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MEMORANDUM

To: **Bay Area Air Quality Management District**

From: **BW Research Partnership**

Date: **June 6, 2024**

Re: **Workforce Challenges for Zero NOx Requirements - Implementation Working Group Research**

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INTRODUCTION

The rule amendments to Regulation 9, Rule 4: Nitrogen Oxides from Natural Gas-Fired Furnaces ("Rule 9-4") and Regulation 9, Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Boilers and Water Heaters ("Rule 9-6") include point-of-sale zero-Nitrogen Oxides (NOx) standards which will impact consumers of residential and commercial space and water heating equipment in the Bay Area. Implementation dates are scheduled to begin Jan. 1, 2027 and Jan. 1, 2029 for residential small water heaters and space heating, respectively. Currently, the only available compliant technologies are all-electric.

As part of the Building Appliance Rules Implementation Working Group, the Air District sought to update its understanding of the relevant workforce across the nine Bay Area counties. BW Research conducted research on existing landscape and current workforce programs addressing Bay Area-located contractors and their competency with heat pump water heater and heat pump space heating market/technology, installation, maintenance, and knowledge of available consumer-facing incentives.

This memo contains a summary of the information and findings gathered by BW Research to support the Bay Area Air Quality Management District's Zero-NOx Appliance Implementation Working Group (IWG). The information in this memo is a collection of primary data from a survey of contractors, interviews with contractors and training providers, and secondary data from existing resources. The findings of this memo highlight that the current market for installation of zero-NOx appliances—particularly in residential buildings—has unique structural challenges that raise workforce-related concerns.

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MEMORANDUM

KEY FINDINGS

1. **Zero-NOx appliance install labor market in the Bay Area is split into two types of buildings: residential and commercial.** These two markets have different workforce dynamics and challenges. The commercial sector tends to have larger projects, which favors larger, typically union-signatory, contractors and offers higher wages and better benefits. The training pipeline for the commercial sector is rather robust; a network of pre-apprenticeships, community college offerings, and union apprenticeships through Joint Apprenticeship Training Centers ensures that the appropriate supply of talent is provided. Because it offers the highest wages, the commercial sector has few challenges attracting workers.

2. **The residential market looks very different than the commercial market.** Lower wages and benefits—if benefits are offered at all—and less formal training and certifications means that there can be particularly high turnover in this sector as workers look to increase their earnings by entering the commercial sector, switching employers, or exiting the industry altogether. A greater share of training often occurs on the job, so employers look for those with some baseline previous experience of working on a job site and familiarity with buildings.

3. **Around two-thirds of contractors expressed they are familiar with the Air District's zero NOx rules 9-4 and 9-6, while 36% and 32%, respectively, expressed they are not.** While this datapoint reflects that most contractors in the Bay Area are familiar with the rules, there is still a notable portion that requires more outreach. Most common contractor touch points such as distributor networks and local training institutions may be the best way to reach these individuals.

4. **Between 44% and 61% of surveyed contractors plan to hire more employees within the next three years.** Of the contractors expecting to grow over the next three years, the average projected growth rate was 23% for firms employing Plumbers, 15% for Electricians, and 14% for HVAC Technicians. A sizable portion (between 37% and 49%) of contractors expect to have the same number of employees in three years. Very few employers expect to have fewer employees in the near future (Figure 8).

5. **Between 70% and 83% of surveyed contractors stated that they had at least some difficulty hiring for Electricians,[1] Plumbers,[2] and HVAC Technicians[3] (Figure 9).** While this number is

[1] Electricians, U.S. Bureau of Labor Statistics' Standard Occupational Classification (SOC) Code 47-2111
[2] Plumbers, Pipefitters, and Steamfitters (Plumbers), U.S. Bureau of Labor Statistics' Standard Occupational Classification (SOC) Code 47-2152
[3] Heating, Air Conditioning, and Refrigeration Mechanics and Installers (HVAC Technicians), U.S. Bureau of Labor Statistics' Standard Occupational Classification (SOC) Code, 49-9021

notable, it is lower than the national average of hiring difficulty for energy efficiency workers, which was 92% in 2022.[4] Employers most frequently identified a lack of training and education, as well as a lack of work experience, as the main obstacles to hiring (Figure 10, Figure 11, and Figure 12). This reflects employers' desire for relevant general construction experience, even for entry level workers (Figure 13).

6. **Most employers (73%) do not work directly with training providers (Figure 17) and there is often not a direct pathway for most training graduates to find employment and the industry relies heavily on job sites or informal avenues in hiring processes.** Many community colleges and technical schools have connections with union apprenticeship programs, which helps connect students to union opportunities. However, roughly half of apprenticeship test-takers fail the test and fewer than one-in-ten applicants get apprenticeship offers. This—combined with the market dynamics of the residential market—means that job seekers currently enter the residential install job market often through postings on job sites like Indeed or through word of mouth.

7. **HVAC Distributors are a key touchpoint for contractors for upskilling and information dispersal.** When asked about preferred pathways for training delivery, HVAC distributors were by far the most popular (56%), followed by local training institutions, such as community colleges and Joint Apprenticeship and Training Centers (JATC)s (26%) (Figure 21). Distributor centers are accessible for contractors, who visit them regularly. Distributors want to make sure their products are being marketed and installed appropriately, and so their interests are aligned in making sure contractors have the best information around new products and practices. Several interviewees noted that existing trainings and programs run through their distributors were immensely helpful and utilized regularly.

8. **Training programs focused on HVAC Technicians, Electricians, Plumbers, and general construction trades[5] are more highly concentrated in parts of South Bay and East Bay and many programs are in or near Low-Income or Disadvantaged Communities (LIDACs).** Among in-person programs, Santa Clara and Alameda Counties host the largest share and the four northern counties (Marin, Napa, Solano, and Sonoma) host only 16% of total identified in-person trainings combined.

   LIDAC regions have access to many of these identified programs as well. However, across the Bay Area, some areas, including LIDACs, lack access to available programs for all of the identified priority occupations. In general, there are many communities that have access to training

[4] https://www.energy.gov/sites/default/files/2023-06/2023%20USEER%20REPORT-v2.pdf

[5] General construction trades programs are those primarily for newer workers to gain some experience and learn foundational knowledge and skills in the construction industry and trades occupations, including in HVAC/R, Electrical, and Plumbing roles.

programs focused on only one or two of the primary occupations. Overall, almost a third of the total identified programs are available online, but online programs lack the hands-on experience that employers often look for among entry-level job seekers.

RECOMMENDATIONS

1. **Support the continuation of training for Plumbers and HVAC Technicians on heat pump water heaters.** Heat pump water heaters were identified as a technology where neither HVAC Technicians nor Plumbers felt entirely confident because it is a combination of technologies that they're less familiar with. These trainings can help "cross train" HVAC installers so that they're more comfortable with piping components and can help Plumbers become more comfortable with heat pump technology and refrigerants. TECH Clean California's "Installing Individual Heat Pump Water Heaters" and "Central Heat Pump Water Heater – Advanced Design and Installation" courses are examples of these trainings that can familiarize existing workers with new technologies.

2. **Support new and existing trainings on "right sizing" and the comparability of electric appliances and outreach to less-engaged contractors.** One area of concern pointed out by several contractors and trainers is that some electric appliances are better suited to serve as replacements for gas equivalents than others. Distributors will similarly be interested in ensuring that contractors know how to "right size" installations to minimize complaints and callbacks. Along with supporting additional trainings on new technologies, helping distributors attract hesitant or time-constrained contractors may be a useful step forward to strengthening the knowledge base across the entire pool of contractors.

3. **Connect community college and other training program graduates that do not get into apprenticeship programs with high road[6] residential employers to gain experience.** High selectivity of union apprenticeships means that many graduates of training programs who do not get into apprenticeships are left to find alternatives. Helping those graduates find work among non-labor signatory contractors can benefit job seekers gain formal experience while also helping non-signatory contractors find and retain talent. Most (73%) contractors do not have close relationships with training programs, which means program graduates may have trouble finding contractors who are looking to hire.

[6] California High Road practices include: Family-sustaining wages and benefits that include health care, pension, paid sick leave; Career pathways that are clearly defined and include access to education, training, and support services; Stable and predictable schedules that are reliable and consistent; Worker voice and agency that includes respecting and valuing the worker and the right to organize and join unions; Healthy work environment with adequate training and protection, that incorporates racial equity practices.

4. **Support more pre-apprenticeships, funding for instructors, and preparation for apprenticeship tests.** Pre-apprenticeship programs are great ways to engage talent at an earlier career stage, give these job-seekers hands on experience, and start them on a pathway to residential installation careers. Additional funding for program instructors is important, as quality teachers can often earn more money working in the field, which can lead to challenges in finding teachers. Finally, offering more support to prepare and pass apprenticeship tests can support those from communities that are underserved (LIDAC) as they seek to enter a union trade.

5. **Increase access for residents living in Low-Income or Disadvantaged Communities (LIDACs) to a variety of available training programs.** While there are many training programs in or around LIDACs, the variety of training by occupational focus for several communities is limited. For example, some community members may need to drive one to three counties over to reach a different occupational focused training. Online programs may be part of a solution by introducing job seekers to foundational knowledge of construction trades, but the lack of hands-on experience that employers look for means that online training cannot be the sole solution. Transit stipends, additional transportation options, and helping existing institutions that are close to LIDACs expand their programs to include programs specific to occupations that are currently missing, can help job seekers access the types of training that employers look for.

6. **Increase access to EPA 608 test preparation materials and certification centers.** Some training programs explicitly mention EPA 608 test preparation as part of their programs, but others do not. Expanding access to these tests is crucial to ensuring that anyone dealing with refrigerants can handle and dispose of them properly. Other than a certification center in Antioch, the next closest center for EPA 608 tests is Sacramento.[7]

7. **Continue to streamline and boost awareness of incentive programs.** Interviews with contractors suggest that awareness of, and access to, incentives is still somewhat of a challenge. Contractors noted challenges with getting reimbursed for incentives in a timely manner and limited awareness of current *and future* incentives available from a range of sources.

8. **Consider opportunities to improve the permitting process for electrification projects.** Permitting was also highlighted as a sticking point, with some contractors noting that permitting was both time-intensive and costly. One contractor praised the City of Menlo Park for waiving permit fees for electrification projects, which can help reduce project costs for residential contractors who are already operating with thin margins.

[7] https://www.epa.gov/section608/certification-programs-section-608-technicians

CONTRACTORS IN THE REGION

The three primary occupations that are highly involved with the installation and maintenance of appliances that emit zero Nitrogen Oxides (NOx) are 1) Electricians, 2) Plumbers and Pipefitters, and 3) Heating, Air Conditioning, and Refrigeration Mechanics and Installers. Understanding the needs and challenges of these occupations, and contractors employing these occupations, can help guide strategy development for increased deployment of appliances, such as heat pumps, for zero-NOx water and space heating purposes.

There are close to 20,000 Electricians,[8] almost 11,000 Plumbers, Pipefitters, and Steamfitters (Plumbers),[9] and around 9,000 Heating, Air Conditioning, and Refrigeration Mechanics and Installers (HVAC Technicians)[10] currently employed in the nine Bay Area counties. Also within this region are just over 2,000 electrical contractors, or establishments classified as electrical or other wiring installation contractors based on the North American Industry Classification System (NAICS), and nearly 2,200 plumbing, heating, and air-conditioning contractors (Table 1).

Although there are thousands of workers currently working in these occupations across the Bay Area, their Location Quotients are below 1, or their concentration in the region is lower than the national average, meaning that these occupations make up a smaller share of the Bay Area workforce than they do for the broader country (Table 1). For example, the concentration of HVAC Technicians is 13% lower in the Bay Area than the national average. Therefore, the additional occupational demand spurred by the zero-NOx appliance rules will need to be met from a smaller-than-average pool of workers.

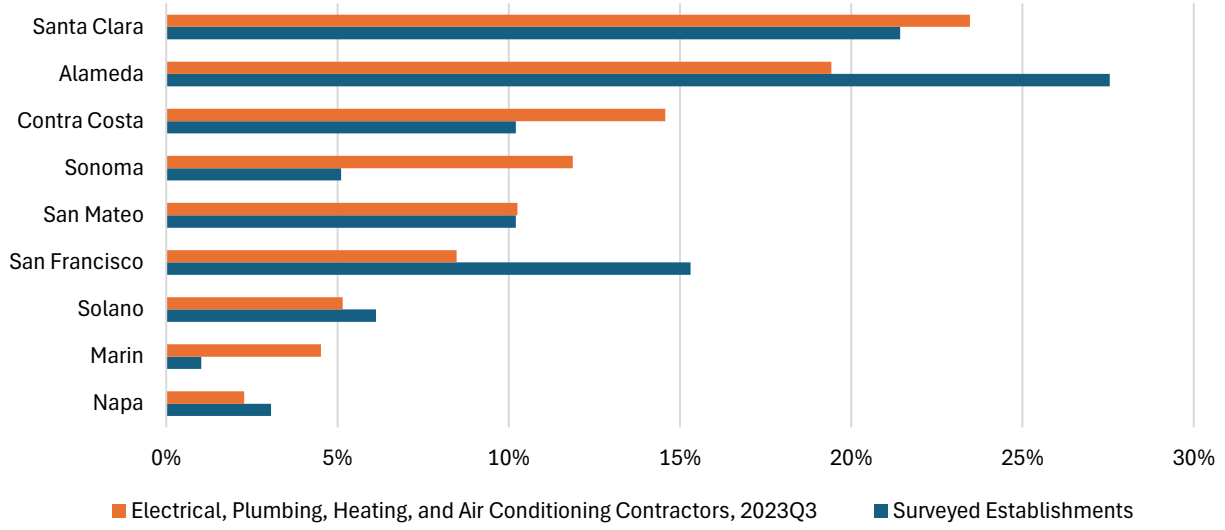
Table 1. Employment of Key Occupations[11]

	Total Employment	Location Quotient	Number of Establishments
Electricians	19,632	0.98	2,090[12]
Plumbers, Pipefitters, and Steamfitters	10,887	0.86	2,180[13]
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	9,339	0.87	

[8] U.S. Bureau of Labor Statistics' SOC Code 47-2111
[9] U.S. Bureau of Labor Statistics' SOC Code 47-2152
[10] U.S. Bureau of Labor Statistics' SOC Code, 49-9021
[11] Data from JobsEQ, 2023Q3.
[12] Electrical Contractors and Other Wiring Installation Contractors (NAICS 23821)
[13] Plumbing, Heating, and Air-Conditioning Contractors (NAICS 23822)

The research team surveyed 98 business establishments with at least one location in the nine-county Bay Area region that are involved with the installation or maintenance of water or air heating, air conditioning, ventilation, and refrigeration equipment (including heat pumps, water heaters, or heat pump space heating and cooling systems) in residential and commercial buildings or properties. Figure 1 highlights the distribution of electrical, plumbing, heating, and air conditioning contractors across the nine counties within the Bay Area region[14] compared to that of the surveyed establishments. As shown in the orange vs. blue bars, some counties may be over-represented in survey responses (i.e. Alameda, San Francisco) while other counties may be under-represented in survey responses (i.e. Contra Costa, Marin).

Figure 1. Distribution of Establishments by County[15]



All three key occupations earn a median hourly wage greater than the regional median hourly wage ($33.18) across all occupations. Electricians earn the highest median hourly wage at $43.82 compared to Plumbers and HVAC Technicians. At 75th percentile, which may be closer to the typical rate for union workers under prevailing wages or project labor agreements, Plumbers tend to earn a wage marginally higher than Electricians. In all three wage ranges, HVAC Technicians earn the lowest wages (Table 2).

Interviews with employers and training providers suggest that in the appliance install job market, the residential sector is often the least desirable. As one training provider mentioned, the commercial sector

[14] Contractors' data sourced from JobsEQ, 2023Q3, for NAICS 23821 and 23822.
[15] Contractors' data sourced from JobsEQ, 2023Q3, for NAICS 23821 and 23822.

is the most attractive, offering the highest wages and benefits, while the residential sector—even within the union—is less financially attractive. This dynamic means that best-trained talent often aims for the more lucrative commercial sector, while the residential sector often serves as further development for those with less training.

The median hourly wages for all key occupations exceed the current living wages[16] for single adults with no dependents, and those for Electricians and Plumbers also exceed the family sustaining wages for households of four with two working parents.[17] It is important to note that the current residential building appliance install job market is largely comprised of low road contractors, which means that wages may be on the lower end of the distribution highlighted below in Table 2.

Table 2. Hourly Wage Ranges for Key Occupations

	25th Percentile Wage	Median Hourly Wage	75th Percentile Wage
Electricians	$30.65	$43.82	$61.86
Plumbers, Pipefitters, and Steamfitters	$30.79	$39.68	$62.78
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$28.68	$38.09	$49.70
All Occupations in the Economy	$21.85	$33.18	$58.27

ADJACENT OCCUPATIONS

O*NET—a free online database supported by the US Department of Labor/Employment and Training Administration—lists the top Knowledge, Skills, and Attributes needed for specific occupations. Many of the top Knowledge, Skills, and Abilities are shared across the key occupations. For instance, all three key occupations have Building and Construction as a one of the most-needed knowledge attributes, Problem Sensitivity and Near Vision as top ability, and Critical Thinking as a top skill.

Knowledge	Skills	Abilities
Building and Construction	Critical Thinking	Problem Sensitivity
Mechanical	Troubleshooting	Near Vision

[16] Living wages—unlike the federal poverty line—include regionally-specific costs, such as housing, healthcare, and transportation, and therefore provide a more local perspective of economic well-being.
[17] MIT Living Wage Calculator. https://livingwage.mit.edu/metros/41860

Mathematics	Repairing	Deductive Reasoning

Based on the skills and experience needed for the job, the O*NET Career Changers Matrix[18] provides a list of the optimal jobs that workers in a specified occupation may transfer into with the least effort. Table 3 shares the top five adjacent occupations, identified by this resource, that are best suited to transition into Electricians, Plumbers, and HVAC Technicians. However, as many of these adjacent occupations are a part of other construction and installation trades--which are also currently in high demand--significant transition from these adjacent occupations into the three priority occupations is unlikely to occur in the current labor market.

Table 3. Top Five Adjacent Occupations of the Key Occupations

	Adjacent Occupation #1	Adjacent Occupation #2	Adjacent Occupation #3	Adjacent Occupation #4	Adjacent Occupation #5
Electricians	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Elevator Installers and Repairers	Telecommunications Equipment Installers and Repairers, Except Line Installers	Mobile Heavy Equipment Mechanics, Except Engines	Millwrights
Plumbers, Pipefitters, and Steamfitters	Maintenance and Repair Workers, General	Millwrights	Commercial Divers	Boilermakers	Stonemasons
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Elevator Installers and Repairers	Electronic Equipment Installers and Repairers	Farm Equipment Mechanics and Service Technicians	Mobile Heavy Equipment Mechanics, Except Engines	Millwrights

CONTRACTOR WAIT TIMES FOR SERVICES

About half (51 percent) of emergency repair customers wait two days or less but waits can be longer for some customers. One-third (33 percent) of surveyed firms disclosed that their customers typically wait three to seven days for emergency replacement or repair work on residential water heaters or HVAC systems. Fortunately, customers of more than half (51 percent) of the firms often wait two days

[18] https://www.onetcenter.org/dictionary/20.3/excel/career_changers_matrix.html

or less while a small percentage (six percent) of firms have wait times that are longer than one week (Figure 2).

Most contractors are not booked out for weeks on end, but a sizable share have wait lists that exceed one month. For non-emergency replacement and repair work of residential water heaters or HVAC systems, most (55%) firms reported that their installation crews are typically available in one week or less. One-quarter (25%) are typically booked out between one and four weeks. Still, six percent of installation crews are booked out for three months or longer (Figure 3). Among those who are booked out for a week or longer, the average wait time is 6 weeks with the median wait time reported as 4 weeks.

Figure 2. Length of Time Customers Typically Wait for an Emergency Replacement or Repair of Residential Water Heaters or HVAC Systems

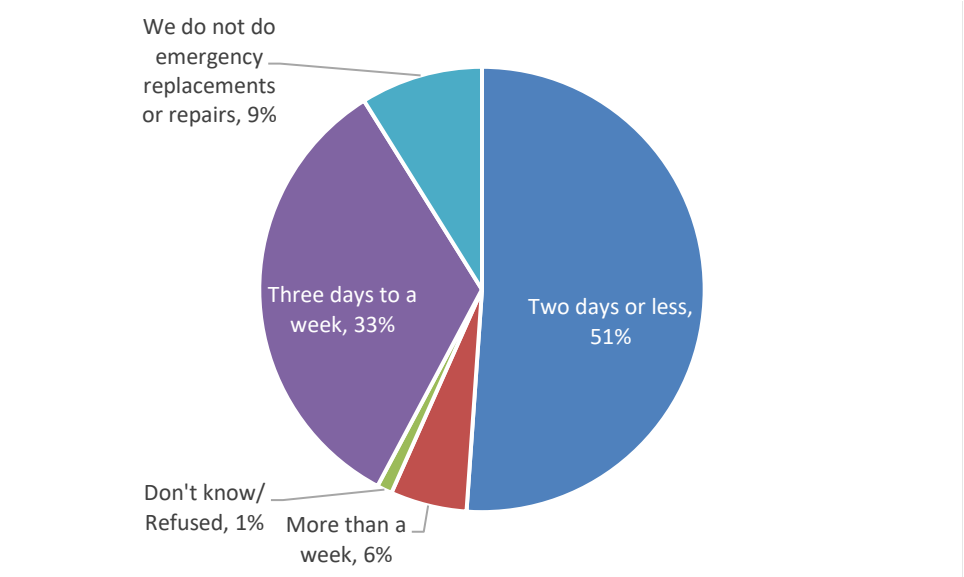
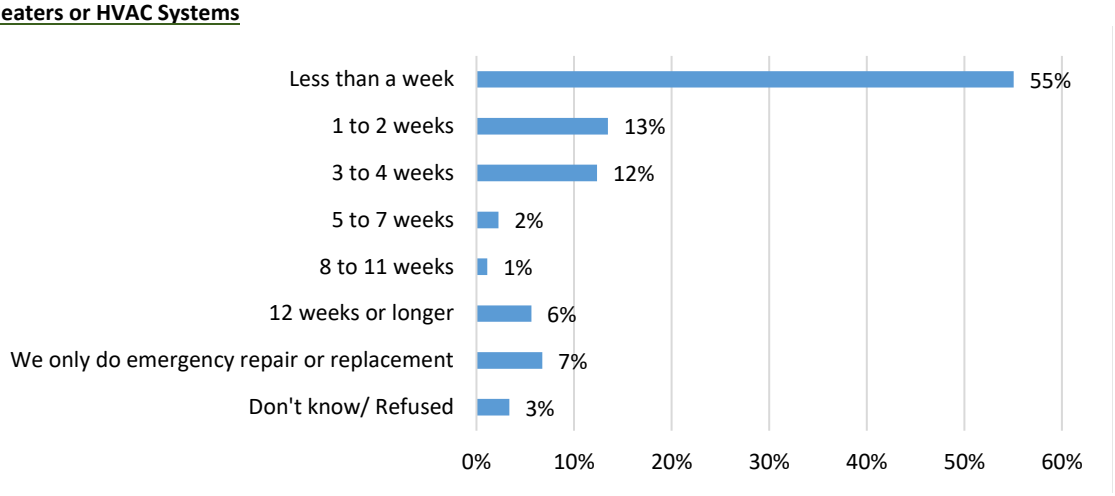


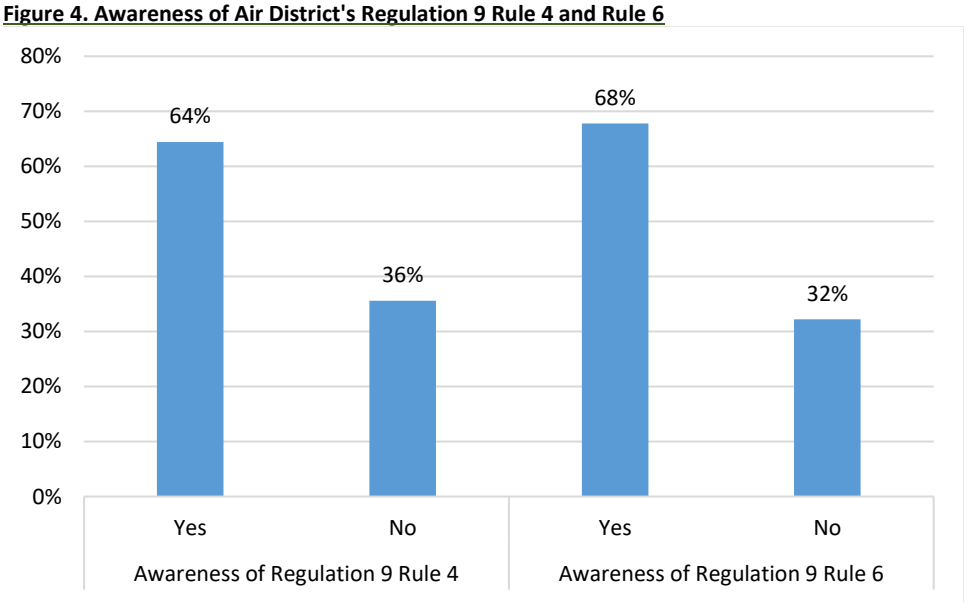
Figure 3. Length of Time Installation Crews are Fully Booked Out for Non-Emergency Repair or Replacement of Residential Water Heaters or HVAC Systems



AWARENESS OF INCENTIVES AND BAY AREA AIR QUALITY MANAGEMENT DISTRICT REQUIREMENTS

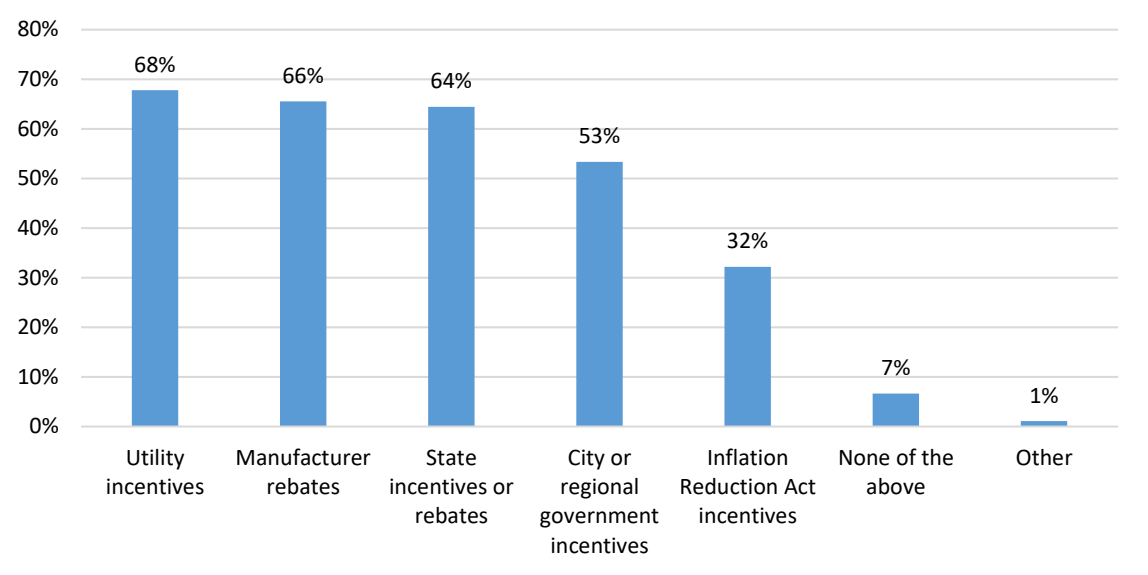
Most surveyed firms reported being familiar with the Air District's Regulation 9 Rule 4 and Rule 6 requiring natural gas-fired furnaces and natural gas-fired water heaters, respectively, manufactured after the rule compliance dates to emit no Nitrogen Oxides. Still, there is a significant proportion of firms, about one-third, that claim to be unfamiliar with these rules (Figure 4). This finding suggests that awareness campaigns through common contractor touchpoints (Figure 21) may be necessary.

Figure 4. Awareness of Air District's Regulation 9 Rule 4 and Rule 6



Incentives and rebates offered by utility companies, manufacturers, and state governments are the most commonly-known programs among surveyed contractors, while Inflation Reduction Act incentives are the least well-known. When asked about their awareness of available incentives, surveyed contractors most frequently highlighted their awareness of utility incentives (68 percent) and manufacturer rebates (66 percent); followed by awareness of state incentives and rebates, as well as city or local government incentives (53 percent). Contractors reported lower rates of awareness of Inflation Reduction Act incentives, likely because they have yet to be rolled out in full (Figure 5).

Figure 5. Familiarity of Incentives Among Surveyed Firms



Roughly half of surveyed contractors participate in state or local direct installation incentive programs. Most contractors not involved in direct install programs (60 percent), felt these programs are not a good fit for their businesses. 40 percent of non-participants attributed their lack of participation to being too busy or already having enough work orders, 13 percent reported that these direct installation programs are not financially viable for their companies, and seven percent said they are not able to meet the qualification standards of these programs. Still, there is some potential for additional uptake of direct install programs, as 24 percent of surveyed firms not already participating noted that they are just not familiar with these programs and nine percent felt unclear about the program application requirements (Figure 7).

Figure 6. Does Your Company Participate in State or Local Direct Installation Incentive Programs?

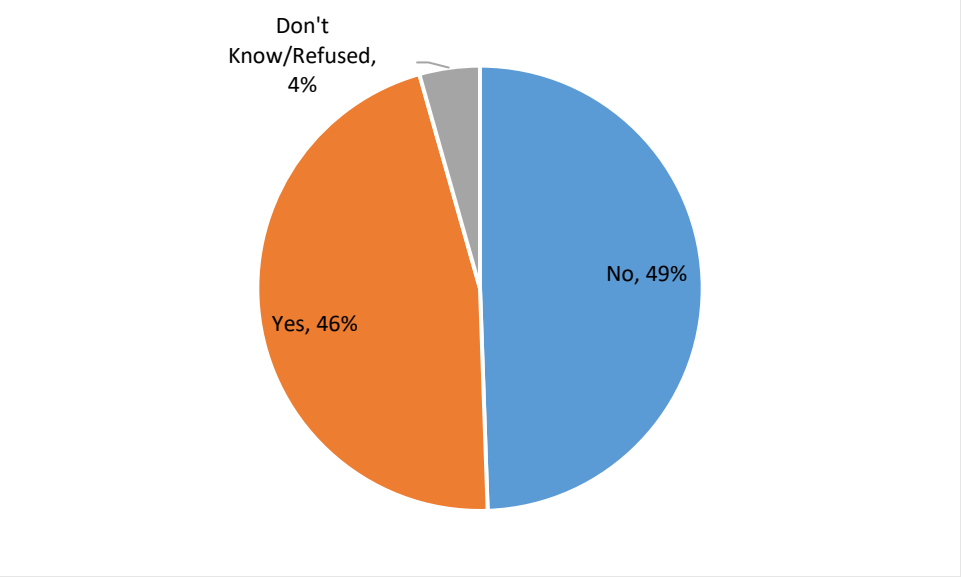
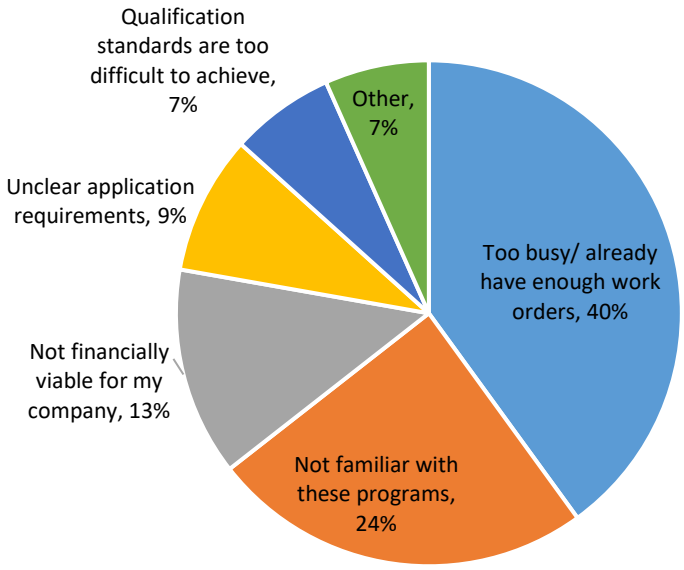


Figure 7. [Among Non-Participants] Why Does Your Company Not Participate in State or Local Direct Installation Incentive Programs?

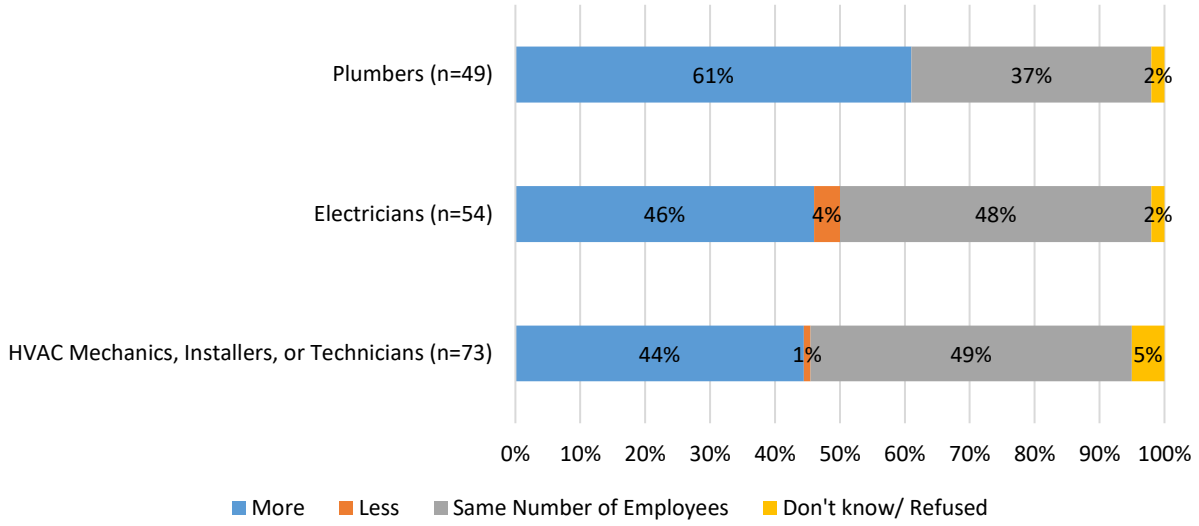


DEMAND FOR WORKERS

FORECASTED DEMAND

More than 90 percent surveyed contractors of HVAC, electrical, and plumbing workers expect to either grow or stay the same size over the next three years. Among the firms that expect to grow, overall growth rates for each occupation are projected to be greater than 10 percent. 61 percent of surveyed contractors employing plumbers (Plumber firms), 46 percent of surveyed contractors employing electricians (Electrician firms), and 44 percent of surveyed contractors employing HVAC Technicians (HVAC firms) anticipate growth (Figure 8). Over the next three years, firms reported having an overall projected growth rate of 23 percent for Plumbers, 15 percent for Electricians, and 14 percent for HVAC Technicians.

Figure 8. Expectation of Employee Growth Over the Next Three Years, by Occupation

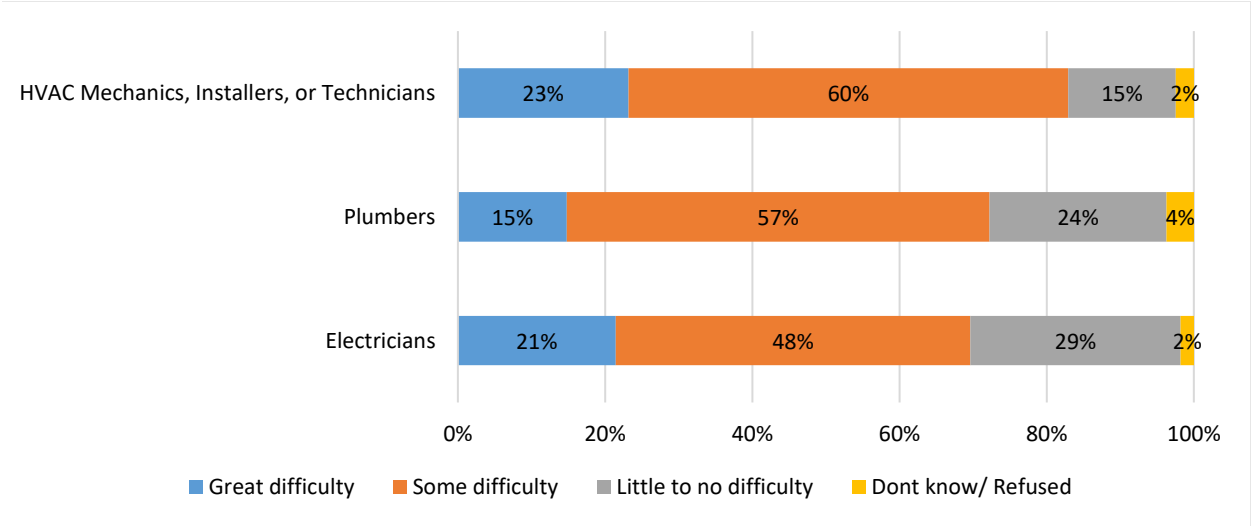


HIRING CHALLENGES

A majority of surveyed employers of Plumbers, Electricians, and HVAC Technicians have at least some difficulties in hiring for the primary occupations impacted by the Air District rules zero NOx appliance requirements. HVAC Technician employers experienced the most hiring difficulty compared to Electrician and Plumber employers; Three-in-five (60 percent) HVAC firms reported "some difficulty" in hiring and almost one-quarter (23 percent) reported "great difficulty" (Figure 9).

Firms with less than half of their HVAC Technician, Electrician, or Plumber employees represented by a union, or covered under a collective bargaining agreement or a project labor agreement (PLA), more frequently reported experiencing at least some hiring difficulty than firms with higher rates of unionization or PLA coverage. In fact, 86 percent of surveyed HVAC firms with less than 50 percent unionization or PLA coverage reported having "great difficulty" or "some difficulty" in hiring HVAC Technicians.

Figure 9. Employers' Level of Difficulty with Hiring Qualified Workers, by Occupation



In the Air District's nine-county region, applicants' lack of training or education as well as a lack of experience were the greatest contributors to hiring challenges for open HVAC Technician, Electrician, and Plumber positions. HVAC Technician, Electrician, and Plumber employers who relayed at least some hiring difficulty most frequently (63 percent, 62 percent, and 49 percent, respectively) agreed that there are enough applicants for positions in these occupations, but they do not have the training or education needed for the job. For all three occupations, this was followed by agreement that these applicants do not have the work experience needed (Figure 10, Figure 11, and Figure 12).

Applicants' lack of training or education, as well as the applicants' lack of prior work experience, were the most prominent issues for both residential and commercial firms. The importance of work experience alongside trainings was relayed in several interviews as well.

Hiring challenges also differed greatly among commercial and residential firms. More than half of the residential HVAC firms agreed that there were not enough applicants for their open HVAC Technician positions while only one-quarter (23 percent) of commercial HVAC firms felt that way. Commercial

plumbing firms did not seem to be struggling with having enough applicants--only one-in-ten (10 percent) commercial electrical firms agreed they are struggling to get applicants.

Figure 10. Level of Agreement with Hiring Difficulty Statements by HVAC Technician Employers

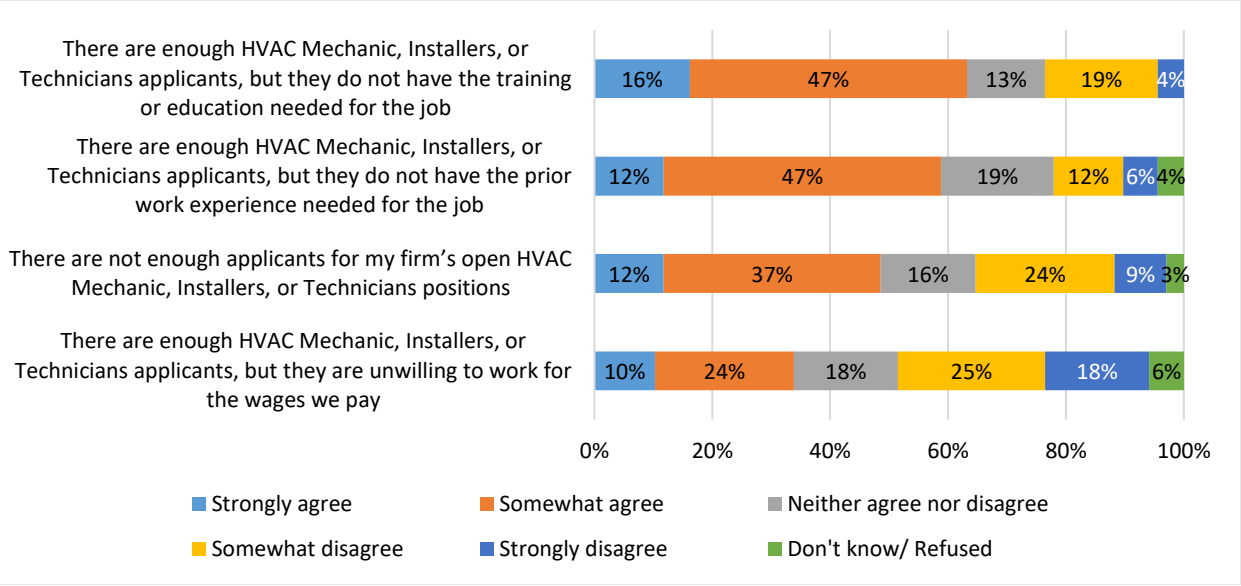


Figure 11. Level of Agreement with Hiring Difficulty Statements by Electrician Employers

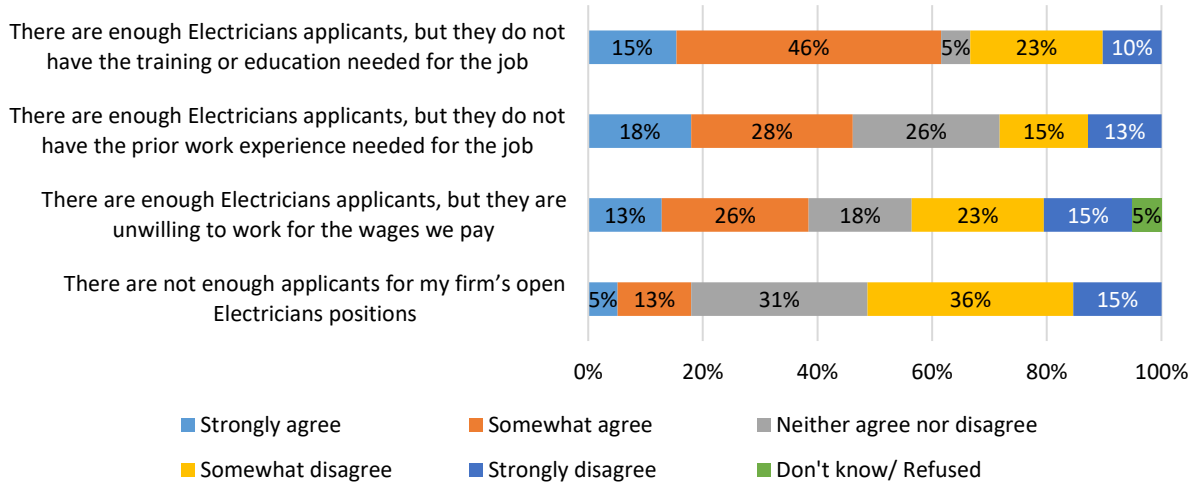
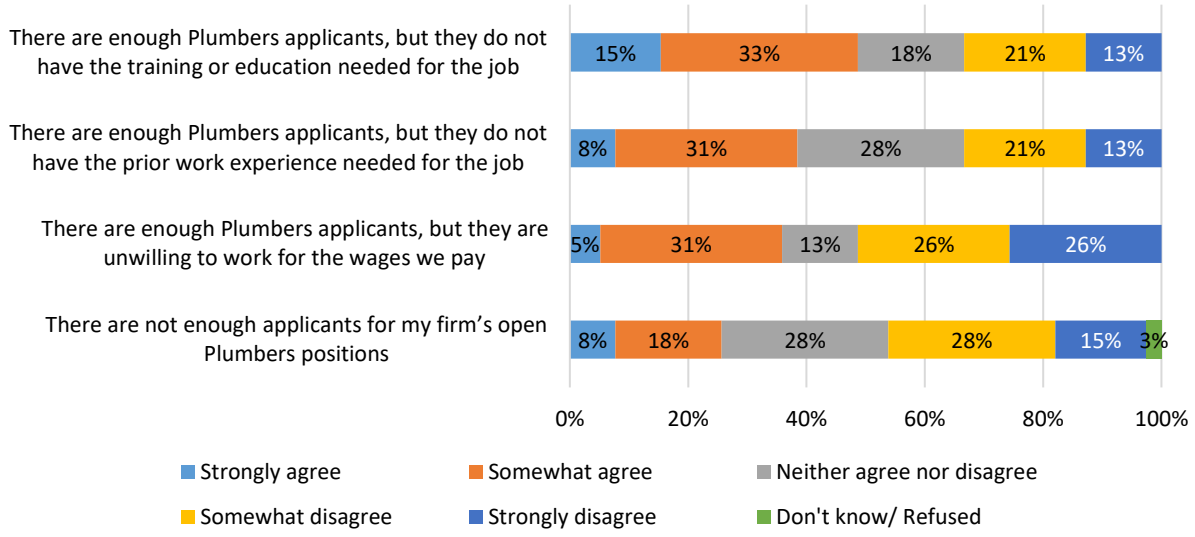


Figure 12. Level of Agreement with Hiring Difficulty Statements by Plumber Employers



KEY SKILLS AND CERTIFICATIONS

The certification process to become a licensed contractor depends on the occupation, but it can present a challenge for some individuals. For example, to get an HVAC contractor's license in California one must pass the trade exam, pass the California Law and Business exam, pass an asbestos exam, provide a contractor bond, meet the insurance requirements, and importantly—pass a background check. This process can present a substantial barrier to potential contractors and may even limit the number of individuals who seek contractor licenses—resulting in fewer employers in the industry. One residential contractor noted that as soon as workers become licensed, they'll often leave their current job to start their own contracting business where they can make more money. This turnover makes some contractors hesitant to get staff formally trained. It was also mentioned that securing licensure outside of a union is rather difficult as well, particularly for Electricians.

Outside of state and local contractor licenses or certifications, common certifications include U.S. Environmental Protection Agency (EPA) 608 certifications for handling refrigerants for HVAC Technicians, plumbing design certifications for Plumbers, and electrical code certifications along with more specialized electrical system certifications (including solar photovoltaic panel systems and lighting

systems) for Electricians. Many employers of these occupations also frequently seek workers with driver's licenses. [19]

To install heat pumps, common certifications sought by surveyed employers include EPA Section 608 Certifications; Occupational Health and Safety Administration (OSHA) certifications; North American Technician Excellence (NATE) certification; and state or local licenses or certifications. More specifically, surveyed HVAC Technician employers frequently listed the EPA 608 Certification--or EPA refrigerant certification, and NATE certification as requirements for their workers installing heat pumps. The most commonly required certifications for Electricians installing heat pumps are local or state certifications or licenses and EPA Section 608 or EPA Universal Certification. Among surveyed employers with Plumbers, the EPA Universal Section 608 Certification and industry certifications such as Microgeneration Certification Scheme (MCS) for quality assurance were cited as requirements for heat pump installing-Plumbers.

Table 4. Common Certifications Required/Preferred by Employers, by Occupation

	Electricians	Plumbers, Pipefitters, and Steamfitters	Heating, Air Conditioning, and Refrigeration Mechanics and Installers
Certifications	Local/state certification or contractor license	EPA 608 Universal Certification	EPA 608 Universal Certification or refrigerant certification
	EPA 608 Universal Certification	Industry certification (incl. Quality Assurance, Manufacturer, NITC, CI, API)	General HVAC or specialty HVAC certification
	Electrician journeyman or master certification	Business or professional certification	NATE Certification
	NATE certification	Plumber journeyman or master certification	Local/state certification or contractor license
	Electrical code	Plumbing design	Driver's license
	Specialized electrical system certification	Driver's license	
	Driver's license		

[19] Sourced from the Bureau of Labor Statistics' Occupational Outlook Handbook, O*NET, and JobsEQ Real Time Intelligence (RTI) Job Postings. Accessed February & March 2024.

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TRAINING & SUPPLY OF WORKERS

PRIOR WORK EXPERIENCE

Employers prefer to hire applicants with at least some job experience for open entry-level HVAC Technician, Electrician, and Plumber positions. For all three key occupations, employers most frequently seek applicants with one to three years of prior work experience in a comparable position (Figure 13). 29 percent said that applicants from community college, apprenticeship, and other job training programs are lacking in certain skills (Figure 14). 48 percent of these surveyed employers reported that these applicants are most frequently missing or lacking skills developed by hands-on training or work experience, followed by professional skills (19 percent) (Figure 15). Training programs that involve on-the-job training as part of the program can provide participants with work experience and exposure to professional workplaces.

While both residential and commercial contractors most frequently prefer applicants to have some level of, or on-the-job training, contractors who primarily work on residential buildings are more willing to hire applicants newer to the field than commercial contractors.

Figure 13. Minimum Required Level of Prior Work Experience Employers Expect Entry-Level Applicants to Possess, by Occupation

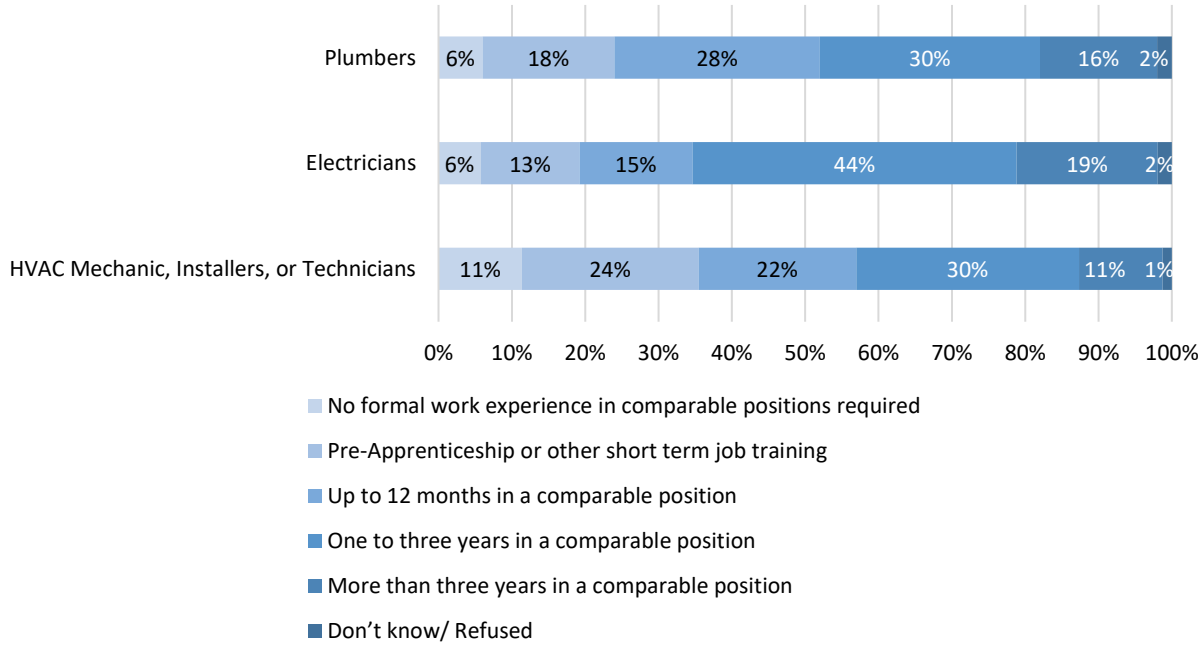


Figure 14. Are There Any Skills That Applicants Coming from Community Colleges, Apprenticeships, or Other Job Training Programs Are Typically Missing or Deficient In?

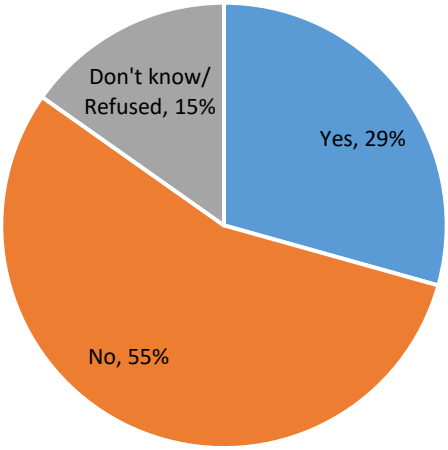
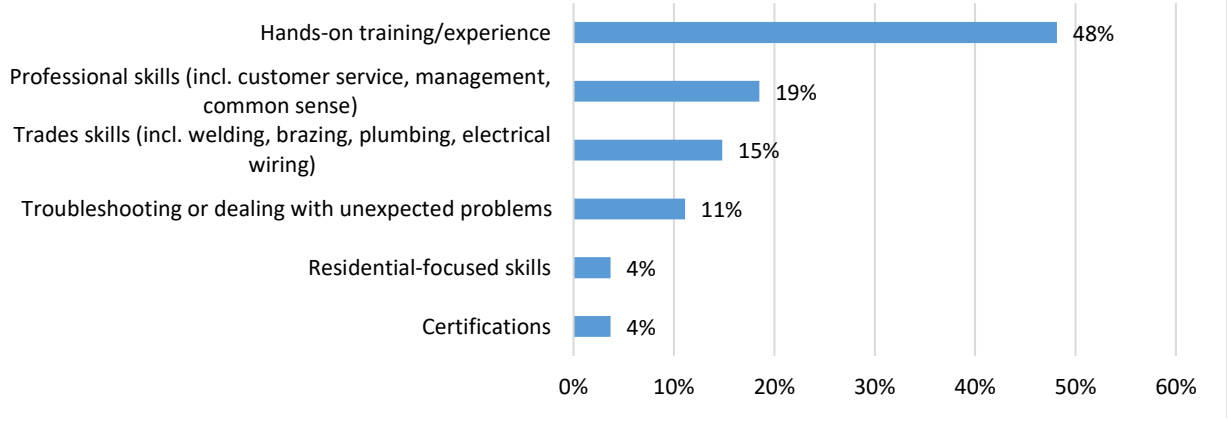


Figure 15. Skills of which Applicants for Key Occupations from Community Colleges, Apprenticeships, or Other Job Training Programs are Deficit or Missing



TRAINING INVENTORY

A comprehensive review of available training and credentialing programs at a variety of organizations for the three key occupations revealed 185 unique training programs available in the Bay Area. While many programs are designed to serve multiple types of workers (current workers, workers in adjacent

occupations, and new workers),[20] across all three occupations, the research team identified over 150 programs for new workers (Table 7).

Just over 34 percent of the identified programs geared towards HVAC Technicians, followed by 26 percent for Electricians, and 14 percent for Plumbers (Table 5). Roughly 21 percent of the programs are not targeted to a specific key occupation but are instead general construction trades programs designed to introduce new workers to the construction industry and trades occupations, including in HVAC, Electrical, and Plumbing roles, with foundational knowledge and skills. Of the identified programs, private training companies host the most at 22 percent, then community colleges (21 percent), and labor unions or Joint Apprentice Training Centers (JATCs) (18 percent).[21] Institutions with Career Technical Education (CTE) programs, such as trade or technical schools, host 16 percent of the identified trainings. Fewer than ten percent of the programs can be found at industry associations and community-based or non-profit organizations (Table 6).

Union apprenticeships are incredibly competitive. About half of those who take entrance exams do not pass. Math and comprehension of work problems were suggested to be the greatest barriers to passing the exam. Even for those who do pass the exam, getting accepted is a long shot. About ten percent of those who pass the exam are offered an apprenticeship. Of those who start the application process at all, only about 5% receive offers. Applicants who get rejected often return to the working world, either to continue to gain job site experience in the non-union residential market or move on to another industry.

Table 5. Number of Identified Training Programs by Primary Occupational Focus

Primary Occupational Focus	Number of Programs	Percent of Total
HVAC Technicians and Mechanics	62	34%
Electricians	49	26%
Plumbers, Pipefitters, and Steamfitters	26	14%
General Construction Trades	39	21%
HVAC Technicians and Mechanics, Electricians, and Plumbers	9	5%

[20] Programs for new workers include apprenticeships, pre-apprenticeship or job readiness programs, associate degrees, and career technical education courses or pathways. Programs for adjacent workers include job readiness, upskilling, and certification programs that workers in adjacent occupations can complete to get a better understanding of these specific occupations. Current worker programs are mostly upskilling programs or continuing education programs designed to give current more advanced or more specialized knowledge in their field.

[21] Note that a single entity may host multiple programs that were identified.

Table 6. Number of Identified Training Programs by Institution Type

Institution Type	Number of Programs	Percent of Total
Private Training Company	40	22%
Community College	39	21%
JATC or Labor Union	33	18%
Technical or Trade School, or CTE Institution	30	16%
Community-Based/Non-Profit Organization	11	6%
Industry Association	11	6%
College/University	9	5%
Utility Company	6	3%
High School	4	2%
Government Agency	2	1%

Table 7. Number of Identified Training Programs for Worker Type by Occupation[22]

	Number of Programs		
Primary Occupational Focus	**Current Workers[23]**	**Adjacent Workers[24]**	**New Workers[25]**
HVAC Technicians and Mechanics	19	40	47
Electricians	11	22	39
Plumbers, Pipefitters, and Steamfitters	3	7	23
General Construction Trades	0	2	39
HVAC Technicians and Mechanics, Electricians, and Plumbers	8	8	4
Total	**41**	**79**	**152**

The identified training programs are more concentrated in the southern part of the nine-county Bay Area region than in the northern part of the region, and there are bigger clusters of training programs in more populated areas. 30 percent of the programs are available online, while Santa Clara County hosts the largest share (19 percent) of in-person training programs, followed closely by Alameda County (18 percent). There is a scarcity of training in Napa, Marin, Solano, and Sonoma counties given that less than four percent of the identified programs were in each these counties. (Figure 16).

[22] Please reference footnote 20 for a description of programs for each type of worker.
[23] Programs geared towards upskilling existing workers.
[24] Programs geared towards transitioning workers from other fields or who already have some fundamental skills.
[25] Programs geared towards new entrants to the labor market or with no relevant experience.

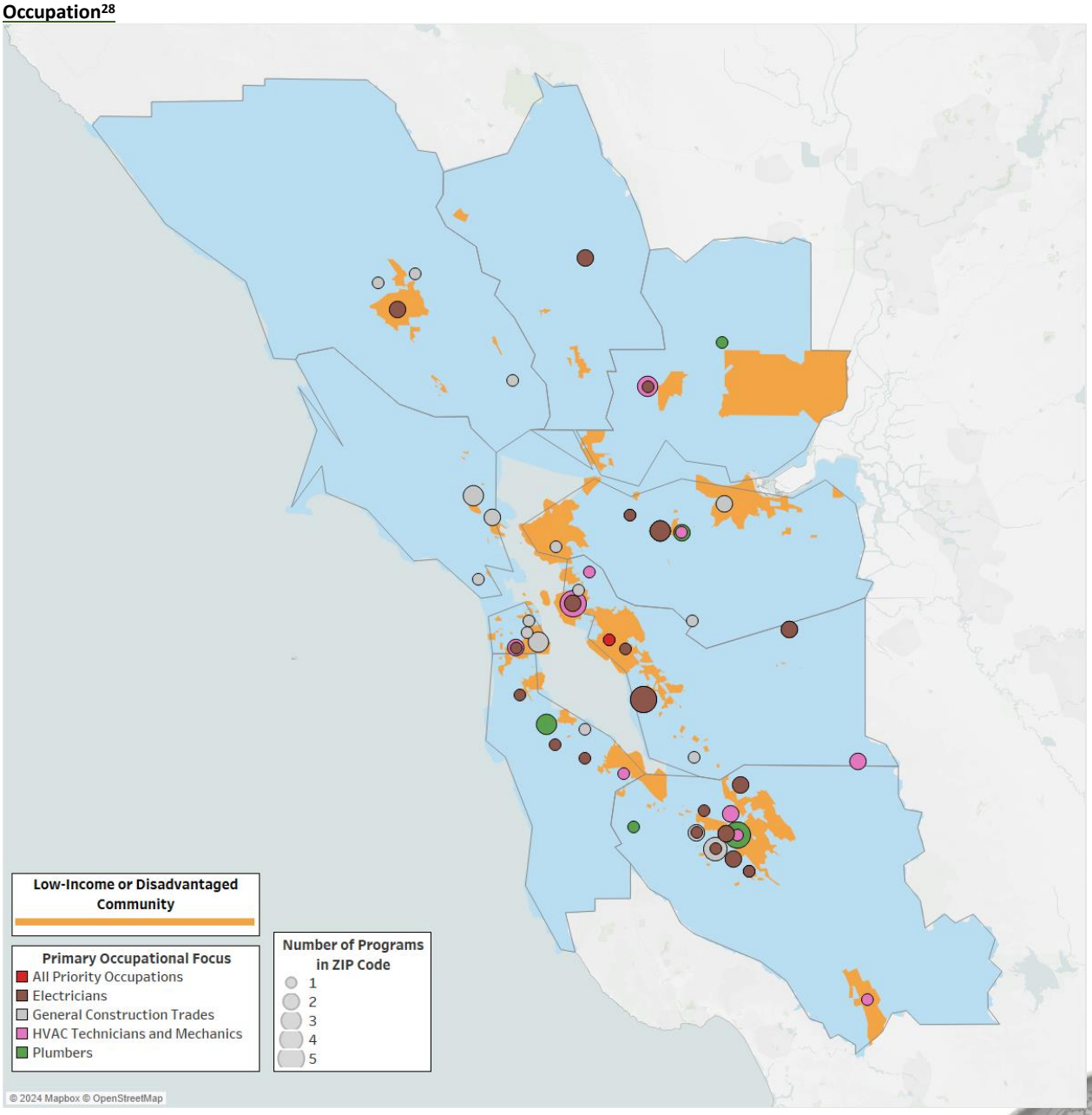
Overall, trainings for HVAC Technicians and Electricians appear to be more centralized in Alameda and Santa Clara Counties while Plumbing trainings are more concentrated in Contra Costa and Santa Clara Counties. General construction trades programs are spread across Santa Clara, Alameda, Contra Costa, Marin, and San Francisco Counties. However, there is low variety in available trainings in the northern counties, Marin, Napa, Solano, and Sonoma, in particular. There are no HVAC Technician trainings in Marin, Napa, or Sonoma Counties and programs for Plumbers are only found in Napa and Solano Counties. (Figure 16).

Many identified training programs are in or near Low-Income or Disadvantaged Communities[26] (LIDACs), yet there are still LIDAC regions that are isolated from training programs, and some that have access to trainings for only one or two key occupations. LIDACs in Napa County are not close to any identified training, and while Marin County LIDAC areas have access to general construction trades programs, they do not have access to HVAC Technician, Electrician, or Plumber programs. Similarly, LIDACs in Santa Clara and Solano Counties that are toward the outskirts of the Bay Area region are close to only a few trainings, limited to HVAC Technicians in the Santa Clara LIDAC and to Plumbers in the Solano LIDAC (Figure 16). A greater variety of trainings in LIDACs would provide additional options or pathways for community members into construction trades and the clean energy industry. Continuing efforts to ensure that trainings are accessible—both geographically and financially—to LIDAC populations is crucial to support a more robust and diverse workforce. Financial barriers not only include direct costs like tuition, but also indirect costs like childcare, transportation, or foregone income.

Teacher staffing and compensation is another challenge. One interviewee noted that they were making 1/3 of the amount of money as a teacher as they had the previous year working in the field. It is no surprise that that teacher was planning to return to the field, and as of the time of the conversation, a replacement teacher had not yet been found.

[26] Low-Income or Disadvantaged Communities are defined as a combination of three types of communities across the nine Bay Area counties: Inflation Reduction Act Disadvantaged Communities defined by the US Environmental Protection Agency; Assembly Bill (AB) 617 communities established by the Community Air Protection Program of the California Air Resources Board; and Metropolitan Transportation Commission Equity Priority Communities.

Figure 16. Map of Identified Training Programs and Low-Income or Disadvantaged Communities[27] in the Bay Area, by Occupation[28]

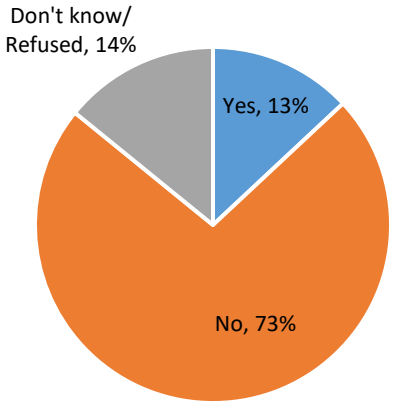


[27] Low-Income or Disadvantaged Communities are defined as California's Assembly Bill 617 Communities, the California Metropolitan Transportation Commission's Equity Priority Communities, and the Environmental Protection Agency's Inflation Reduction Act Disadvantaged Communities, at the block group level.

FINDING AND RECRUITING TALENT

There is a lack of partnership or direct collaboration between employers and education or training providers in the Bay Area which may be hindering the region's HVAC Technician, Electrician, and Plumber talent pipeline. Overall, almost three-quarters (73 percent) of all surveyed firms reported having no direct partnerships with any education or training providers (Figure 17). Fostering these types of partnerships could help bridge the gaps between student/program participant outcomes and employer requirements as well as streamline the pathway for trainees and job seekers to employment. Among surveyed firms who do partner with education or training providers, common collaborations included labor unions or Joint Apprentice Training Centers (JATCs) while others partner with industry associations or not-for-profit organizations involved in building science or activities.

Figure 17. Do You Work Directly with Any Education or Training Providers?



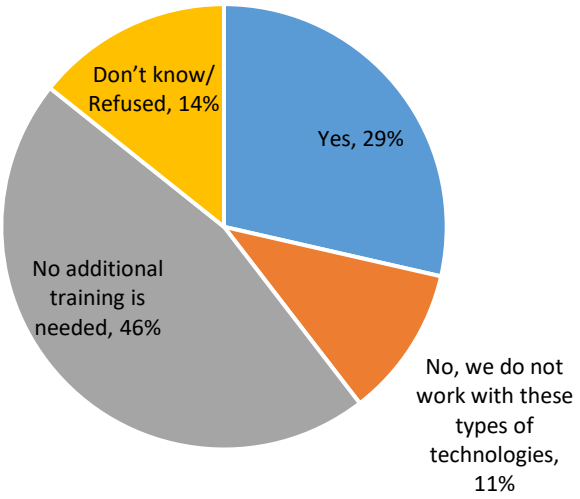
CURRENT TRAINING NEEDS AND INTEREST IN ADDITIONAL TRAINING

Almost half (46 percent) of HVAC, electrical, and plumbing firms surveyed do not think additional training for HVAC heat pumps or heat pump water heaters is needed. Only 29 percent of these firms shared that they are planning to provide their staff with this additional training while one-in-ten (11

[28] Trainings identified as being for "All Priority Occupations" refer to trainings that are available for HVAC Technicians, Electricians, Plumbers, as well as other types of contractors, primarily for upskilling or training contractors in specific residential building topics such as heat pump water heaters, building science, and home electrification for energy retrofits.

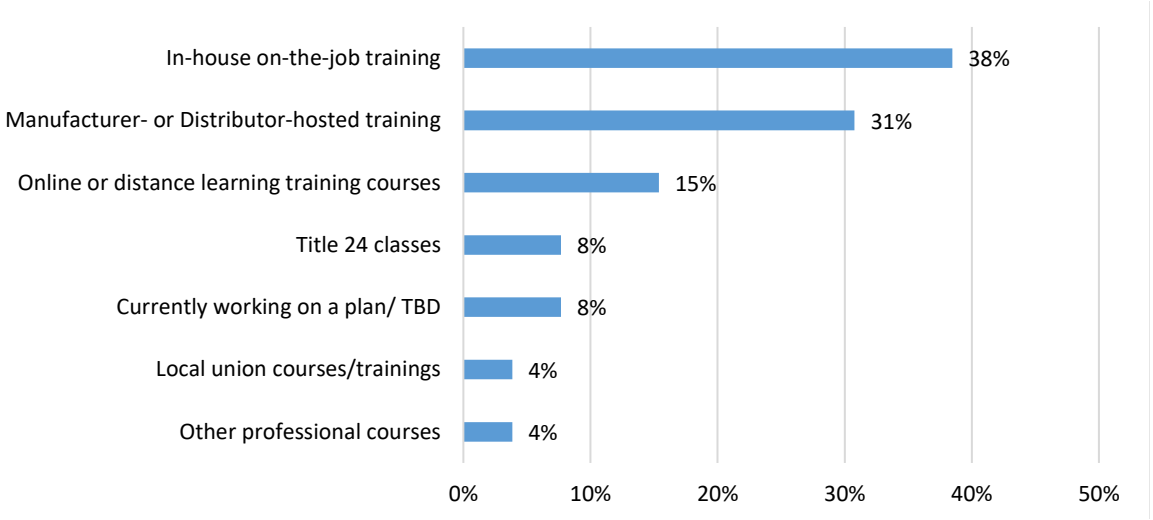
percent) do not work with ~~these~~ heat pump technologies and will not be providing the training (Figure 18).

Figure 18. Are You Planning on Providing Your Staff with Additional Training for HVAC Heat Pumps or Heat Pump Water Heaters?



For the 29 percent of contractors who said they are planning to provide additional HVAC heat pump and heat pump water heater training, in-house instruction while on the job was the most popular method of providing the training (38 percent), followed by manufacturer- or distributor-hosted trainings (31 percent) (Figure 19). To streamline the dissemination of heat pump technology instruction and information, entities such as manufacturers, distributors, and online resources should be targeted as a way to reach employers and share the instruction or information. Organizations that already offer trainings—such as TECH Clean California—could serve as the implementer of these actions, while BAAQMD may work in a more supportive role. Labor unions, JATCs, and industry associations are other training resources commonly utilized by contractors to administer additional trainings to staff.

Figure 19. Ways That Surveyed Firms Are Planning to Administer Additional Training for HVAC Heat Pumps and Heat Pump Water Heaters to Staff



Contractors who want their employees to learn more about or to become certified in new HVAC or plumbing technologies prefer to send their employees to HVAC distributor training facilities or local training institutions. Among the surveyed contractors who did not report that additional training is unnecessary for their staff, more than half (53 percent) shared that they are "very interested" in opportunities to get their employees trained or certified in new HVAC and plumbing technologies and 27 percent are "somewhat interested" (Figure 20). 56 percent of the contractors who expressed interest in this type of training reported that an HVAC distributor training facility is the best way for training to be delivered, followed by 26 percent who said that hosting trainings at local training institutions (including community colleges and JATCs) is the best delivery method (Figure 21).

78 percent of HVAC firms reported working closely with air-source heat pumps for HVAC, while 67 percent said they work closely with heat pump water heaters. This leaves a portion of contractors who may still need the right information and training on installing, maintaining, and repairing air-source heat pumps. This discrepancy may also reveal some of the technology challenges for some HVAC-specific contractors. Plumbers are typically the ones who will work with installations involving water, and so a contractor that doesn't have Plumbers on staff may not feel comfortable installing a water heating unit. As one interviewee noted, water heat pumps reside in a grey area between HVAC and Plumbing, and neither professional is entirely comfortable with the technology. Ramping up efforts to increase familiarity with heat pump water heaters among HVAC contractors may help increase the installation of these appliances across the Bay Area.

Right-sizing of heat pumps is also an area of concern. As one training provider noted, it is important that a student learns how to properly size a water heater to match the performance expected since HPWHs have a longer heating period, and that a student learns when a panel upgrade might be needed thus

requiring an Electrician and another contact point. Other important technologies, such as ducted heat pumps and watt diet approaches, were viewed as an advanced skill and something that is learned as an individual spends more time in the field, and less likely learned in a pre-apprenticeship or community college program.

Figure 20. Would Your Organization be Interested in Opportunities to Get Your Employees Trained or Certified in New HVAC or Plumbing Technologies, Including HVAC Heat Pumps or Heat Pump Water Heaters?

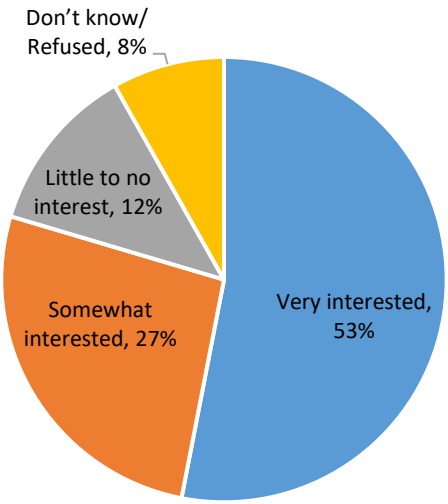
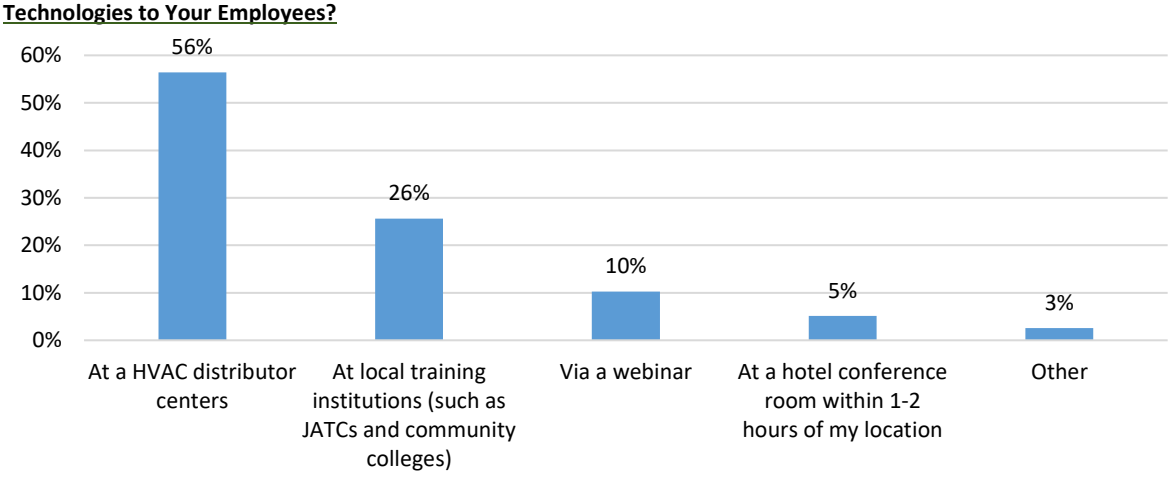


Figure 21. Best Way for the Bay Area Air Quality Management District to Deliver Training on New HVAC or Plumbing Technologies to Your Employees?



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APPENDIX

BW Research conducted employer surveys with contractors that work in the nine-county Bay Area (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties). The survey sample included a compilation of electrical contractor or HVAC contractor firms that had completed surveys for the United States Energy and Employment Report (USEER) in the last 3 years, online panel through a third party of relevant businesses, and a sample of firms known to employ the relevant industry codes (NAICS) from DataAxle. The survey instrument was programmed internally by BW Research and each respondent was assigned a unique ID to prevent duplication.

The employer survey was fielded between January 25th and March 4th, 2024 and resulted in 98 total survey completions. The average survey duration was 12 minutes.