyses.

Table 7. Types of Technical Assistance Requested by Stakeholders

Technical Assistance	Percent of Stakeholders (n=93)
Comparative Cost Analyses for All-Electric Equipment Choices	69%
Introduction To Sources of Incentives, Financing, and Other Funding Opportunities	68%
Code Compliance and Permitting	66%
General All-Electric Building Design	62%
All-Electric HVAC System Design	58%
All-Electric Water Heating System Design	53%
Help Completing the Application Process for Receiving Incentives	51%

There is a desire for technical assistance among new construction stakeholders; however, most do not know where to seek it out. Among interested stakeholders, the most common barrier to technical assistance was a lack of awareness on where to access it (51%). Comparatively, just under one-third of stakeholders (31%) reported they had no problem accessing technical assistance (Figure 29).

Figure 29. Barriers to Accessing Technical Assistance.

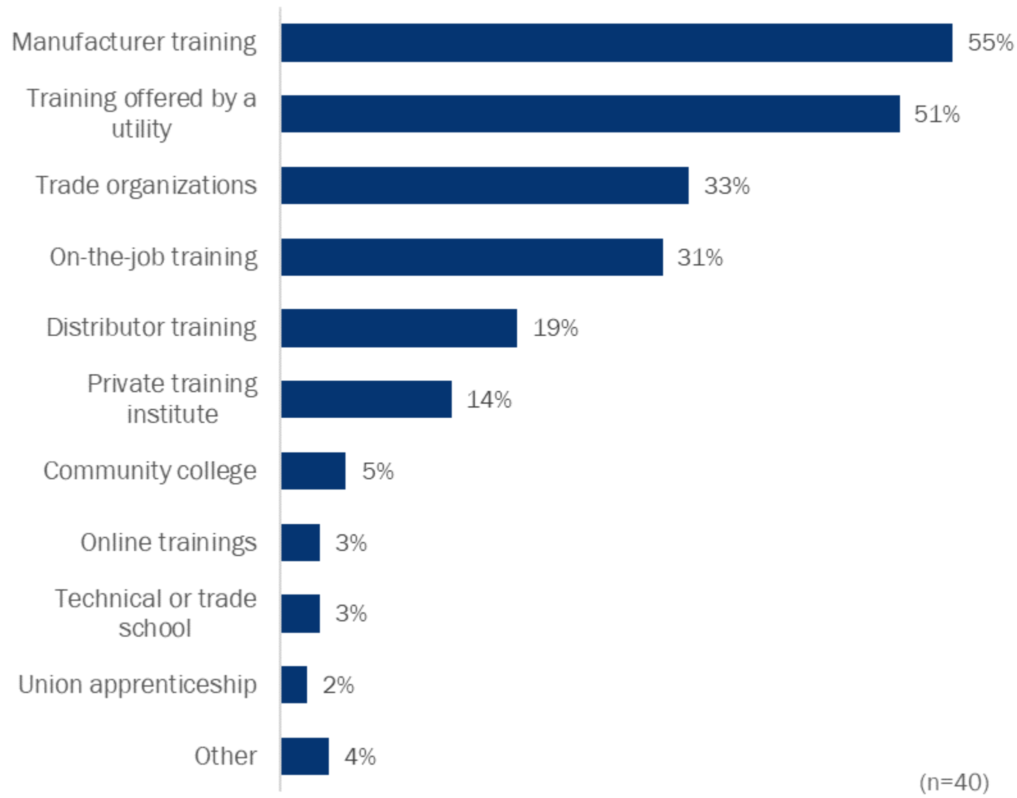


4.6.2 Training

Most surveyed stakeholders reported never receiving training on all-electric building design. Just over one-third of respondents (39%) reported receiving such training or technical assistance. Of those who mentioned they had participated in all-electric building design training (n=40), the majority reported the trainings were offered by a utility (43%), a trade organization (38%), or a manufacturer (30%). Many of these stakeholders reported being trained on the job as well (43%).

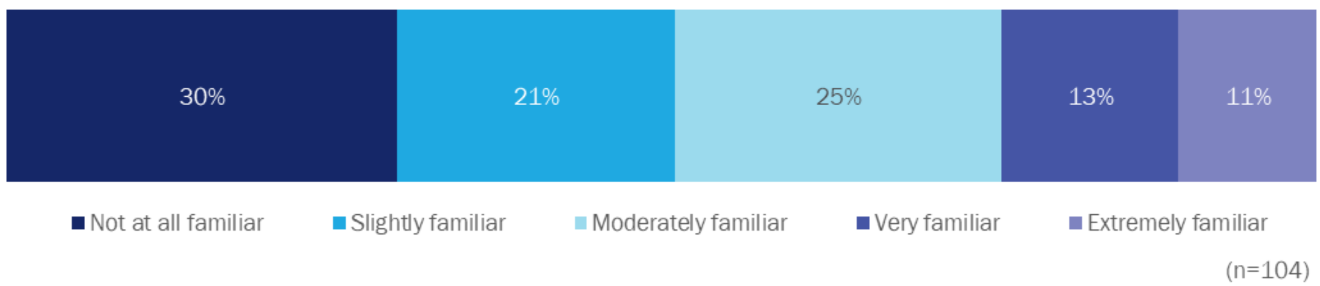
Similarly, most stakeholders would prefer to receive training and technical assistance on all-electric building design from a manufacturer (55%) or a utility (51%). Figure 30 shows from whom stakeholders prefer to receive trainings on all-electric design.

Figure 30. Stakeholder's Training Preferences of All-Electric Design



Most surveyed stakeholders reported never receiving training on reach codes or all-electric building codes. Only 17% of stakeholders reported receiving such training, but 14% of stakeholders were unsure if they had received training. Overall, 24% of stakeholders reported being "very" or "extremely" familiar with these codes as shown in Figure 31. On the other hand, 41% of stakeholders reported they have worked on a team that built a residential new construction project in a jurisdiction with reach codes, and of this group, just under one-half (42%) reported being "very" or "extremely" familiar with these codes (n=43). Training on all-electric building and reach codes will become increasingly important as more jurisdictions adopt these codes.

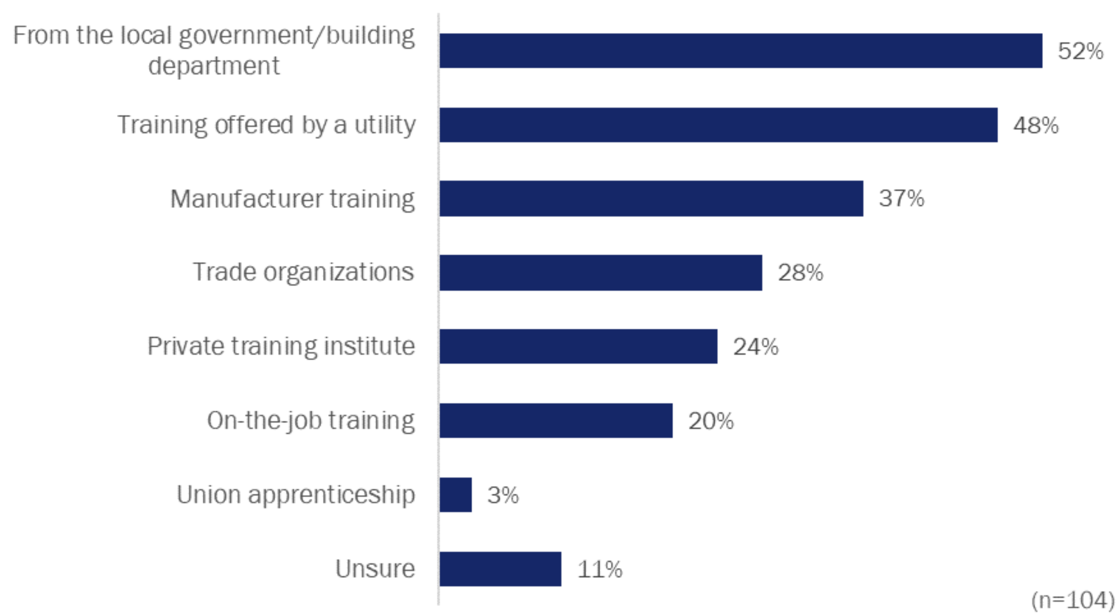
Figure 31. All-Electric Reach Code Familiarity



Of those who mentioned that they had participated in all-electric or reach code training (n=18), the majority reported receiving it from the local government and or building department (50%). Other common sources of technical assistance included trade organizations (33%), trainings from private institutions (17%), trainings offered by a utility (17%), and manufacturer trainings (17%). Many of these stakeholders reported being trained on the job as well (39%).

Most stakeholders would prefer to receive training on all-electric and reach codes from the local government and/or building department or from a utility. Similarly, market actors in the Heat Pump Market Characterization and Baseline Study also reported that local building departments are a good source of information for builders to learn about reach codes. Figure 32 below shows from whom stakeholders prefer to receive trainings on reach and all-electric building codes.

Figure 32. Stakeholder's Training Preferences of All-Electric and Reach Codes



5. Workforce Trends

Increasing employment opportunities in the building decarbonization space is a potential outcome of the BUILD Program. In the following sections we summarize the current state of the residential new construction workforce in California and the prevalence of contractor licenses relevant to the installation of all-electric technologies.

5.1 Residential New Construction Workforce

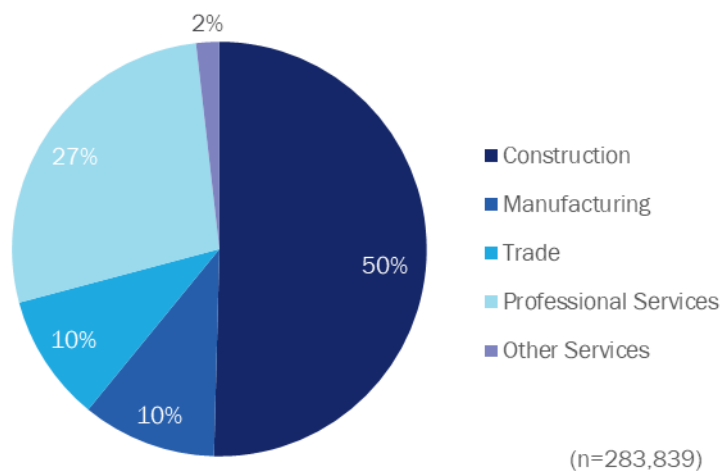
Increasing interest and demand to build all-electric residential buildings in California will require the new construction workforce to adapt and potentially grow over the next decade. A key barrier to building all-electric housing is a lack of skilled workforce available to install heat pumps, which play an integral part of all-electric buildings.[28] In this section we characterize the residential new construction workforce in California, overall and with a focus on energy efficiency–related jobs, and we summarize the status of contractors with the relevant licenses to support building decarbonization.

According to one estimate, approximately 640,000 Californians worked in residential new construction in 2019,[29] accounting for 3.3% of the state's employed labor force (compared to 2.8% nationally). The overall construction industry in California, including commercial new construction, grew 3.5% between March 2021 and March 2022.[30]

According to USEER,[31] California employed just over 275,000 people in energy efficiency jobs in 2020.[32] This represents a 12.3% decrease relative to 2019. Jobs in the construction industry made up the majority of energy efficiency jobs in California (50%, or just under 150,000 jobs) (Figure 33).

[28] Opinion Dynamics, "Opinion Dynamics CPUC Heat Pump Market Study Report" (California Public Utilities Commission, May 13, 2022).
[29] This estimate only includes workers directly employed by the industry and excludes jobs in related industries (such as design and architecture, furniture, making, building materials, landscaping, etc.).
[30] Home Builders Institute, "Spring 2022 HBI Construction Labor Market Report" (Home Builders Institute, June 2022).
[31] BW Research Partnership and MG Strategy & Design, "United States Energy & Employment 2021 State Reports" (Department of Energy, 2020).
[32] As defined by USEER, the energy efficiency workforce includes the manufacture of ENERGY STAR–labeled products, and building design and contracting services that provide insulation, improve natural lighting, and reduce overall energy consumption across homes and businesses.

Figure 33. Energy Efficiency Employment by Industry



5.2 Trade Ally Market

All businesses or individuals who construct or alter any building, highway, road, parking facility railroad, excavation, or other structure in California must be licensed by the CSLB if the total cost (labor and materials) of one or more contracts on the project is $500 or more. Licenses are issued to individuals, partnerships, corporations, joint ventures, and limited liability companies (LLCs). Each license requires a "qualifying individual" who must undergo a background check and meet experience and exam requirements. In addition, the licensee must submit documentation to prove they meet insurance and bond requirements. CSLB licenses are separated into three classifications: Class A (General Engineering Contractor), Class B (General Building Contractor), and Class C (Specialty Contractor). Within the Class C license classification, there are 42 Class C licenses for work that requires specialized skills. For example, installing HVAC heat pumps, HPWHs, and solar photovoltaic requires specific knowledge and a Class C license.

Depending on specific circumstances, the relevant licenses for building an all-electric new construction residential building could include a B-General Building Contractor license, a C-20 HVAC license, a C-36 Plumbing license, a C-46 Solar Contractor license, a D-34 Prefabricated Equipment license, and a C-10 Electrical license.

There were 139,337 contractors with at least one of the relevant licenses in California in 2021. A summary of the number of licensed contractors by license type is shown in Table 8. Please note that some contractors hold more than one license and are represented multiple times in the table. Contractors with Class B licenses outnumber the other licenses.

Table 8. Count of Licensed Contractors in California in 2021

Classification	Number of Contractors with Active License [a]
C-10 Electrical	25,013
C-20 HVAC	12,316
C-36 Plumbing	15,795

Classification	Number of Contractors with Active License [a]
D-34 Prefabricated Equipment	1,226
C-46 Solar Contractor	1,216
B General Building	99,222
Total (unique)	**139,337**

Source: State of California. "List by Classification." Contractors State License Board: Public Data Portal. Accessed May 2022. https://www.cslb.ca.gov/onlineservices/dataportal/ListByClassification.

[a] Active in 2021.

Licensed contractors with a business address outside of DACs outnumbered those contractors with a business address inside of DACs (Table 9). Overall, only 16% of licensed contractors have a business address within a DACs, which is also fairly consistent by license type. Again, please note that contractors with more than one license type are represented more than once.

Table 9. Count of Licensed Contractors by DAC Classification

Classification	Contractors outside of DACs	Contractors in DACs	Total	Contractors outside of DACs (%)	Contractors in DACs (%)
C-10 Electrical	20,301	4,712	25,013	81%	19%
C-20 HVAC	9,592	2,724	12,316	78%	22%
C-36 Plumbing	12,630	3,165	15,795	80%	20%
D-34 Prefabricated Equipment	962	264	1,226	78%	22%
C-46 Solar Contractor	1,022	194	1,216	84%	16%
B-General Building	84,778	14,444	99,222	85%	15%
Total (Unique)	**117,087**	**22,250**	**139,337**	**84%**	**16%**

6. Conclusion

The BUILD Program is intended to encourage the design and construction of all-electric, energy-efficient buildings by providing incentives for the construction of all-electric residential housing and offering technical assistance to support project planning and educate stakeholders about electric technologies and all-electric building design. The primary goal is to engage with new construction market actors to raise awareness of building decarbonization technologies and encourage them to design, develop, and build all-electric new construction. Based on our research, we offer several key findings and recommendations to ensure the BUILD Program is effective in increasing low-income all-electric new construction in California.

- **Finding: The market for all-electric new construction is still relatively nascent in California.** California added, on average, almost 100,000 housing units per year between 2012 and 2021, but only an estimated 0.5% to 1.5% of single family homes and 7% to 13% of multifamily homes are all-electric.
- **Finding: Affordable housing stakeholders reported having more experience building all-electric buildings compared to market rate stakeholders.** Stakeholder experience with all-electric new construction is comparatively high (66% of respondents overall, n=116), especially in the multifamily affordable housing market (75%, n=48). While most stakeholders reported being at least moderately knowledgeable about all-electric design and construction, less than half reported attending formal training in all-electric design.
  - **Recommendation:** Given that a large percentage of multifamily affordable housing stakeholders already have experience building all-electric, CEC may want to consider adding a second New Adopter Awards that is focused on all-electric high efficiency buildings.
- **Finding: Multifamily stakeholders are generally familiar with high efficiency all-electric design and technologies and see limited technical barriers to their installation.** Most multifamily affordable housing stakeholders felt that building all-electric is practical within this market (57%, n=46). Yet, many stakeholders reported never recommending electric technologies in their projects. Respondents in the multifamily sector who indicated high efficiency all-electric design and technologies were impractical today generally cited concerns about the ability of the electric grid to support additional load (5 of 12), the high upfront costs to build all-electric including costs to build and equipment costs (3 of 12), limitations of electric water heating systems in multifamily applications (3 of 12), and costs of utility bills to residents in all-electric buildings (3 of 12).
  - **Recommendation:** The CEC should address these topics in technical assistance.
- **Finding: Stakeholders surveyed reported that recent supply chain issues, including labor and material shortages, have heavily impacted their new construction projects by increasing project costs and delaying projects.** Affordable housing projects also may be coordinating with a variety of other statewide incentive and rebate programs. One key finding from the Terner Center Report on the Costs of Affordable Housing Production[33] was that developers reported delayed project timelines due to utility delays. LIHTC-imposed deadlines were the main driving factors that increased their costs on LIHTC-funded projects. Construction delays often caused developers to pay contractors overtime to meet these deadlines.
- **Finding: The majority of stakeholders surveyed felt building high efficiency all-electric housing was more expensive than building dual-fuel housing, but the incidence of this sentiment was lower among**

[33] Carolina Reid, Adrian Napolitano, and Beatriz Stambuk-Torres, "The Costs of Affordable Housing Production: Insights from California's 9% Low-Income Housing Tax Credit Program," 2020, 32.

stakeholders with experience building all-electric. Most stakeholders also agreed that high efficiency all-electric homes often qualify for incentives and rebates.

- **Recommendation:** Stakeholders suggested technical assistance should focus on comparative cost analyses for all-electric equipment choices as well as sharing sources of incentives, financing, and other funding opportunities.

- **Finding**: **Few respondents have received training on all-electric or reach codes, and respondents also express interest in technical assistance focused on code compliance and permitting.** Few respondents received training on this topic but showed a preference for receiving this type of technical assistance through utility-sponsored programs and local government or building departments.
  - **Recommendation:** The CEC should consider leveraging the relationships with local governments they are cultivating through their education and outreach. Local governments are trusted sources of information on building codes and the program could leverage their existing relationships with market actors to increase participation in code-related trainings and technical assistance.
- **Finding**: **Stakeholders were overwhelmingly interested in receiving technical assistance,** although a significant portion were only interested if the technical assistance is free. The lack of awareness of where to access technical assistance is the largest barrier (51% of those interested in technical assistance, n=88) to stakeholders taking advantage of such resources.
  - **Recommendation:** BUILD E&O should focus on the availability of free technical assistance to help increase participation.

Appendix A. Market Size by Climate Zone and Zip Code

Figure 34. Distribution of 2021 New Construction Units by Climate Zone

	Count			Percent		
Climate Zone	Single Family	Multifamily (2–4)	Multifamily (5+)	Single Family	Multifamily (2–4)	Multifamily (5+)
1	211	13	41	<1%	<1%	<1%
2	1,086	70	1,276	2%	2%	3%
3	2,438	255	7,488	4%	6%	15%
4	2,198	92	3,087	3%	2%	6%
5	414	82	196	1%	2%	<1%
6	1,877	444	2,237	3%	10%	5%
7	1,531	308	5,014	2%	7%	10%
8	3,545	688	6,612	5%	15%	14%
9	3,903	1,111	8,983	6%	24%	18%
10	6,776	393	3,630	10%	9%	7%
11	4,726	129	960	7%	3%	2%
12	11,720	198	4,874	18%	4%	10%
13	6,216	154	680	10%	3%	1%
14	2,173	15	827	3%	<1%	2%
15	2,434	26	307	4%	1%	1%
16	392	23	27	1%	<1%	<1%
Unknown	13,381	576	2,454	21%	13%	5%
Total	**65,022**	**4,576**	**48,692**	**100%**	**100%**	**100%**

Figure 35. Distribution of 2021 Single Family New Construction Units by Zip Code

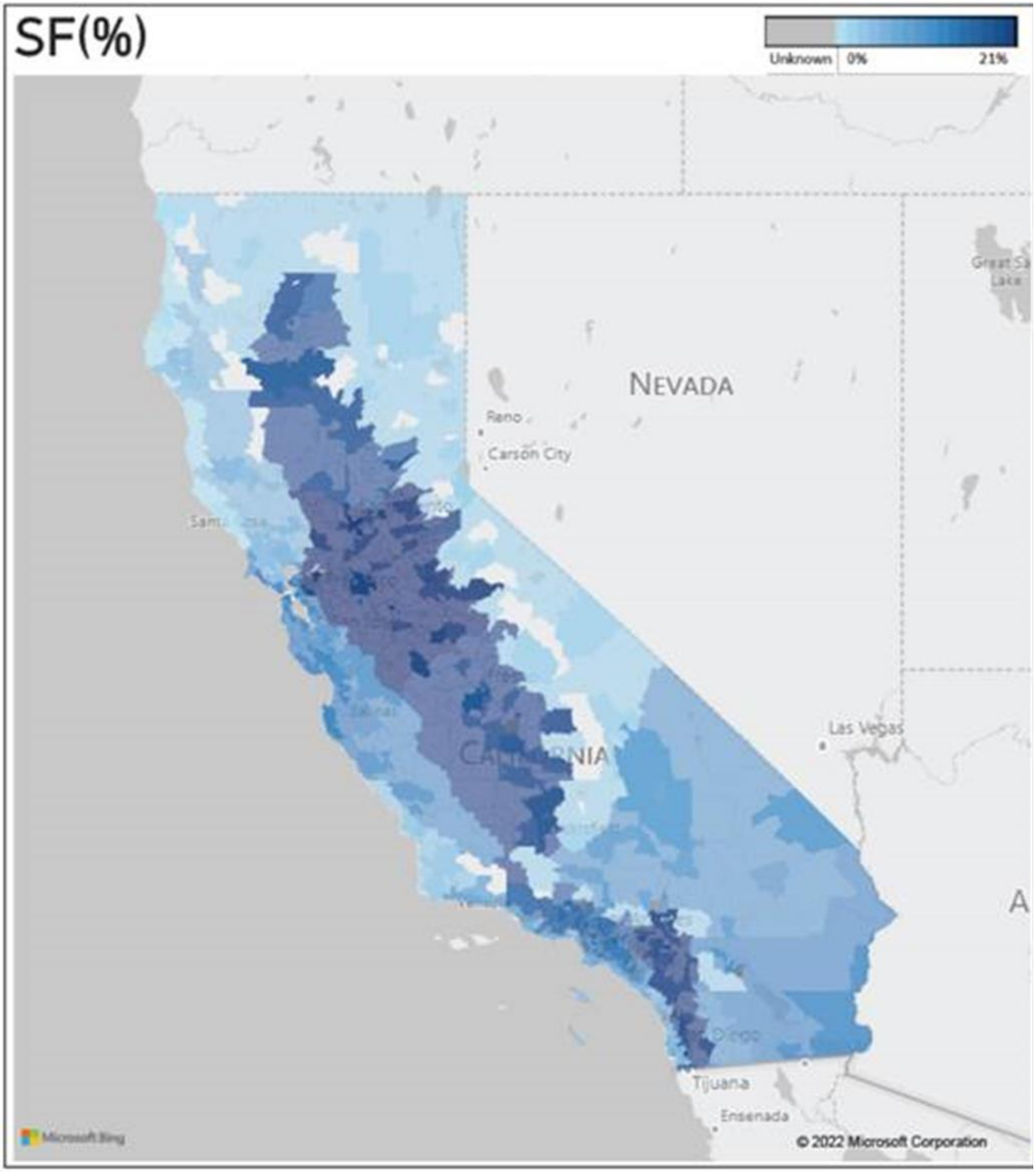


Figure 36. Distribution of 2021 Small Multifamily New Construction Units by Zip Code

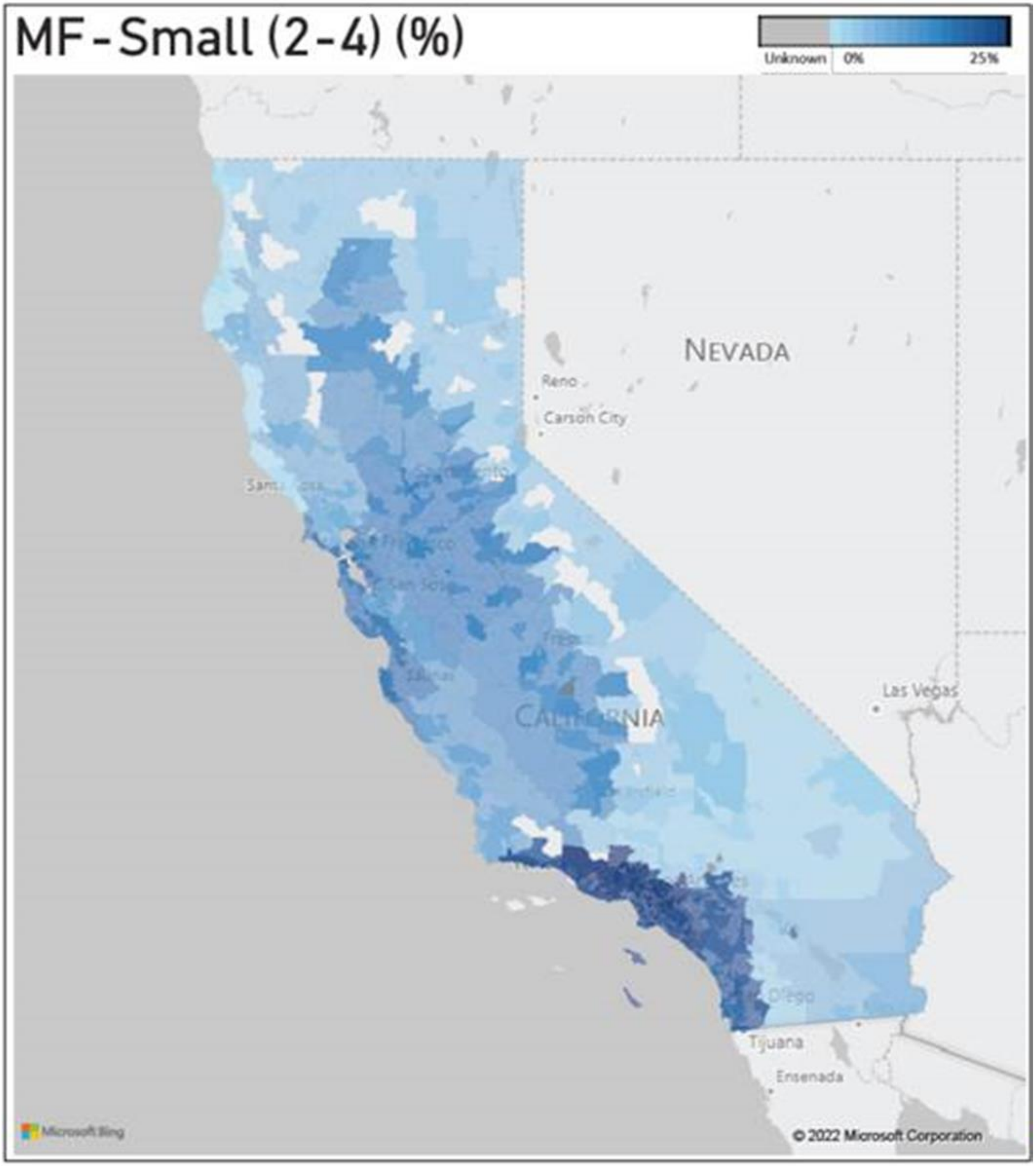
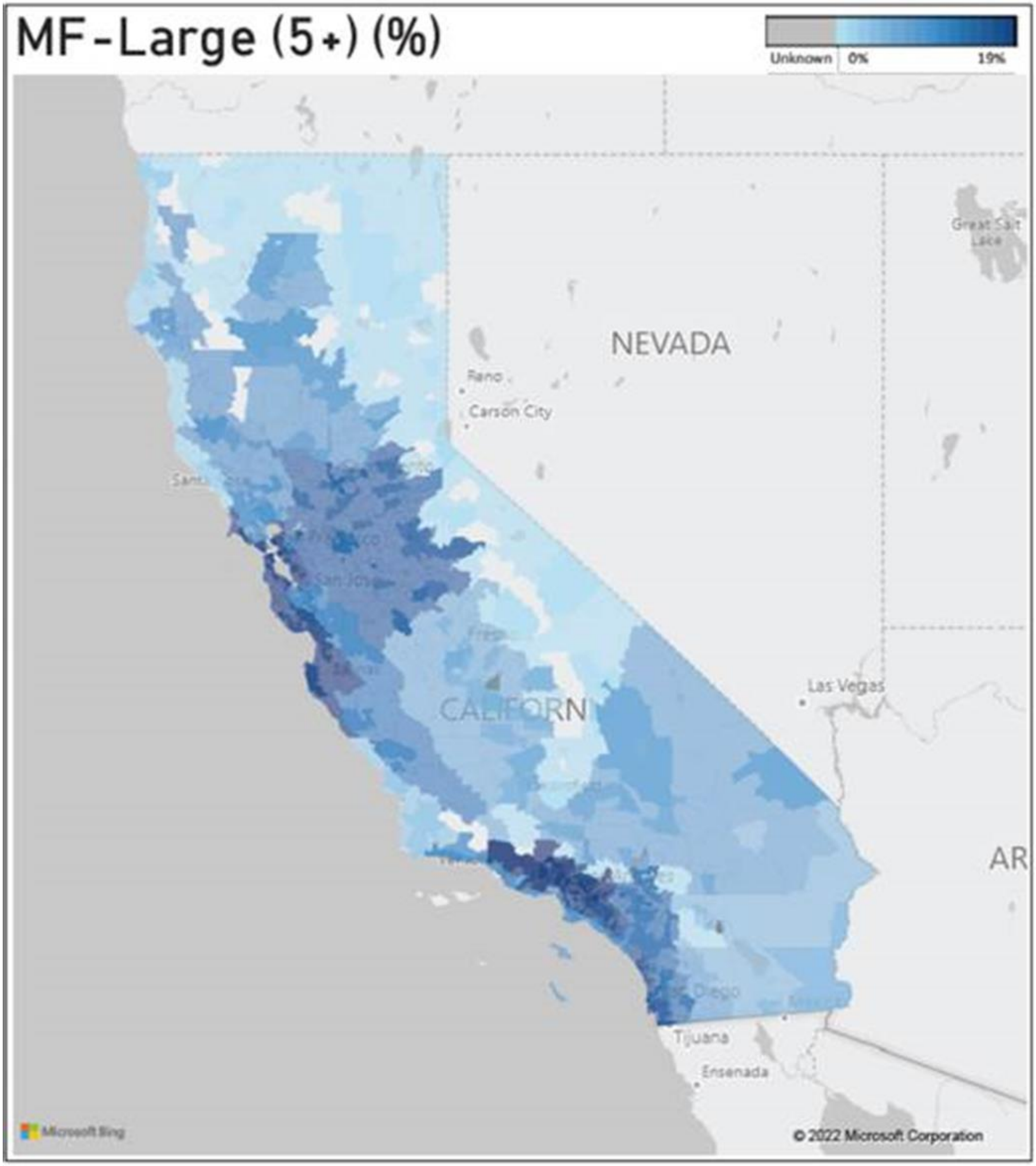


Figure 37. Distribution of 2021 Large Multifamily New Construction Units by Zip Code



Appendix B. Data Collection Instrument

CPUC BUILD
Stakeholder Survey

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