

Contractor Needs for Supporting Building Electrification in the State of California

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ABSTRACT

California's greenhouse gas (GHG) emissions targets aim to reduce emissions to 40% below the 1990 level by 2030 and 80% below by 2050. One crucial pathway for achieving these goals is through building electrification -- replacing fossil fuel-driven systems in buildings with efficient electric systems such as heat pump space heating and heat pump water heaters. Because consumers often rely on contractors to recommend the appropriate equipment for their homes, it is important to ensure that contractors are ready to support the installation of these technologies. While California is a unique state, the findings from this study may act as a jumping-off-point for understanding market barriers and for partnering with contractors to advance electrification efforts in other jurisdictions.

This paper summarizes results of research conducted by TRC (formerly EMI Consulting) on behalf of the Building Decarbonization Coalition to better understand barriers to building electrification in existing residential homes. TRC completed 39 interviews with HVAC, electrical, plumbing, and general contractors in California to assess the awareness, preferences, opinions, and motivations of contractors related to natural gas and electric end-uses.

Results suggest that contractors generally prefer natural gas as a fuel source, and the lack of awareness and misperceptions about heat pumps and heat pump water heaters that have previously been identified with residential customers also exist among contractors. The paper includes a number of recommendations for overcoming these barriers, aimed at both increasing demand from end users as well as education and training for contractors.

Introduction/Background

As part of SB-32, the California Air Resources Board was charged with ensuring that California greenhouse gas (GHG) emissions are reduced to 40% below the 1990 level by 2030 and 80% below by 2050 (SB-32 California Global Warming Solutions Act of 2006; California Air Resources Board 2021). To help advance these goals, the Building Decarbonization Coalition ("the Coalition") is focused on building electrification, replacing fossil fuel-driven systems in buildings with efficient and effective electric systems such as heat pump space heating and heat pump water heaters. Coalition members include energy providers, environmental organizations, equipment manufacturers, and building industry professionals.

The Coalition sponsored this research to better understand contractors and their needs related to residential retrofits, specifically installers of heat pump space-heating and heat pump water-heating (HPWH) technologies. Given that many residential customers rely on contractors to recommend and install the appropriate equipment for their building, engagement with these groups is critical for the successful transition to an electrified built environment. This includes identifying the preferences, opinions, and needs of contractors related to natural gas and electric end-uses as well as any electrification market barriers (including training, accreditation, and availability).

Since this research was conducted in Fall 2019, an increasing number of state policies allow incentives for fuel switching (ACEEE 2020), including California, where the Public Utilities Commission recently set energy savings goals that account for fuel substitution (CPUC 2021). Furthermore, heat pump technology and testing standards for cold climates continue to improve (Gartman and Shah 2020). Despite these advances in policy and technology, recent findings from research conducted in Minnesota suggest

that low-volume contractors remain unaware of cold-climate heat pump technology, and even high-volume contractors are not often installing the technology (Minnesota Commerce Department Energy Resources & CADMUS 2021). While contractor awareness has likely improved over time, and the proportion of contractors installing heat pump technology has likely grown, the barriers identified by this research in 2019 probably still exist among a sizeable share of contractors in many states.

Research Objectives

The research objectives for this study addressed the following topics related to space heating, water heating, and electrification in general:

- Identify and explore the attitudes of contractors towards target electric end-uses that can advance near-term and long-term building electrification in California.
 - Assess contractor preferences related to gas vs. electric technologies
 - Assess the current awareness and perception of electric equipment among contractors.
 - Identify the drivers that influence various contractors to recommend/ install electric appliances over gas appliances (and vice versa).
- Identify existing barriers to greater adoption of electrification among contractors (e.g., awareness, training, equipment availability).
- Assess contractor receptiveness to possible solutions that support electrification.

Methodology

To support the study's objectives, TRC (then EMI Consulting) completed in-depth interviews with 39 contractors across the state of California. TRC sought to balance interviewees across the northern and southern parts of the state, and also to include those that are fully engaged in electrification technologies as well as market actors that focus on more traditional equipment. The sampling plan ensured a variety of perspectives in terms of industry and current knowledge of electrification of residential buildings. This included those who install heat pumps and other HVAC equipment, electrical contractors who are involved in the installation of heat pump technology particularly when panel upgrades or other types of electrical work are needed, general contractors who make decisions and hire specialty contractors to install HVAC and water heating equipment, and plumbing contractors who install water heating equipment. The final sample included:

- 10 HVAC contractors
- 10 electrical contractors
- 10 general contractors
- 9 plumbing contractors

Interviews were completed between October and December 2019. Interviews lasted 30 to 45 minutes each and included topics such as contractor preferences related to gas vs. electric technologies, awareness and perception of electric equipment, motivations and barriers to greater adoption of electrification among contractors, and receptiveness to policies that support electrification. All interviewees were offered a \$75 gift card for participation in the study.

Sample Sources

We used a wide variety of sample sources and methods for recruiting purposes. TRC worked with Coalition members, many of them industry experts in the fields targeted for the study, to identify sources for industry contacts. Coalition members shared contact lists, suggested industry organizations to partner

with, and in some cases volunteered to be interview subjects for the study.¹ TRC used both email and phone recruitment methods, and in some cases asked organizations to advertise the study in member newsletters or send email blasts to members. A summary of all sample sources used for this study is below:

- Association for Energy Affordability
- Bay Area Regional Energy Network (BayREN) HomePlus contractors
- Build It Green
- Building Decarbonization Coalition listserv and individual contacts referred my members
- California State Licensing Board (specifically for plumbers)
- Efficiency First California
- Google searches for California contractors
- SMACNA (Sheet Metal and Air Conditioning Contractors' National Association)
- Southern California Edison energy-efficiency program HVAC contacts
- Tri-County Regional Energy Network (3C-REN) contractors

Results

Interviewed contractors were asked questions related to their (1) Attitudes Toward Electrification, (2) Perceptions of Electric Equipment and (3) Receptiveness to Policies Supporting Electrification. The following sections detail the results of these interviews, reporting results by contractor type when relevant.

Attitudes Toward Electrification

When asked what kind of associations they had with the term “electrification,” and how it factors into their work with customers or the equipment they used, contractors most commonly provided positive responses, as shown in Figure 1. Eighteen out of 39 total contractors shared statements that communicated a positive association with electrification generally. Of those with positive associations, General Contractors and HVAC contractors most frequently provided positive responses (14 out of 18 positive responses).

Twelve out of 39 contractors had negative associations with the term “electrification” – commonly expressing a preference for natural gas, stating that it is less costly and more efficient. Plumbers had the most negative associations (5 out of 12 negative associations).

Eight out of 39 contractors were unfamiliar with the term “electrification,” and electricians were least familiar with the term. Electricians were most likely to be unfamiliar with or have undefined opinions on technologies associated with electrification as well, and infrequently communicated concrete attitudes toward heat pump (HP) technology.

¹ Specifically, two interviewees in the electrical contractor category were Coalition members.

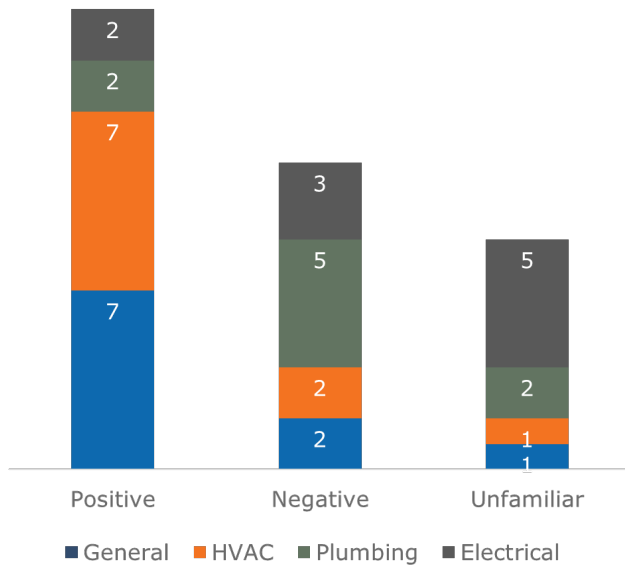


Figure 1. Attitudes toward electrification.

Attitudes towards electrification by contractor type. Overall, General Contractors most frequently expressed positive views on electrification, when compared to other contractor types. General Contractors were often familiar with the term “electrification,” and when asked to define electrification, described it as “switching from gas to electricity as a fuel source.” Seven general contractors were well-versed on the carbon-reduction benefits of electrification or described personal ethics related to lowering their carbon footprint: “Electrification is a topic that’s close to my heart. That’s the way to go. I feel like we need to get away from gas, natural gas and.... convert buildings to all-electric using renewable energy sources.”

HVAC contractors expressed a variety of associations with the term “electrification” but largely expressed positive feelings. Four HVAC contractors said they felt especially positive towards electrification when combined with solar installation. Most HVAC contractors had heard of electrification, and five said they mention electrification when working with customers. Two were unfamiliar with the term, but one of these understood it when termed “fuel-switching”: “We call that fuel switching usually...How familiar are we? We do it a lot.” Only one HVAC contractor described switching customers frequently to electricity, but typically from propane rather than natural gas.

Plumbers were generally more likely to feel negative associations towards electrification. Five plumbers had negative associations with the term “electrification” and primarily expressed a preference for natural gas as a fuel source. Two plumbers mentioned power outages in Northern California, which negatively affected their perceptions of electrification: “Yeah, for most of the people in our county, decarbonization and electrification are kind of bad words.” Additionally, plumbers felt that electrification was costly and less efficient than natural gas, noting that recovery rates for electric water heaters were lower than those of gas water heaters.

Electrical contractors were most unfamiliar with the term “electrification,” associating the term primarily with the process of providing power. They were less familiar with the concept of switching from gas as a fuel source to electric: “My immediate association with the word electrification would be providing power, electric power, to an existing structure. It’s not a term that I have ever used before.” Additionally, four electricians associated electrification with high costs.

Preference for natural gas or electricity as a fuel source. Generally, the interviewed contractors described preferring natural gas as a fuel source. Nine respondents preferred gas as a fuel source over electricity. Respondents who preferred gas as a fuel source primarily did so because of the lower cost of natural gas versus electricity (n=4). Respondents also associated natural gas as being no less clean than electricity (n=3), more reliable (n=2), more efficient (n=3), more effective (n=2) and more easily available (n=2) than electricity.

Four respondents stated that they preferred electricity as a fuel source over gas. Respondents who preferred electricity as a fuel source primarily felt that it was safer than natural gas due to risk of combustion (n=2). Respondents also associated electricity with having a lower carbon footprint (n=1), being more efficient (n=1) and cheaper installation (n=1) compared to gas.

Perceptions of Electric Equipment

While electric equipment was perceived as safer by some respondents, natural gas was viewed as cheaper and more reliable. Heat pumps were perceived as costly, and respondents continue to raise concerns about their performance on cold winter days. On the other hand, heat pumps were viewed as beneficial for lowering one’s carbon footprint, as well as for being energy efficient. While heat pump water heaters were perceived as energy efficient, there were a variety of drawbacks cited by respondents. These drawbacks included the need for maintenance, upfront costs, time required to heat water, location concerns, and space requirements. Some contractors felt that the lack of a “whole house” approach to heat pump installation meant that heat pumps are often not performing optimally. Additionally, some respondents felt there was a lack of customer awareness and understanding of heat pump operation, meaning that heat pumps were likely not always operated optimally (e.g., keeping the thermostat within a narrow range rather than expecting a sudden increase of temperature in a short time).

Overall, respondents felt that a lower carbon footprint (n=9) and energy efficiency (n=7) were the primary benefits of heat pump technology in California (see Figure 2). Other benefits described by several respondents included versatility (n=6), cost savings (n=6), and health and safety (n=5). Three contractors said they did not know of any benefits of heat pumps.

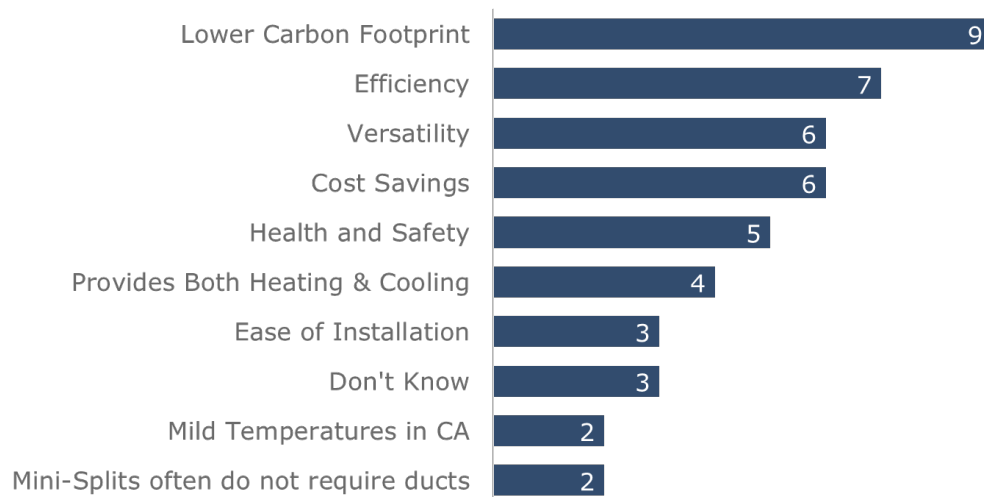


Figure 2. Primary benefits of heat pumps.

In terms of negatives, shown in Figure 3, respondents mentioned performance concerns in cold weather as the primary drawback of heat pump technology in California (n=11). Other commonly cited drawbacks included high upfront costs (n=8) and aesthetics (n=4).

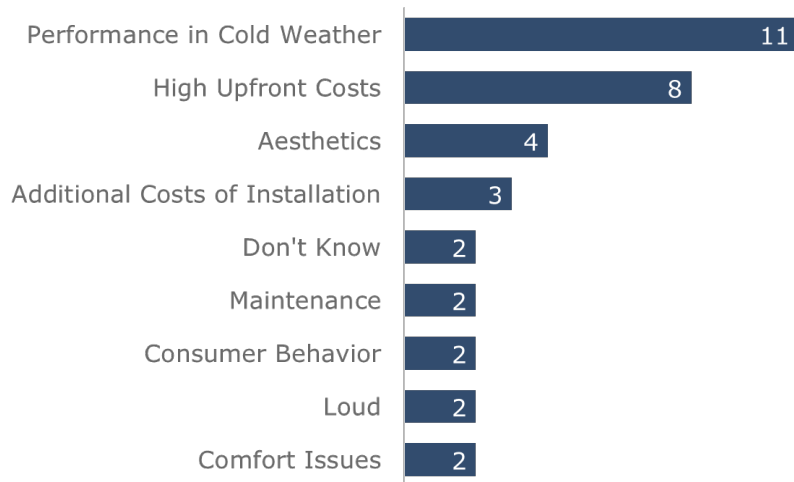


Figure 3. Primary drawbacks of heat pumps.

When asked about heat pump water heaters, respondents felt that efficiency was the primary benefit of heat pump water heater technology in California (n=10), as shown in Figure 4. Other benefits described by several respondents included a lower carbon footprint (n=6), and health and safety (n=4). Two contractors did not know of any benefits of heat pump water heaters.

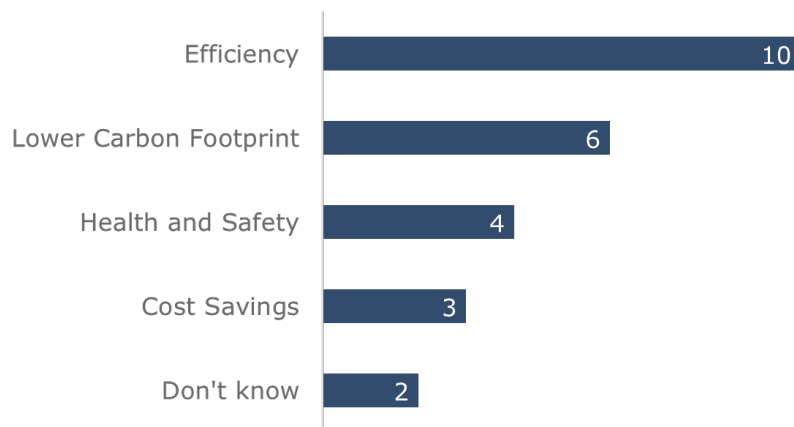


Figure 4. Primary benefits of heat pump water heaters.

Respondents also felt that the time required to heat water (slow recovery) was the primary drawback of heat pump water heater technology in California (n=6), shown in Figure 5. Maintenance (n=5), high upfront costs (n=4), locating the unit (n=4), and the space required to install an HPWH (n=4) were also commonly cited as drawbacks to HPWH technology.

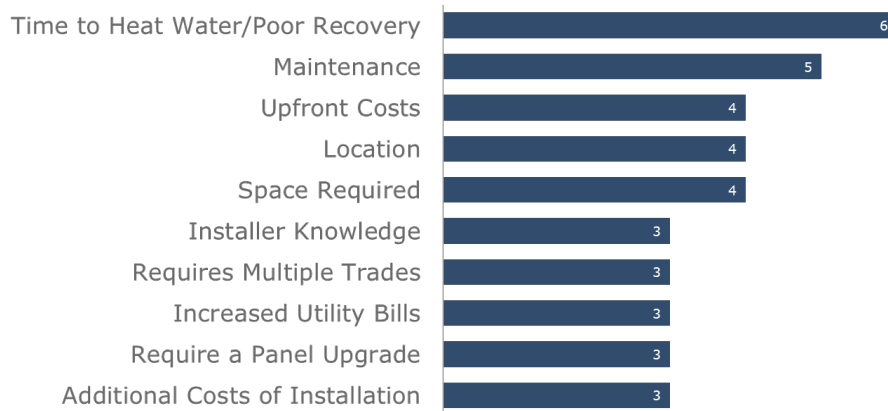


Figure 5. Primary drawbacks of heat pump water heaters.

Perceptions of electric equipment by contractor type. According to General Contractors, the benefit of heat pump technology was primarily the versatility in style and installation options, which allowed them to, for example, mount the unit on a wall or ceiling based on customers’ needs. Drawbacks described by general contractors included high upfront costs and the aesthetics of mini-split wall units: “A lot of it is aesthetics, you know? People don’t like the look of the thing hanging on their wall.” The benefits of heat pump water heaters most frequently mentioned by General Contractors were the low carbon footprint and greater energy efficiency as compared to gas-using water heaters. The drawbacks of HPWHs most frequently mentioned by General Contractors were the space required to install the unit, and relatedly, where to locate the water heater in the home: “They’re larger in size than the typical water heater. They’re a little noisy. They make the space that they’re in cold, so they’re not ideal for interior installations. That could be an issue.”

The benefit of heat pumps most frequently mentioned by HVAC Contractors was the lower carbon footprint of a heat pump, as compared to a gas furnace. The drawbacks of heat pumps most frequently mentioned by HVAC Contractors was poor performance of the heat pump in cold weather, as well as the need for an auxiliary heat source: “In our area, it would be just the fact that the colder it gets outside, the worse [heat pumps] work and that’s when you need it the most.” HVAC contractors also described the high upfront costs of heat pumps as a primary drawback.

Plumbers most frequently mentioned opportunities for improved energy efficiency as the primary benefit of heat pump water heaters. The drawback of heat pump water heaters commonly described by Plumbers included the difficulty of maintenance and service due to a shortage of knowledgeable service technicians: “Most of these guys can’t work on regular water heaters that are just strictly gas, let alone you mix electric in them, then they get few and far between.” Plumbers also felt that the required addition of multiple mechanical systems that are prone to breakage causes heat pump water heaters to be difficult to both install and maintain.

While Electrical Contractors are brought in for heat pump and heat pump water heater installations, they had difficulty thinking of benefits and drawbacks of electric equipment. Three said they “did not know” the benefits of heat pumps, and two said they did not know the drawbacks: “The decision



CONCERNS ABOUT HEAT PUMP PERFORMANCE

“In our area, it would be just the fact that the colder it gets outside, the worse [heat pumps] work and that’s when you need it the most.”

- HVAC CONTRACTOR

was completely made between the HVAC contractor and the general contractor. And so, I wouldn't know the benefit or the drawback.”

Perception of heat pump comfort. Perceptions of limits to the comfort that a heat pump can provide end users continues to be a barrier to their increased installation, but several respondents felt that a focus on installation best practices would improve the comfort level heat pumps are able to provide. HVAC Contractors and General Contractors both described the importance of installing heat pumps in conjunction with an evaluation of the entire building envelope in order to provide the most comfort. Four General Contractors and three HVAC Contractors stated that, if installed correctly, heat pumps should be able to provide as much or more comfort than a standard gas furnace. General Contractors sometimes felt that HVAC Contractors did not always install heat pumps using a “whole-house” approach to address the building envelope, which contributed to issues with comfort: “So say an HVAC contractor, they might take a normal split system and put a heat pump in. Okay, they do that all the time. But are they going to make sure the ducts are air-sealed? Are the ducts even adequate?” Five HVAC Contractors and five General Contractors also described a need to educate end-users on how to operate the heat pump optimally to achieve comfort, underscoring the need for behavior change.

Barriers to and drivers of electric equipment adoption. Respondents described several installation challenges that were barriers to increased adoption of electric equipment – most notably, required panel upgrades and more generally, the costs associated with more complex installations. Respondents also underscored the drawbacks of poor installation – that it reduced comfort, could potentially leak greenhouse gases from the refrigerant, and could be oversized.

The need for panel upgrades was perceived as a barrier for both HP and HPWH installation. Wiring issues were particularly top-of-mind for HPWHs as they would require both a plumber and electrician for installation. The availability of electrical equipment was generally not seen as a barrier to recommending HPs and HPWHs by respondents. While several mentioned it had been difficult in the past to obtain HPs or HPWHs on a short timeline, most contractors indicated that they now would have no problem finding this equipment.

Heat pump barriers. The primary heat pump installation challenges described by contractors were panel upgrades, which respondents described as expensive and time-consuming. Six respondents described panel upgrades as the biggest challenge, including 5 Electricians and 1 HVAC Contractor, stating that the upgrade “is kind of a roadblock in some cases... You're going to have to spend a few more thousand dollars just to be able to support that electric appliance. So yeah, it can be cost prohibitive for some people to do that.” No General Contractors described panel upgrades as an installation challenge.

Though many noted that HP technology is improving, respondents noted that they continue to recommend a backup heat source in certain situations. Sixteen respondents said they always or sometimes recommend installing a backup heat source. Four stated they would only install a backup heat source if their client lived in a very cold area. Two said they had only installed backup heat for clients in remote locations. “They've really improved them, so even in our north county, where it drops down in temperatures, that really doesn't matter anymore. There was a wives' tale and an urban legend that, ‘Oh, you can't use them in cold temperatures.’ And that's just not true.”

Heat pump water heater barriers. Similar to challenges for HPs, the primary installation challenge



LACK OF INSTALLER MOTIVATION

“So why would [a plumber] want to learn something like [installation of heat pump water heaters] when he can put in his normal water heater he's always put in, and get several done in a day if he wanted to?”

-PLUMBER

described by respondents for HPWHs was a perceived need for panel upgrades. Five contractors felt that panel upgrades were the greatest challenge to HPWH installation. Five contractors also noted that lack of installer knowledge was a major challenge. Motivation to overcome the knowledge barrier is also a challenge: “So why would [a plumber] want to learn something like [installation of heat pump water heaters] when he can put in his normal water heater he's always put in, and get several done in a day if he wanted to?” Other commonly cited challenges included the size of the HPWH (n=3) and location of the HPWH (n=3).

Respondents often mentioned that the installation of a HPWH would require both a plumber and an electrician, which increases the cost associated with installation: “If I had a [heat pump water heater], you'd have to have an electrician come in and run electric to it and all that stuff.” Four plumbers said they would work with an electrician to install a HPWH. One plumber said he would do some electrical work himself. Five electricians said they would never do any plumbing because their license doesn't allow it. One electrician said he would work with a plumber to install a heat pump water heater, but he felt there were plumbers who would install HPWHs without an electrician.

Challenges to obtaining equipment. While availability of HPs and HPWHs may have posed a challenge in the past, the majority of respondents reported they have no problem obtaining equipment currently: “It's becoming more and more available as more and more vendors stock them in the Bay area, and they stock them for us because we actually purchased enough of them for them to justify stocking a bunch of them. So no, not anymore.” Sixteen respondents said they had no issues obtaining HPs or HPWHs when they needed them. Five respondents (three of whom were plumbers) said they sometimes had issues obtaining equipment. Those respondents who did mention that it was a challenge were less familiar with the equipment or worked outside of city centers.

Receptiveness to Possible Solutions Supporting Electrification

Various policies and initiatives promoting electrification are being considered across all levels of government, among utilities, and by other stakeholders. These policies aim to proliferate electric technology, including increasing access to electrification opportunities among low-income communities. While most respondents felt that financing would be useful in engaging low-income communities, a few expressed reservations. Some respondents felt that assistance with upfront costs would be more beneficial than financing, while other expressed concerns about low-income end users taking on additional loans.

In addition, respondents were generally not fluent in California's greenhouse gas reduction goals. While respondents often stated that they were aware of California's carbon reduction goals, many struggled to name specifics. However, contractors were interested in the opportunity for training on both California's decarbonization strategy and electric equipment, as long as the trainings are “practical.” Respondents primarily favored in-person seminars and webinars as their preferred channel for participation, and they emphasized that the trainings would need to highlight how these goals could impact or influence their business and operations.

Financing for low-income and disadvantaged communities. Respondents were divided in their opinions on providing financing to drive uptake of electric equipment in low-income communities. Sixteen respondents felt that financing would be useful in engaging low-income communities. Three of these respondents said providing incentives would be better than financing. Three said they would be useful if they were associated with low- or no-interest loans. In general, those in favor felt that any assistance with bringing down up-front costs would be useful.

Nine respondents did not feel financing would be useful in driving uptake for low-income communities. Four of these felt that low-income end users did not need to take on additional loans. Two respondents also mentioned that utility bill costs would also need to be reduced along with their upfront costs: “One thing, that always kind of gets in my craw is when you talk about somebody who's low income, financing is the last thing they should be doing on anything because of the interest rates.”

Contractor awareness of California’s carbon reduction goals. Respondents brought up California’s carbon reduction goals during conversation, but often were not familiar with the specifics and did not see a strong relationship between these goals and the work they do. Twenty-seven out of 39 contractors said that they were familiar with California’s carbon reduction goals, but many of these contractors could not identify specific goals; the goals and policies that respondents identified are shown in Table 1. Eleven respondents said they were not familiar with California’s carbon reduction goals. Contractors also had trouble understanding the impacts of carbon reduction policies on their industry: “Whenever they change policy, usually the supply house [tells] us because they have to abide by it also. They can't sell equipment that's not allowed. So, they'll come out and tell us, "Hey, we're coming out with these new models," and I'm not fixed on any particular system or model, so I don't see how that would affect me at all.”

Table 1. Goals and policies related to California’s carbon reduction goals as identified by contractors

Category	Goal or Policy Mentioned
Legislation	Assembly Bill 32
	California’s Renewables Portfolio Standard
Codes & Standards	New Construction Electrification Mandate
	Net Zero Building Code
	Requiring solar for new construction
	General changes to code and standards
	Car emissions standards
	SEER ratings
Rebates & Incentives	Incentives for Fuel Switching (or lack thereof)
	Rebates for solar installation
	Incentives for battery systems
Other	Time of Use changes for PG&E

Support for potential trainings. Most respondents stated that they felt training on California’s decarbonization strategy would be useful (n=24). Only three contractors said they did not think it would be useful. Six respondents who felt the training would be useful qualified their answer by underscoring that the training would need to be convenient and make business sense for them, by for example, giving them a leg-up on the green construction market: “Until people are educated, they’re going to keep doing what they’ve always done. Even with proper education, we’re going to have those guys out there that just don’t want to change...until they’re forced.”

Respondents generally preferred in-person seminars (n=12) and webinars as channels for training (n=12), stating “I’d rather sit down in a classroom and have an instructor helping it out. When it’s done in that way, you have an opportunity not only to learn from the instructor, but other people around you that might already be involved in it that have ideas.”



NEED FOR TRAINING

“Until people are educated, they’re going to keep doing what they’ve always done.”

- PLUMBER

Limitations

The results of this study should be interpreted with several limitations in mind. First, the small sample size limits the generalizability of findings. While the sample size was small, TRC targeted contractors throughout the state to gather a variety of perspectives across geographical regions.

Additionally, sample sources were generally limited to contact lists provided by Coalition members. However, the authors note that this likely skewed results toward greater awareness of electrification and more positive views toward electrification and HP technologies. Still, the findings suggest common barriers to electrification and opportunities for overcoming these barriers.

It is worth noting that while the above limitations warrant interpreting results with caution, the findings are in line with other recent studies (e.g., Bond 2019; Whitsett 2019).

Conclusions & Recommendations

The results of this study and other similar studies suggest that contractor education is one of several necessary components of advancing building electrification goals in California. Although the Northeast Energy Efficiency Partnership (NEEP) published guidance for cold-climate heat pump selection and installation in 2017 (Dunn 2017), this research conducted in 2019 showed that misconceptions about heat pump performance in cold weather persisted. Several California utilities responded to this need. For example, PG&E offers an on-demand training that provides an overview of heat pumps and heat pump water heaters, including a variety of system types, efficiency, and optimal installation factors (PG&E 2021). Southern California Edison offers a variety of courses through its Energy Education Center including heat pumps in retrofit construction and engineering and design of commercial & multifamily heat pump water heating (SCE 2021). SCE focused on heat pump water heaters in particular, as this technology especially had low awareness among installers. Contractor awareness in California has likely increased since this research was conducted, in part due to these utility efforts, but also due to other market forces such as state policies and technology improvements.

Although this study was specific to contractors in California, it is likely that similar education will be needed in other states as electrification goals become more common. Based on the results of this study, the research team developed the following recommendations:

- 1. Support rebates and incentives for fuel switching and for upgrading to efficient electric equipment.** Bringing down upfront costs motivates end-users to pursue those options and will help contractors sell this equipment more frequently.

2. **Promote manufacturer training to installers regarding proper installation and maintenance techniques.** Improper installation can hinder equipment performance, and misconceptions about the performance of HPs in cold weather or maintenance requirements of HPWHs may prevent installation entirely. It is in manufacturers' interest to ensure installers understand installation requirements and that the equipment is properly maintained, and the industry should capitalize on these trainings by promoting them to installers.
3. **Provide education to installers regarding how electrification and carbon reduction goals impact their business.** Installers are interested in learning more about what electrification is and how going green can be cost effective and good for their business.
4. **Educate end-users on the benefits of electrification and efficient electric technologies.** Some installers may not want to recommend or install efficient electric equipment until customers are demanding this equipment. Thus, it is important to not only educate installers, but also end-users. Furthermore, customers will need to understand different expectations for operating this equipment.
5. **Provide marketing materials and training materials for sales staff and installers.** Provide collateral that installers can use both when pitching electric equipment to end-users and when training their own staff. Materials should underscore cost effectiveness of (and available incentives for) electric equipment.
6. **Provide low-interest or no-interest financing options to engage low-income end-users.** To further assist with the upfront costs associated with electrification, financing options should be made available to low-income households. So as not to place additional monetary burden on these households, low- or no-interest loans should be offered. This could also include the option to pay at least a portion of the loan directly through utility bill savings (i.e., on-bill financing).

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