

Stakeholder Assessment of All-Electric Residential New Construction

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**BUILDING
DECARBONIZATION
COALITION**

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The Building Decarbonization Coalition is a 501(c)(3) nonprofit organization whose mission is to convene the stakeholders necessary to drive the conversation around building decarbonization at the state level. The Coalition brings together industry, advocacy, government experts, and the private sector to develop integrated and effective approaches to make decarbonization a reality. A list of members can be found here: www.buildingdecarb.org/members.

TRC completed this assessment on behalf of the Building Decarbonization Coalition.

Background & Objectives

Background

The residential new construction (RNC) market sector offers a significant opportunity for electrification through the design and construction of all-electric homes. Constructing all-electric homes, for much of the RNC market, would require changes to current construction practices and customer acceptance. Accordingly, the Building Decarbonization Coalition (BDC) identified the need for a deeper understanding of the RNC market's perception of, or concerns with, all-electric new construction, with the goal of determining any programmatic and/or regulatory interventions that might help to mitigate these concerns.

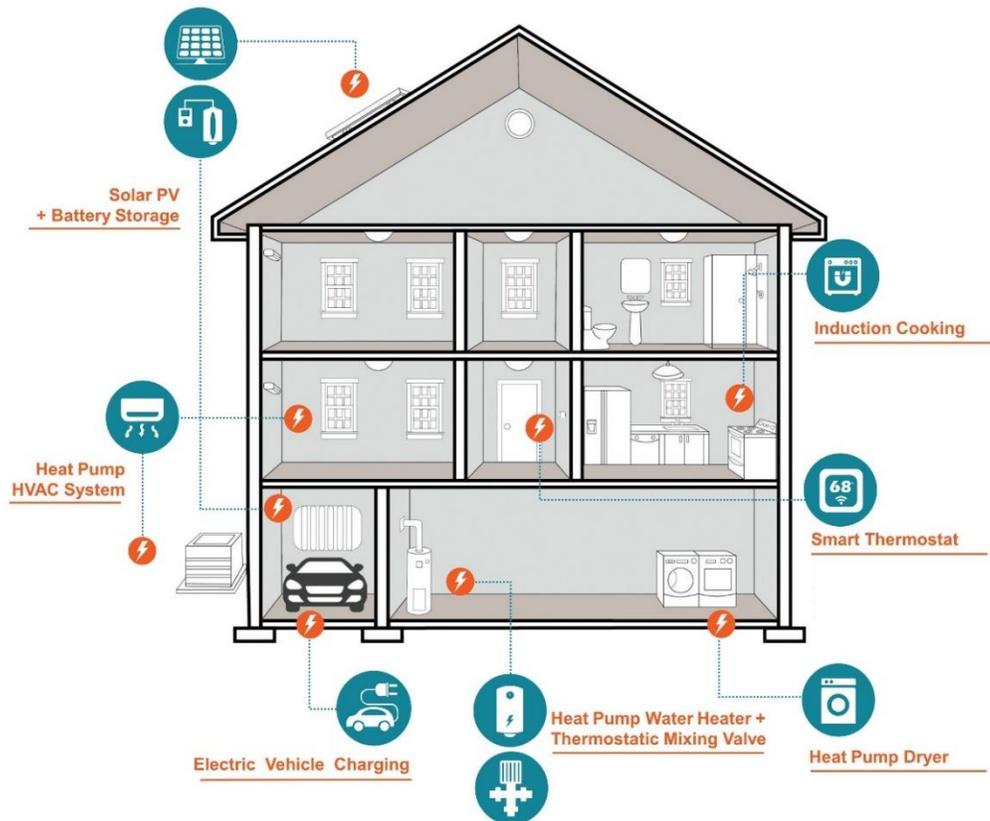


Figure 1: Recommended All-Electric Home Advanced Technologies

Objectives

On behalf of the BDC, TRC surveyed RNC stakeholders, focusing on residential builders and energy consultants throughout California. TRC designed the survey questionnaire and interview process to answer the following research questions:

- **Perspective on and experience with all-electric construction**
 - Do you have previous experience with all-electric design and construction?
 - What are builders' perceived barriers to all-electric construction?
 - Are builders open to construction of all-electric homes in the current market?
- **Regulatory and programmatic needs for adoption of all-electric construction**
 - What regulatory changes, both state and/or local, would influence the decision to construct all-electric homes?
 - What programmatic interventions would make a builder more likely to construct all-electric homes?
 - How could all-electric construction compliance issues be rectified?
- **Availability of and familiarity with all-electric systems**
 - Do builders understand the benefits of electric heating, hot water systems, and induction cooking?
 - Are the contractors installing the equipment familiar with the installation of all-electric appliances and mechanical components?

This report summarizes the interview responses collected and identifies the challenges perceived by builders and energy consultants when moving from typical split commodity (natural gas and electric) construction practices to all-electric. The results cover:

- Builders' current perception of, and attitude towards, all-electric construction.
- Current market barriers facing the implementation of all-electric construction.
- Compliance issues with all-electric construction.
- Availability of all-electric appliances and mechanical components.

Methodology

Overview of Survey Respondents

Respondents were representatives of RNC builders and energy consultants (i.e. California Title 24 HERS raters, architects, and designers) actively engaged in constructing new single-family detached, attached, and multifamily residential buildings. Respondents occupied a variety of roles within the builder or consultant organizations, including purchasing agents, owners, executives, directors, and principles. Figure 2 illustrates the number of respondents by type.

To the degree possible, TRC selected respondents who would broadly represent the RNC market in California. Respondent companies varied by size, type, and geography they serve. Collectively, the respondents constructed homes across large areas of the state, in both urban and rural areas (e.g. Central Valley). Many respondents provided the location of current, or recent, housing developments in specific cities as illustrated in Figure 4.

Respondents also represented builders constructing a variety of housing types as illustrated in Figure 3.

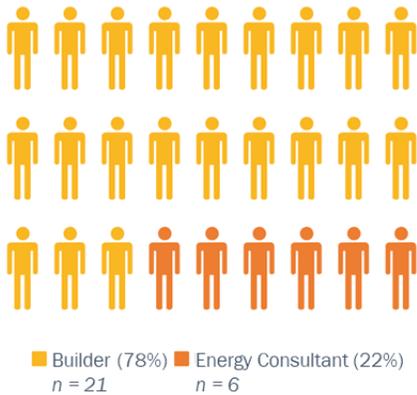


Figure 2: Survey Respondent Type

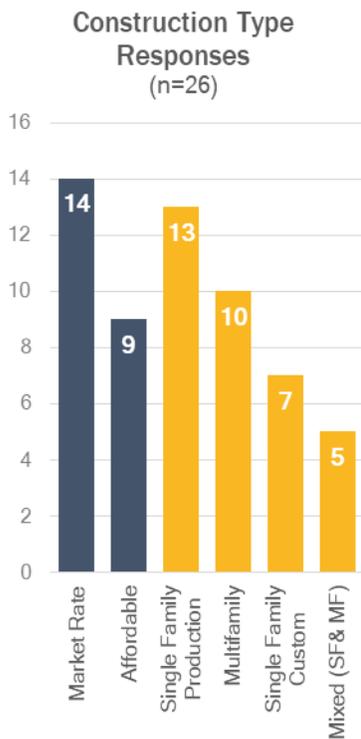


Figure 3: Construction Types

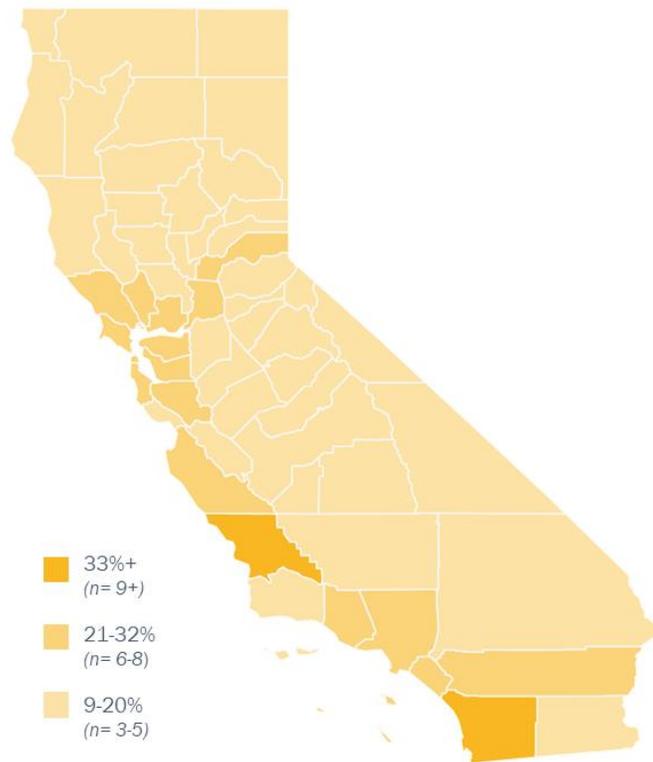


Figure 4: Survey Respondents Geographic Reach

Interviews and Survey Instrument

TRC recruited respondents from stakeholder lists compiled from private and public sources, including the California Building Industry Association. Recruitment emails offered respondents a \$100 gift card for participation in a 30-40 minute phone survey. TRC followed generally accepted survey and evaluation industry practices, using two-person teams to conduct the interviews (consisting of a primary interviewer and a note taker). All interviews utilized a standardized questionnaire containing 39 questions, which yielded a variety of scaled, open-ended, multiple choice, and yes/no responses. TRC conducted the interviews in a relaxed and informal manner, allowing respondents to ask clarifying questions, elaborate on answers, and engage in dialogue with the interview team. In total, TRC interviewed 21 builder respondents, representing 19 builder companies (in two instances, 2 people from the same company were interviewed) and 6 energy consultants.

Q: Have you built an all-electric home?
(n=26)

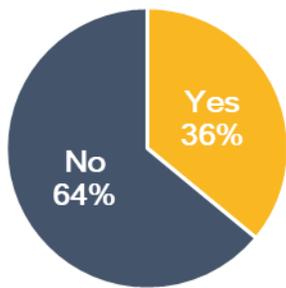


Figure 5: All-Electric Experience

Results

Perspective and Experience with All-Electric Construction

Most builders and consultants surveyed said they did not have experience with constructing all-electric homes, as illustrated in Figure 5. For those who have built all-electric homes, specific motivations were evident. For example, builders aiming to construct zero net energy homes and homes that include photovoltaic (PV) or battery storage more often build all-electric. Builders working in the multifamily and affordable housing market segments also have experience with all-electric construction.

Although experience with all-electric construction is not prevalent, all respondents indicated some experience and familiarity with installation of the three typical electric end-uses, as illustrated in Figure 6.

Respondents indicated that the builder, architect, or specifying engineer often determines the space and water heating fuel, but cooking and clothes drying fuel choices are often based on homebuyer preference.

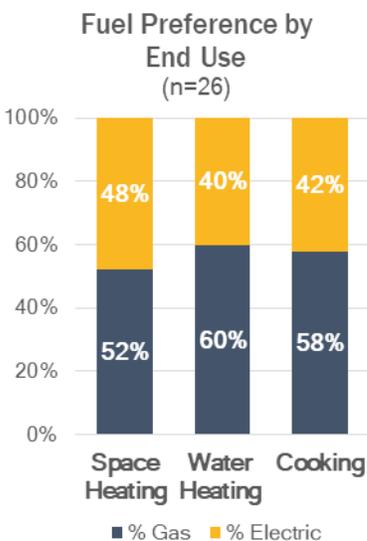


Figure 6: Fuel Preference by End Use

Q: Do you agree or disagree with the statement: *The construction of an all-electric home is practical today.*

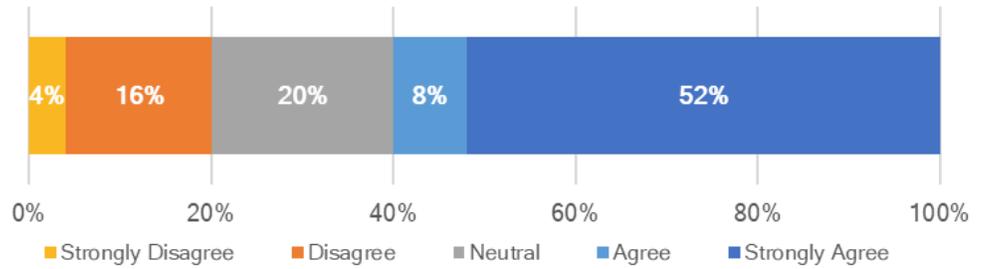


Figure 7: Practicality of All Electric Construction



STAKEHOLDER VOICES

"All-electric is not common and accepted. People have misconceptions about it. You need to educate the market. Builders do not want to limit their market..."

Practicality of All-Electric Construction

Overall, 60 percent of respondents agreed that construction of all-electric homes is practical today, with slightly more than half strongly agreeing. Unfamiliarity with electric space and water heating technology (i.e. heat pump) was the primary reason indicated by respondents who contended that all-electric construction is not practical today.

Barriers to All-Electric Construction

The interview team asked respondents a series of questions to discover their perspective on current barriers to constructing all-electric homes. Homeowner preference for gas cooking clearly emerged as the most significant barrier to all-electric construction. Even among respondents who indicated construction of all-electric homes is practical today, homeowner preference for gas cooking was considered a barrier. Gas-fired cooking appliances were the dominant choice for builders of high-end, production, and custom homes. Multifamily and affordable home builders reported regularly installing electric resistance cooking appliances but cited installing electromagnetic induction cooking as cost prohibitive. Respondents were most familiar with electric resistance cooking appliances, and they were generally unfamiliar with electromagnetic induction cooking (i.e. many have heard of induction ranges, but had no practical experience using or installing them). Figure 8 illustrates the most prevalent barriers to all-electric construction, as expressed by respondents.

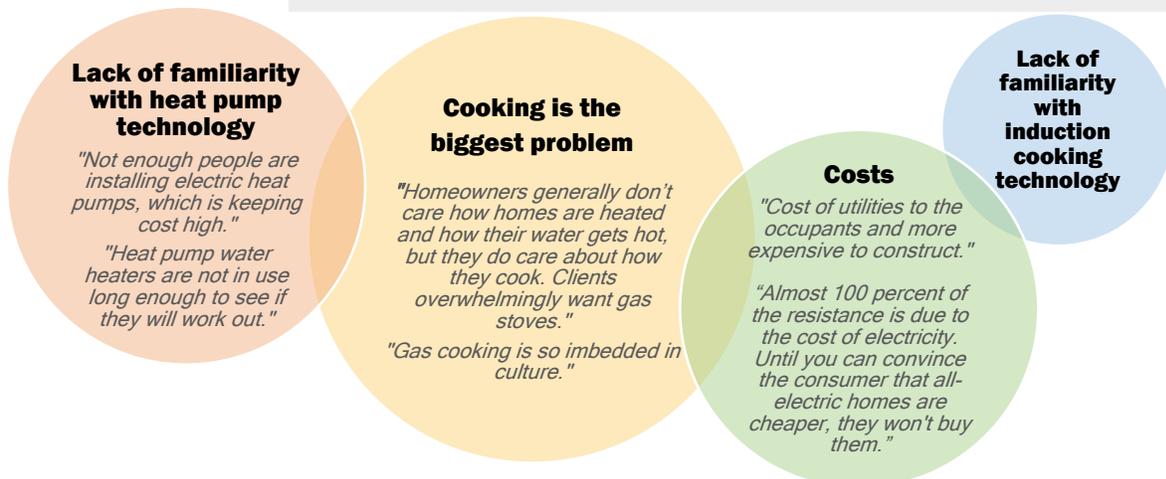


Figure 8: Barriers to All-Electric Construction

Q: Do you agree or disagree with the statement: Gas water heaters cost less to operate than electric water heaters for water heating.

Q: Do you agree or disagree with the statement: Gas furnaces cost less to operate than electric heat pumps for space heating.

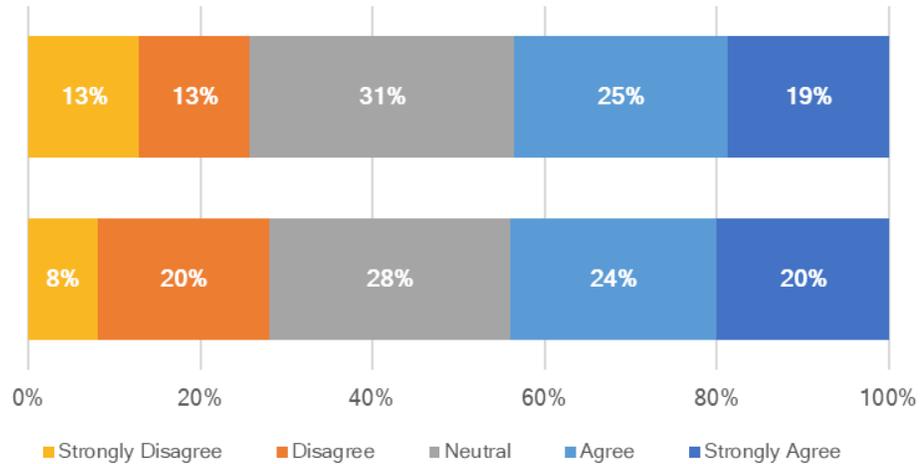


Figure 9: Perceived Operational Costs for Electric Space and Water Heating



STAKEHOLDER VOICES

“Shiny and new appliances are more important than the fuel behind the appliances... Aesthetic matters more than fuel type.”

“Energy independence for homeowners and reducing greenhouse gas emissions are important. Electric homes provide homeowners the ability to gain energy independence immediately and over time.”

Respondents cited homeowner operating costs and the incremental cost of construction as barriers to the construction of all-electric homes. However, respondent’s perceptions on operating costs of water heaters and space heaters were mixed, as illustrated in Figure 9. Respondent’s perceptions on operating costs appeared to be related to familiarity with heat pump technologies for space and water heating. Respondents claiming familiarity with heat pump technologies disagreed that gas appliances cost less to operate, whereas respondents with less familiarity tended to perceive heat pump technology as costlier to operate than gas appliances. Many said they simply did not know whether gas appliances were more or less expensive to operate.

Although assessment of the grid-impacts of all-electric construction was not an objective of the survey, one respondent expressed a concern regarding the impact on the electrical grid if all-electric homes became the norm:

“My concern is the reliability of power sources and the amount of energy required to produce the electrical power that we will need for all-electric homes.”

Q: Do you agree or disagree with the statement: *It will be difficult for home buyers to accept electric water heating.*

Q: Do you agree or disagree with the statement: *It will be difficult for home buyers to accept*

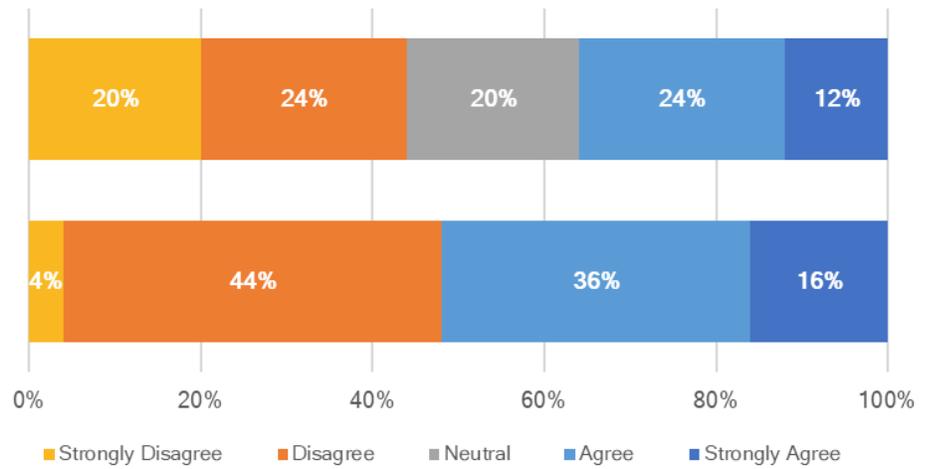


Figure 10: Homeowner Acceptance of Electric Space and Water Heating



STAKEHOLDER VOICES

“My interest [in building all-electric] depends on customer choice, buyer acceptance, and market perception. If everyone wanted all-electric, I would build all electric.”

Homeowner Acceptance of All-Electric Construction

In addition to the builders’ and energy consultants’ opinions of all-electric construction, TRC asked respondents about the homeowners’ perception of all-electric construction. The interview team asked respondents to rate the degree of difficulty homeowners will have accepting all-electric construction.

As indicated in Figure 10 above, respondents had varied responses about home buyers’ perception and acceptance of electric space and water heating.

As with the respondents themselves, the most significant barrier to all-electric construction for home buyers (as perceived by the respondents) relates to the choice of cooking fuel. Not surprisingly, respondents believed that home buyers would have the highest degree of difficulty accepting electric cooking appliances and induction cooking, as Figure 11 illustrates.

Q: Do you agree or disagree with the statement: *It will be difficult for home buyers to accept electric induction cooking.*

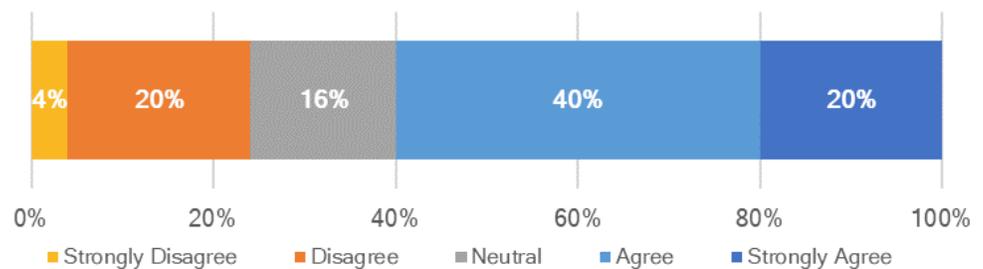


Figure 11: Homeowner Acceptance of Induction Cooking



STAKEHOLDER VOICES

“We have practical experience that it is less expensive to do all-electric than mixed fuel projects. [All-electric leads to] reduced greenhouse gas emissions, avoided explosion hazards, and better indoor air quality. Connection fees to utility, piping, and combustion safety testing are additional [avoidable] costs.”

“All-electric is cheaper for single family and way cheaper for multifamily.”

“All-electric is possible because people are doing it. Most builders and energy consultants do not think there is a lot of opportunity for incentives to help. It mostly lies with education and training developers, contractors, sub-contractors, and architects on how these systems work and how to best incorporate/install them in their projects.”

Perceived Benefits of All-Electric Construction

Cost Savings from All-Electric Construction

Several respondents indicated that all-electric construction would avoid gas infrastructure costs. Respondents said that gas infrastructure costs are difficult to assess due to the variation of community size (i.e. larger communities result in lower costs per site), location of gas mains, site-specific considerations, and non-specific plumbing invoices. However, several respondents did provide gas installation cost information.

For sites with existing gas mains, a branch connection (i.e. from the “curb” to the meter) and internal distribution piping within the home would range in cost between \$2,000 and \$12,000 per home. One very large production builder quoted the average cost of installing gas lines from the existing main to each home at \$2,000 per home (cost averaged by taking the total cost of gas service and dividing it by the number of homes in the community).

In some locations, setbacks from electric and sewer utilities and requirements for piping depth increased gas installation costs. Respondents also reported that elimination of the gas line excavation, permitting, gas piping installation, inspection and testing, and meter setting would result in significant savings in time and cost. More than one developer mentioned that waiting for gas companies to close trenches and set new meters caused scheduling issues. One developer said gas installation and testing delays created a pain point for homeowners by delaying closing dates and affecting mortgage time frames.

Improved Indoor Air Quality/Safety

Several respondents reported that all-electric construction would enhance indoor air quality and occupant safety by removing combustion appliances from the home.

Q: Do you agree or disagree with the statement: *Education would be effective in gaining widespread adoption of all-electric induction cooking.*

Q: Do you agree or disagree with the statement: *Education would be effective in gaining widespread adoption of all-electric water heating.*

Q: Do you agree or disagree with the statement: *Education would be effective in gaining widespread adoption of all-electric space heating.*

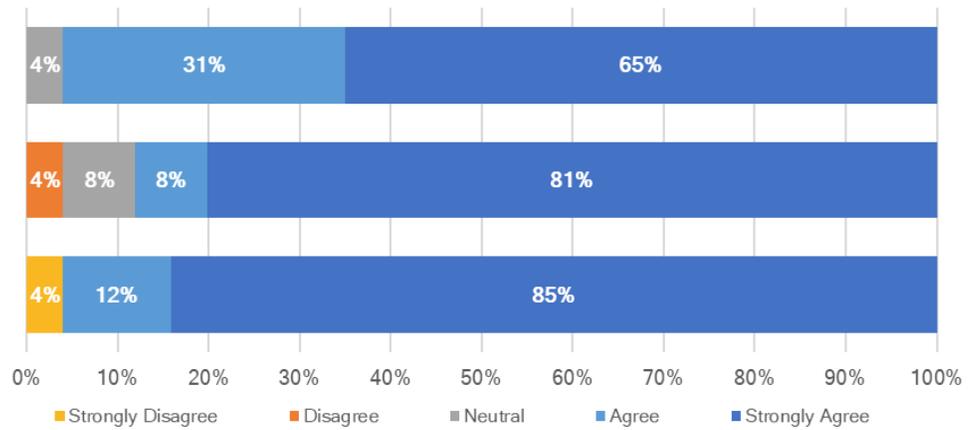


Figure 12: All-Electric Education



STAKEHOLDER VOICES

“Create a program to incentivize and transform the market on heat pump technology just like the solar program.”

“Our architect will hire consultants to design the electric appliance and services, and they need to be educated about the new products when the code changes.”

“There needs to be a lot of education on energy storage. Instead of having zero net energy homes, we should be doing grid-optimized homes.”

Education and Awareness to Support All-Electric Construction Is Necessary

Given the general lack of familiarity with all-electric construction and electric appliances among both respondents and home buyers (as perceived by the respondents), TRC asked respondents about the importance of awareness and education regarding all-electric construction.

As illustrated in Figure 12, there was strong agreement among respondents that education would be necessary for widespread acceptance and adoption of all-electric construction.

Respondents clearly indicated that unfamiliarity with induction cooking was the principal barrier to adoption of all-electric construction, both by builders and home buyers. Therefore, the features and benefits of induction cooking should be made available to prospective home buyers. Respondents suggested a few tactics for raising awareness of induction cooking, including:

- Providing information on the benefits and dispelling myths related to induction cooking.
- Addressing concerns that induction cooking is not suitable for woks or high temperature cooking (certain cuisines are perceived to require “high” heat or woks).
- Providing hands-on demonstrations with induction cooking, which allows home buyers to experience it for themselves.
- Creating sell sheets with talking points for builders to customize and use with prospective customers.

Many respondents believe their customers will accept electric heating and electric hot water, but they believe it will be difficult convincing some customers to forgo gas cooking. Gas cooking appliances are typically considered a premium feature, and the buyer of gas cooking appliances is generally the higher-end buyer. One developer said:

“If we don’t provide it, they can go down the street and buy a new home from my competitor with a gas stove”.

However, respondents were confident that if training were provided, they could learn to effectively communicate the benefits of induction cooking to prospective home buyers.

What Can Be Done to Help Builders?

Builders will face a variety of challenges when constructing all-electric homes, and they will incur both hard and soft costs as they transition from current practices to new ones. Respondents indicated that they are familiar with adapting to change and appreciate any support provided. Some mentioned financial incentives as helpful in offsetting both hard and soft costs, and respondents spoke highly of utility incentive programs that encouraged all-electric construction.

TRC also asked respondents to identify significant soft costs related to residential construction, but that are not necessarily related to all-electric construction. The interview team also asked what assistance could be provided to help them build all-electric homes. Figure 13 represents several examples of challenges stated by respondents and their suggested solution.



STAKEHOLDER VOICES

“The law that’s going into effect next year requiring solar on all new homes will be a huge help. A legislative mandate to have all homes be built to all-electric by x-date would probably be the best thing.”

All-Electric Construction and Solar

Most respondents made a connection between the upcoming building code changes, which will mandate on-site PV, and the feasibility of all-electric construction. Respondents believe that all-electric construction would be a “no brainer” if customers could offset operating costs with PV generation. One large production builder suggested a marketing campaign around residential solar and all-electric homes with a tag line “create electricity on your house, then use it in your home.”

Figure 13: Challenges and Recommended Solutions for All-Electric Home Construction

Challenges:	Builder and Energy Consultant Recommended Solutions:
<p>Permit costs are high and keep increasing. Permit fees named include: park, sewer, air quality, public facilities, school, regional service, water, environmental, and gas and electric.</p> <p><i>“In one jurisdiction, the fees are \$8,000 a house.”</i></p>	<p>Lower permitting fees. High fees are impacting the ability for affordable housing developers to build as they have significantly increased the cost of the entire project. For market rate developers, high fees are causing increased home prices and affecting their customer market potential.</p> <p><i>“California Energy Commission should mandate cities give breaks on permitting fees.”</i></p> <p><i>“Not sure which fee in particular would be favorable to waive or reduce but would benefit greatly from a break of some kind.”</i></p>
<p>Permitting is now more complicated. Builders perceive permitting as complicated and unfair. Builders now hire more consultants to help with permitting.</p> <p><i>“The fee structure in California is literal rocket science. People get paid handsomely to figure out fees.”</i></p>	<p>Make permitting less complicated or supply technical assistance. For an all-electric home, you now need an electrical consultant, which adds to design time and costs.</p> <p><i>“Lower permitting fees for affordable projects. Make the process less complicated.”</i></p>
<p>Permitting takes too long. Project costs for material and labor increase with time, so waiting for a permit can result in a changed or cancelled project.</p> <p><i>“The review process cuts into the timing of the project, which leads to delays and cost overruns, scheduling issues with trades, losing momentum, and loan issues with lender... This causes a domino effect that heavily impacts the builder.”</i></p>	<p>Accelerate permitting time and/or provide expedited permitting for all-electric projects. Increase efficiency of permitting process.</p> <p><i>“Increased knowledge of permit reviewers would also help. If the submitted documentation were being reviewed by someone who is knowledgeable of the technologies being used in the site plan, then that would help.”</i></p> <p><i>“Greater efficiencies in permitting processes at the city level. How long it takes to get things done is crazy. This is slowing down construction across the state.”</i></p>
<p>Zoning. There were no specific complaints about zoning, but when asked what could be done to encourage all-electric construction, a few developers suggested changes to the zoning code.</p>	<p>Adjust the zoning code for all-electric construction. Allow greater density or increased building height for all-electric projects.¹</p> <p><i>“Eliminate local zoning as a state mandate. Reduce the house size, implementing a mandatory limit based on median income.”</i></p>
<p>Lack of education is a challenge for many of the builders, and they asked for training for their internal teams, customer service, construction, design professionals, and the trades.</p> <p><i>“We install gas appliances because that is what we have always done and that is what the trades know.”</i></p>	<p>Education and training for builders, architects, energy consultants, electricians, and HVAC companies.</p> <p><i>“Make all-electric appliances mandatory. Then, everyone would have to get on board and learn it.”</i></p> <p><i>“Architects don’t quite understand the sizing needs of heat pump water heaters.”</i></p>

ZONING ALLOWANCES

¹ Sunnyvale, CA - offers increased lot coverage and density bonuses for green construction. A similar approach could encourage all-electric construction

Challenges:	Builder and Energy Consultant Recommended Solutions:
<p>Code requirements are costing more, taking longer, and becoming increasingly complex. Many of the builders interviewed complained about code requirements.</p>	<p>Provide financial assistance to meet code requirements.</p> <p><i>“We build small homes, 1000 sq. ft, and the incoming building code will be hard for us, and we will need some assistance in the way of dollars from somewhere particularly to help with solar.”</i></p>
<p>Redesigns for code updates incur significant costs when updating project plans to meet current codes, particularly when builders are not aware of new requirements during the design phase.</p>	<p>New code training.</p> <p><i>“One of the more difficult things I face is learning about new rules and regulations that are being implemented. If it was possible to learn about them without reading the entire new code, then that would be helpful.”</i></p> <p><i>“We will need incentives to help with learning the new code.”</i></p>
<p>Title 24. Builders and energy consultants expressed concerns and commented on Title 24, California’s energy code.</p> <p><i>“We spend too much on unnecessary insulation due to incorrect climate assumptions.”</i></p> <p><i>“Title 24 favors gas right now.”</i></p> <p><i>“How is all-electric going to impact our Energy Design Rating score?”</i></p>	<p>Create more climate zones to adjust for temperate climates.</p> <p><i>“One zone has many different microclimates and so the energy efficiency requirements, particularly insulation, do not exactly match.”</i></p> <p>Use Title 24 to incentivize all-electric buildings.</p> <p><i>“Have natural gas projects comply with a reach code and all-electric projects comply with normal Title 24.”</i></p>
<p>Solar’s effects on electric infrastructure is a concern for builders. Builders also mentioned the need to provide training for solar and battery design and the desire for incentives to help bring down the cost.</p> <p><i>“We are having to take on the cost of upgrading transformers in the neighborhood, as they don’t have enough power to the transformers.”</i></p>	<p>Incentivize solar and/or battery storage.</p> <p><i>“Incentives are weighted to gas and gas credits from solar thermal. Change solar thermal incentives for an easy win.”</i></p> <p><i>“Include battery storage in incentive programs to make nice with utilities to help them tackle supplying at peak-demand times. Process has been hostile with utilities.”</i></p> <p>Provide training for architects, designers, and energy consultants to correctly size solar systems and optimize the use of electricity generated on site.</p> <p>Support upgrades to Pacific Gas and Electric Company infrastructure so builders do not have to pay for the upgrades.</p> <p><i>“Need financing for photovoltaic and storage systems training for architects and energy consultants and contractors.”</i></p>

Conclusion

Respondents overwhelmingly care about their customers and are very knowledgeable of their market. The largest market-rate California production builders are primarily building with gas appliances now, but they know the market is shifting, see that solar mandates are making all-electric construction desirable, and are interested in venturing into all-electric homes. Both builders and energy consultants believe that the primary barrier to all-electric construction is a general lack of awareness and experience with heat pump and induction cooking technology. To encourage and facilitate all-electric construction, interventions should focus on the following:

- Conduct general awareness campaigns that demonstrate the features and benefits of all-electric homes, including providing:
 - Information regarding true operating costs for all-electric homes, with and without onsite generation.
 - Support for hands-on experiences with induction cooking.
 - Talking points on the features and benefits of all-electric construction that builders can use with their customers.
- Support builders that are building all-electric homes through trade-offs or incentives (e.g. reduced permitting fees, expedited permitting, zoning relief, code, or other regulatory compliance relief).
- Follow proven and successful code adoption methods (e.g. Commissioner A. McAllister’s engagement with stakeholders to establish a code compliance trade-off structure for PV and Storage)
- Provide trainings and certifications offered by CABEC and others, that support builders, reduce code compliance challenges, and offer reach code support to local code ordinances.
- Create and distribute case studies and/or supply technical support for builders going all-electric, especially the first few times.
- Provide training for builders, trades, architects, consultants, and particularly for electrical designers. Educate on design for PV and battery storage.

Finally, respondents’ interest in building all-electric homes, and learning more about all-electric construction was high, which corresponds to their stated need for education. As Figure 14 indicates, 88 percent of respondents are *interested* and 60 percent are *very interested* in constructing all-electric homes.

Q: How interested are you in building all-electric homes?

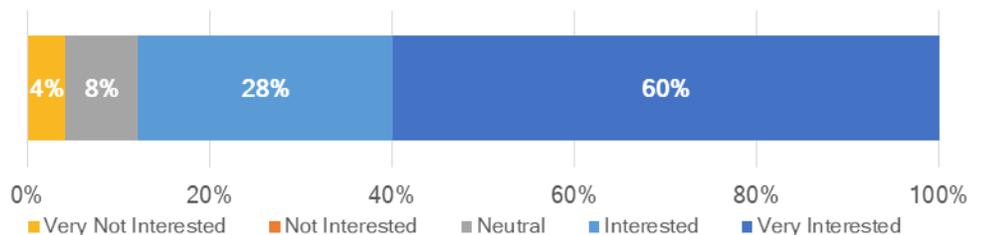


Figure 14: Interest in Building All-Electric Homes