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CENTERS OF EXCELLENCE
FOR LABOR MARKET RESEARCH

California Workforce Needs in the Water/Wastewater Industry

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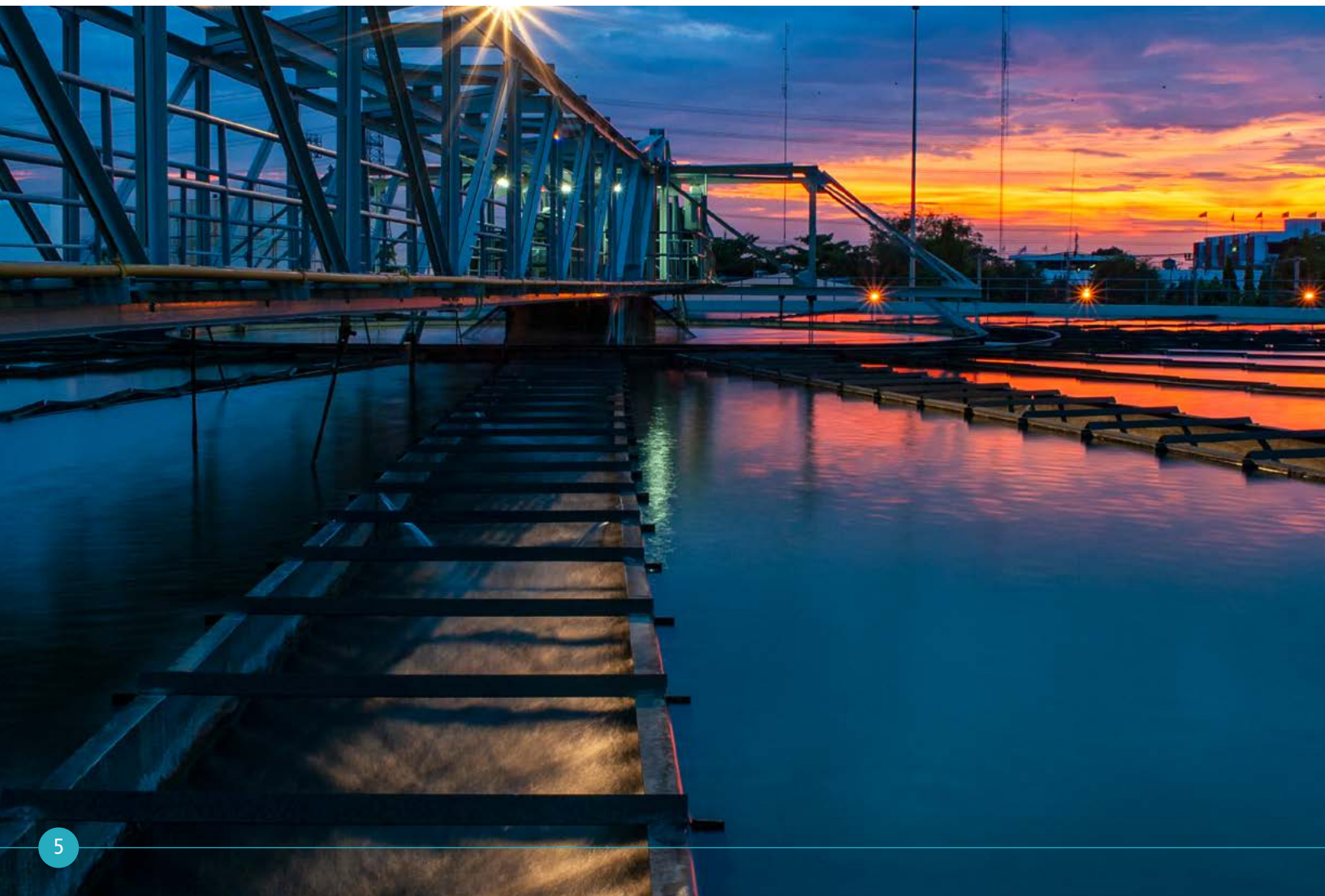


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EXECUTIVE SUMMARY

The purpose of this report is to provide a comprehensive overview of the workforce needs for mission-critical occupations in the water/wastewater industry across the state of California. Mission-critical occupations are defined as essential positions in water and wastewater operations that are difficult to fill and typically require at least a high school diploma. This report includes specific and actionable recommendations for employers and community colleges to address current and future workforce challenges for mission-critical occupations. Building on more than a decade of research on the water/wastewater industry, the Centers of Excellence for Labor Market Research (COE) previously authored regional studies on this subject, but this report marks the first time that the COE conducted such an analysis at the statewide level.

Research Questions, Findings, and Recommendations

This report is guided by three research questions that were developed through a combination of reviewing prior literature and interviews with industry representatives. Each research question contains subquestions that informed the quantitative and qualitative data collection process. After analyzing both primary and secondary data, the COE then developed key findings and recommendations. Exhibit 1 lists each respective research question and its subsequent findings and recommendations. These recommendations were developed in response to the findings for each research question and are not listed in order of importance.

Recommendation Themes

Through the analyses conducted in this report, four themes emerged from the recommendations. While some recommendations may address multiple themes, each recommendation has been categorized based on its dominant theme.

Awareness

This theme describes the need for increased water/wastewater industry awareness to attract more students and job candidates.

Diversity

This theme relates to increasing diversity in the water/wastewater industry and how the industry and community colleges can build on existing efforts.

Partnership

This theme describes how community colleges and the water/wastewater industry can improve their partnerships to make them more effective.

Skills

This theme relates to the identification of skills required for water/wastewater occupations and how community colleges can help students prepare for these occupations.



Exhibit 1. Findings and Recommendations

Research Question (RQ)	RQ Findings	Recommendations
RQ1: What is the labor market for the water/wastewater industry?		
RQ1a: What are the mission-critical occupations?	<p>RQ1a Findings: This report identified eight-mission critical occupations, which are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma:</p> <ol style="list-style-type: none"> 1. Calibration Technologists and Technicians 2. Electrical and Electronic Engineering Technologists and Technicians 3. Electricians 4. Industrial Machinery Mechanics 5. Machinists 6. Maintenance and Repair Workers, General 7. Operating Engineers and Other Construction Equipment Operators 8. Water and Wastewater Treatment Plant and System Operators <p>All eight mission-critical occupations have high entry-level wages and low typical entry-level education requirements and are relatively homogenous when considering workforce demographics.</p> <p>Throughout the state, the water/wastewater industry accounts for 13% of employment in these mission-critical occupations and these occupations account for 4% of water/wastewater employment.</p>	<p>The water/wastewater industry may want to conduct further research on emerging occupations developing due to technological advancements, legislation and/or regulatory requirements, or other factors to predict future mission-critical occupations in preparation for future industry needs. Though the intent of the industry survey was to identify potential emerging areas, most respondents either did not respond or said they did not know which areas were developing in the industry. It is unclear whether that is due to respondents' lack of interest in emerging occupations or lack of knowledge.</p>
RQ1b: What is the supply and demand for water and wastewater treatment plant and system operators and other mission-critical occupations?	<p>RQ1b Findings: There is significant demand but low supply for these mission-critical occupations in California, indicating a labor supply gap of 32,049 awards.</p> <p>There is a projected labor market demand of 37,459 annual job openings statewide through 2026.</p> <p>Of those, 12% (4,442) are projected to be in the water/wastewater industry.</p> <p>An average of 5,410 awards (supply) have been conferred by educational institutions over the past three years.</p> <p>Community colleges account for 71% of the supply from educational institutions in California and provide training programs for all but one mission-critical occupation.</p>	

Research Question (RQ)	RQ Findings	Recommendations
<p>RQ1c: What are the essential skills for these mission-critical occupations across all industries and within the water/wastewater industry?</p>	<p>RQ1c Findings: The essential skills for water/wastewater mission critical occupations are similar across all industries yet skills identified by survey respondents and listed in job postings vary greatly.</p> <p>This report identified the top 10 skills listed in online job postings for each mission-critical occupation.</p> <p>Essential skills are highly transferable across all industries.</p> <p>Most skills identified by survey respondents do not align with those requested in online job postings for any of the mission-critical occupations.</p> <p>This potential misalignment could contribute to industry’s challenge of hiring qualified employees and deserves to be studied further.</p>	<p>Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.</p> <p>Address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnership with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly in age and gender.</p> <p>The water/wastewater industry should conduct further research to determine if there is a misalignment between the skills in online job postings and those considered essential by hiring managers and, if so, the degree of misalignment.</p> <p>Once essential skills for each mission-critical occupation have been identified, industry and community colleges, via advisory boards, should collaborate to refine curriculum and address these skills.</p> <p>Leverage industry and community college partnerships to develop cooperative work experiences and other work-based learning opportunities that will help students earn as they learn skills for employment in the water/wastewater industry.</p>
<p>RQ2: What are the current and potential challenges facing the water/wastewater industry?</p>		
<p>RQ2a: What methods do water and wastewater agencies typically use to recruit new hires (e.g., unions, online job postings, word of mouth)?</p>	<p>RQ2a Findings: Water/wastewater companies rely on online recruiting platforms and company job boards for recruitment, but report difficulty in finding qualified candidates.</p> <p>Nearly 60% of survey respondents indicated that these platforms ranked as their top two resources for hiring; community colleges ranked fourth.</p> <p>Survey respondents have the most difficulty finding job candidates with relevant prior work experience, adequate technical skills, and required licenses or certifications.</p>	<p>While most water/wastewater recruitment comes from online platforms, building continued awareness of the industry as a whole should attract more candidates.</p> <p>Utilize the opportunity of hiring new people to address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnerships with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly when considering age and gender.</p>

Research Question (RQ)	RQ Findings	Recommendations
<p>RQ2b: Are existing connections between industry and supply from community colleges and other training providers in place to fill demand for these occupations?</p>	<p>RQ2b Findings: While some connections exist, improvement is required to address the high demand for water/wastewater workers.</p> <p>Community colleges have had the most success finding job opportunities for students by directly partnering with employers.</p> <p>Interview participants shared they would like to partner with water/wastewater companies to develop on-the-job training, internship, and/or other work-based learning (WBL) opportunities, which could help students meet job qualifications for mission-critical occupations.</p>	<p>Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.</p>
<p>RQ3: How are these industry challenges mitigated?</p>		
<p>RQ3a: How have water/wastewater agencies addressed challenges associated with a retiring workforce?</p>	<p>RQ3a Findings: Water/wastewater agencies have created opportunities for internal employees to be developed, promoted in-house opportunities, and have partnered with educational institutions.</p> <p>These agencies report that 5% of their current workforce is eligible to retire without penalty within the next five years.</p> <p>37% of workers in the eight mission-critical occupations are 50 and older, which is comparatively higher than all occupations throughout the state as well as the California population.</p>	<p>Address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnership with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly in age and gender.</p> <p>The water/wastewater industry should examine their current workforce - specifically how internal training, professional development, and job promotion opportunities are offered as well as participation rates for traditionally underrepresented groups. These factors directly impact hiring and recruitment practices and may contribute to pay gaps. Improving on them may increase opportunities for underrepresented groups.</p>
<p>RQ3b: How can the California Community Colleges support these efforts?</p>	<p>RQ3b Findings: California Community Colleges offer training programs for all but one mission-critical occupation and students in those programs are generally more diverse than the current water/wastewater mission-critical workforce</p>	<p>Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.</p> <p>Due to the skills transferability for these mission-critical occupations, it would behoove community colleges to provide students with sufficient knowledge to enter employment in a variety of industries thereby increasing employment opportunities for students.</p> <p>Community colleges could consider adding specialized courses to address water/wastewater industry-specific needs and/or offer customized training options to water/wastewater employers.</p>



INTRODUCTION

The water/wastewater industry is a critical component of local, state, and national infrastructure. There are over 150,000 public drinking water systems and more than 16,000 publicly owned wastewater treatment systems throughout the country; more than 80% of the US population receives their drinking water from these systems.¹ Water/wastewater systems are also vital to public health by treating water for contaminants such as natural chemicals and minerals, fertilizers and pesticides, and heavy metals.² As California continues to suffer through drought conditions, water reuse and wastewater recycling is critical to clean water provision. In 2013, the State Water Resources Control Board encouraged water agencies to increase water recycling efforts, increase the use of stormwater, and substitute as much recycled water for potable water as possible by 2030.³ Numerous water districts responded to this call to action. For example, the Sacramento Regional County Sanitation District completed wastewater treatment upgrades in 2021 that remove 99% of ammonia from wastewater while the Orange County Water District treats 100% of its wastewater for indirect potable use with the world's largest water purification system.⁴

Despite the importance of water/wastewater systems, the infrastructure for these systems is aging. A report from the Bipartisan Policy Center noted that "much of our drinking water infrastructure is nearing the end of its useful life." Additionally, the American Society of Civil Engineers estimated that \$3.6 trillion would need to be invested to raise infrastructure support systems to acceptable levels by 2020.⁵ The recently passed Infrastructure Investment and Jobs Act, commonly known as the Bipartisan Infrastructure Law, allocates \$55 billion to water initiatives over the next five years.⁶

In addition to these infrastructure challenges, the water/wastewater industry continues to report workforce vulnerabilities related to a large number of impending retirements and hiring difficulties for mission-critical occupations, which are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma. National research on the workforce needs of the water/wastewater industry has been conducted by government organizations, think tanks, and industry associations.

Current Workforce Challenges and Vulnerabilities

In a report from 2020, the Environmental Protection Agency (EPA) noted that approximately one-third of drinking water/wastewater operators will be eligible to retire in the next 10 years.⁷ The Brookings Institute found that water/wastewater workers tend to be older and lack gender and racial diversity, "pointing to a need for younger, more diverse talent."⁸ Additionally, Brookings observed that there were several gaps to address in order to hire and retain a skilled and diverse workforce, including the scale between urban and rural areas to address hiring issues and expand workforce opportunities, lack of public visibility for the water/wastewater workforce, a lack of diversity within the industry, as well as identifying and hiring skilled workers. The American Water Works Association (AWWA) has published an annual report on the water industry since 2004. The 2022 AWWA report found that an aging workforce/anticipated retirements ranked 4th among issues facing the water sector in 2022; diversity and inclusion ranked 24th.⁹

¹ Cybersecurity & Infrastructure Security Agency, "Water and Wastewater Systems Sector," CISA, accessed October 6, 2022, <https://www.cisa.gov/water-and-wastewater-systems-sector>.

² Centers for Disease Control and Prevention, "Importance of Water Quality and Testing," Centers for Disease Control and Prevention, last modified October 30, 2020, https://www.cdc.gov/healthywater/drinking/public/water_quality.html.

³ California State Water Resources Control Board, "Amendment to Recycled Water Policy," California State Water Resources Control Board, accessed October 6, 2022, https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/rs2013_0003_a.pdf.

⁴ Edward Ring, "The Abundance Choice, Part 10: Time to Stop Wasting Wastewater," California Globe, last modified June 4, 2022, <https://californiaglobe.com/articles/the-abundance-choice-part-10-time-to-stop-wasting-wastewater/>.

⁵ Bipartisan Policy Center, "America's Aging Water Infrastructure," Bipartisan Policy Center, last modified September 2016, <https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2019/03/BPC-Aging-Water-Infrastructure.pdf>.

⁶ McKinsey & Company, "The US Bipartisan Infrastructure Law: Reinvesting in Water," McKinsey & Company, last modified February 17, 2022, <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/the-us-bipartisan-infrastructure-law-reinvesting-in-water>.

⁷ U.S. Environmental Protection Agency, "America's Water Sector Workforce Initiative: A Call to Action," U.S. Environmental Protection Agency, accessed October 6, 2022, https://www.epa.gov/sites/default/files/2020-11/documents/americas_water_sector_workforce_initiative_final.pdf.

⁸ Joseph Kane and Adie Tomer, "Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity," Brookings, last modified March 8, 2022, <https://www.brookings.edu/research/water-workforce/>.

⁹ American Water Works Association, "2022 State of the Water Industry," AWWA, accessed October 6, 2022, <https://www.awwa.org/Professional-Development/Utility-Managers/State-of-the-Water-Industry>.

The Centers of Excellence for Labor Market Research (COE), a grant-funded labor market information technical assistance provider for California Community Colleges, have conducted multiple water/wastewater industry studies over the past decade; each report employed a mixed-methods study of quantitative labor market information combined with qualitative information collected through employer surveys. Though these reports have primarily focused on the Bay Area and Southern California, the findings from these studies mirror national trends.

Results from a 2009 COE survey of Bay Area water/wastewater employers, conducted in collaboration with BAYWORK, found that regional employers had difficulty hiring for seven mission-critical occupations, including water and wastewater treatment operators, instrument technicians, and electricians. These employers reported that 40% of workers in these mission-critical occupations would be eligible to retire in five years.¹⁰

In 2011, the COE conducted a similar survey of Southern California water/wastewater employers in collaboration with AWWA. In it, employers reported that up to 18% of workers in seven mission-critical occupations would be eligible to retire in the next five years. Employers also expressed concerns that the on-the-job knowledge for retiring workers would be lost, with younger workers unable to receive adequate knowledge and mentoring from these experienced workers.¹¹

An updated survey of Bay Area water/wastewater employers was conducted in 2017 in collaboration with BAYWORK and Jewish Vocational Service (JVS). This report expanded the list of “mission-critical” occupations from seven to nine and surveyed employers representing more than 5,900 employees. Additionally, the study provided an overview of training programs related to the selected occupations in the Bay Area. The study found that most surveyed employers faced worker shortages for mission-critical occupations due to a large number of imminent retirements, difficulties in hiring qualified candidates, and difficulties in promoting existing workers. The study also noted that Bay Area programs supplied fewer labor for mission-critical occupations than employers needed to fill openings.¹²



¹⁰ “Water and Wastewater Occupations,” Centers of Excellence for Labor Market Research, last modified October 10, 2009, <https://coecc.net/bay-area/2009/10/water-wastewater-occupations-2/>.

¹¹ “Water and Wastewater Occupations in Southern California,” Centers of Excellence for Labor Market Research, last modified October 15, 2011, <https://coecc.net/inland-empire-desert/2011/10/key-findings-water-wastewater-occupations-in-southern-california-3/>.

¹² “Water and Wastewater Career Pathways,” Centers of Excellence for Labor Market Research, last modified February 15, 2017, <https://coecc.net/bay-area/2017/10/water-and-wastewater-career-pathways-2/>.

The findings from previous reports conducted by the federal government, think tanks, industry associations, and the COE can be grouped into three categories:

- 1. Aging Workforce and Looming Retirements:** Though estimates vary, employers report that a significant percentage of their workforce will become eligible for retirement in the near future.
- 2. Workforce Diversity and Inclusion:** Because water/wastewater workers tend to be older and nearing retirement age, there is a lack of young workers. Additionally, there is a lack of gender and racial diversity.
- 3. Industry Awareness:** The industry is not well known among students and often neither they nor job seekers are aware of opportunities in the water/wastewater industry.

Existing Efforts to Address Workforce Challenges

These challenges are not new. Since at least 2005, AWWA has been reporting on the issue of impending shortages due to demographic shifts and Baby Boomer retirements.¹³ AWWA noted that within the 10-year period between 2005 and 2015, 35% of utility employees would become eligible to retire and raised concerns about the potential loss of institutional knowledge associated with those retirements.¹⁴

Recognition of these issues and strategies to address them have appeared in water districts' strategic plans since at least 2007. For example, the East Bay Municipal Utility District's (EBMUD) 2007 strategic plan notes that EBMUD had been examining the demographics of its workforce and making plans to address the anticipated shortage of workers. These efforts included developing in-house staff for promotional opportunities where shortages are expected, enhancing recruitment and retention efforts to "attract new workers who may not be aware of the variety of career opportunities we offer."¹⁵ In its 2020 strategic plan, EBMUD outlined similar strategies for workforce development, such as determining future needs and implementing actions to close the gaps, developing internal employees to "grow our own", and enhance its ability to recruit qualified and diverse staff.¹⁶ Other examples include strategic plans from the South San Joaquin Valley Irrigation District¹⁷, San Diego County Water Authority¹⁸, and Metropolitan Water District of Southern California.¹⁹

The EPA has also analyzed efforts by the water/wastewater industry to address workforce challenges. In September 2022, the EPA updated its compendium of water workforce studies throughout the country. Two of these case studies come from California, with one focused on retention and the other focused on community partnerships.

The EPA reports that the Moulton Niguel Water District in Orange County has implemented several efforts, two of which address the aging workforce and create industry awareness through partnerships with local educational institutions. The Future Leaders of Water (FLOW) Initiative was created in 2019 and "seeks to inspire a new generation of water champions through education and recruitment."²⁰ According to the EPA, Moulton Niguel has had 20 FLOW engagements, which focus on the career opportunities available within the water/wastewater industry. Moulton Niguel meets with students enrolled in career and technical education (CTE) programs at local high schools and community colleges and has created partnerships with Santiago Canyon College, as well as UC Davis and UC Irvine. Moulton Niguel has also hired several employees who attended Santiago Canyon College.

¹³ Gay P. DeNileon and John Stubbart, "Employment Outlook Good for Operators, Grim for Utilities," *Opflow* 31, no. 5 (2005): xx, doi:10.1002/j.1551-8701.2005.tb01800.x.

¹⁴ Myron A. Olstein, "Managing the coming brain drain," *Journal - American Water Works Association* 97, no. 6 (2005): xx, doi:10.1002/j.1551-8833.2005.tb10911.x.

¹⁵ Neil S. Grigg and Mary Zenzen, *The Water Workforce: Recruiting & Retaining High-performance Employees* (American Water Works Association, 2009), https://www.google.com/books/edition/_/LBit2BU2tvoC?hl=en&gbpv=1&pg=PA1&dq.

¹⁶ East Bay Municipal Utility District, "Strategic Plan - 9th Edition," East Bay Municipal Utility District, accessed October 10, 2022, https://www.ebmud.com/download_file/force/3390/801?Strategic_Plan_06_30_2020.pdf.

¹⁷ South San Joaquin Irrigation District, "South San Joaquin Irrigation District Strategic Plan, 2017-2021," South San Joaquin Irrigation District, accessed October 15, 2022, <https://www.ssjid.com/wp-content/uploads/2020/04/flipbook.pdf>.

¹⁸ San Diego County Water Authority, "2019-2023 Business Plan," San Diego County Water Authority, last modified October 2018, https://www.sdewa.org/sites/default/files/business_plan.pdf.

¹⁹ The Metropolitan Water District of Southern California, "Succession Planning: Workforce Excellence," The Metropolitan Water District of Southern California, accessed October 16, 2022, https://es.mwdh2o.com/media/20036/mwd_succession.pdf.

²⁰ U.S. Environmental Protection Agency, "Making Water a Career Choice: A Compendium of Water Workforce Studies from Across the County," U.S. Environmental Protection Agency, last modified September 2022, https://www.epa.gov/sites/default/files/2021-01/documents/wf_case_study_compendium.pdf.



Additionally, the San Francisco Public Utilities Commission (SFPUC) has engaged more than 77,000 students since 2012 through its Kindergarten-to-Career Strategy. The SFPUC engages students starting in elementary school through an animated video, a water curriculum aimed at students in 4th through 6th grades, and a learning garden. These efforts continue in middle school with wastewater treatment plant tours and culminate in internship and other work-based learning opportunities for high school students. These opportunities include summer and academic-year youth project-based learning programs and paid after-school and summer internships. A partnership with John O’Connell High School in San Francisco was launched in 2017, with the SFPUC partnering with teachers to develop project-based curriculum with the goal of creating student awareness of career opportunities in the utility industry, providing students with work-based learning experience, and connecting graduating students to internship, apprenticeship, and job opportunities. Since 2017, there has been an annual average of 320 John O’Connell High School students engaged as well as 160 internship participants.

Another compendium from the Water Environment Federation includes one case study from California. In 2008, LA Sanitation and Environment (LASAN) established the Plant Equipment Trainee Program that hires approximately 30 Plant Equipment Trainees per 12-month period. These trainees are hired as full-time employees and need a high school diploma to qualify. LASAN also partners with Los Angeles Trade Technical College (LATTC) to reduce the time it takes to become a certified water/wastewater treatment operator.²¹

Research Questions

Despite these efforts to address workforce challenges and vulnerabilities, the water/wastewater industry continues to report that it faces the same challenges today as it did in the mid-2000s. To build upon this extensive body of work, this report analyzes traditional labor market information (LMI) for the water/wastewater industry, as well as specific information for eight mission-critical occupations, and provides results from both the first COE statewide survey of water/wastewater employers and interviews of community colleges from around the state that offer water/wastewater programs.

Traditional LMI includes job counts, projections, wage data, typical education requirements, and other data collected and published by public agencies such as the Bureau of Labor Statistics (BLS), Census Bureau, and California Employment Development Department. The traditional LMI analyzed throughout this report is sourced from Lightcast, a labor market analytics firm. The survey was developed in conjunction with the Water Energy Education Alliance (WEEA) and other industry partners to identify current and future workforce needs for this critical industry.

²¹ Water Environment Federation, “Compendium of Successful Water Workforce Practices,” Water Environment Federation, accessed October 16, 2022, https://navigatetheflood.org/wp-content/uploads/sites/3/2021/10/2021_Workforce_Case_Study.pdf.

The goal of this report is to provide specific, actionable recommendations that address current and future workforce challenges which water/wastewater employers can act upon and to better connect industry with California Community College programs that train for mission-critical occupations. These mission-critical occupations are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma.

After reviewing the extensive body of literature related to water/wastewater both nationally and regionally, as well as consulting California Community College and industry stakeholders, the COE developed three main research questions (RQ), each with sub-questions, to guide this study:

RQ1. What is the labor market for the water/wastewater industry?

- a. What are the mission-critical occupations?
- b. What is the supply and demand for water and wastewater treatment plant and system operators and other mission-critical occupations?
- c. What are the essential skills for these mission-critical occupations across all industries and within the water/wastewater industry?

RQ2. What are the current and potential challenges facing the water/wastewater industry?

- a. What methods do water and wastewater agencies typically use to recruit new hires (e.g., unions, online job postings, word of mouth)?
- b. Are existing connections between industry and supply from community colleges and other training providers in place to fill demand for these occupations?

RQ3. How are these industry challenges mitigated?

- a. How have water/wastewater agencies addressed challenges associated with a retiring workforce?
- b. How can the California Community Colleges support these efforts?



Defining the Water/Wastewater Industry

For the purposes of this report, the water/wastewater industry is defined by a set of North American Industry Classification System (NAICS) codes. These codes are used by public agencies such as BLS and the Census Bureau to classify firms and track economic activity. NAICS codes are defined at the two, four, and six-digit levels, with more digits adding specificity within a larger sector or industry.

The NAICS codes that were used to define the water/wastewater industry throughout this report are listed below. Examples of employers that fall under each code are also included. Detailed descriptions of these industries are included in Appendix A.

- Water Supply and Irrigation Systems (221310)
 - Examples of Employers: Atascadero Mutual Water Company, Imperial Irrigation District, Redding Water Utility Department
- Sewage Treatment Facilities (221320)
 - Examples of Employers: Leucadia Wastewater District, San Rafael Sanitation District, Tuolumne Sewer District
- Water and Sewer Line and Related Structures Construction (237110)
 - Examples of Employers: Advanced Drainage Systems, Bakersfield Well & Pump Company, Eaton Drilling Company
- Other Heavy and Civil Engineering Construction (237990)
 - Examples of Employers: American Civil Constructors, Ghliotti Construction
- Site Preparation Contractors (238910)
 - Examples of Employers: Graniterock, Southern California Grading
- Local Government, excluding Education and Hospitals (902999)
 - Examples of Employers: Alameda County Waste Management Authority, Goleta Sanitation District, Sacramento County Environmental Management
- State Government, excluding Education and Hospitals (903999)
 - Examples of Employers: California Department of Water Resources, California Pollution Control Financing Authority

The definition used in this report is meant to capture a broad spectrum of employers in the water-wastewater industry, such as utilities, construction firms, and regulatory agencies. However, the COE recognizes that not all employers related to water and wastewater treatment, testing, or distribution will be captured by these NAICS codes. Additionally, not all employers classified under these industry codes – particularly those within construction as well as Local and State Government – will deal directly with water treatment, testing, or distribution. The employers and occupations examined in this report align with the labor supply that can be prepared through California Community College CTE programs.



Mission-Critical Occupations in the Water/Wastewater Industry

Building on previous work from the COE, this report focuses on eight mission-critical skilled trade occupations. Mission-critical occupations are defined as occupations that are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma. Like NAICS codes, these occupations are defined by a federal taxonomy of codes and descriptions. Standard Occupational Classification (SOC) codes are defined by BLS to classify workers into occupational categories for collecting and analyzing data. While all previous COE studies have used a set of common job titles that were mapped to SOC occupations, this report uses the SOC occupations directly for clarity, accuracy of reporting, and repeatability.

The mission-critical occupations are grouped into three categories: electrical, maintenance, and operational. These groups include occupations that share similar knowledge, skills, and abilities, and for which California Community Colleges provide training programs. The definition for each group is listed below.

- **Electrical Group:** Includes electricians, as well as electrical and electronic technologists and technicians that may work with controls and automated systems. One notable difference is that electricians may require completion of an electrical apprenticeship program and/or significantly more work experience than technologists or technicians.
- **Maintenance Group:** Includes general maintenance workers, calibration and instrumentation technicians that may work with supervisory control and data acquisition (SCADA) systems, and industrial machinery mechanics. Workers in these occupations install and repair pumps, motors, and other equipment in water/wastewater treatment facilities. Typically, specialized knowledge and skills are required for calibration technologists and technicians as well as industrial machinery mechanics.
- **Operational Group:** Includes three occupations with distinct functions that are essential to the core functions of a water/wastewater treatment plant. These occupations are specialized and may require a license or certification. Operating engineers and other construction equipment operators utilize heavy machinery such as backhoes, excavators, dump trucks, and other related equipment to complete construction projects and may perform repairs to water/wastewater lines. Machinists perform lathe and mill-work to fabricate parts for water/wastewater treatment plant equipment. Finally, water and wastewater treatment plant and system operators treat water and wastewater.

Exhibit 2 shows the SOC codes and occupational titles for each mission-critical water/wastewater occupation, as well as related job titles that are commonly used by employers.

Exhibit 2. Water/Wastewater Mission-Critical Occupations

Functional Group	SOC Code	Occupation Title	Related Job Titles
Electrical	17-3023	Electrical and Electronic Engineering Technologists and Technicians	Electrical Technician, Control Systems Technician,
	47-2111	Electricians	Electrician, Water Systems Electrician, Sewer Pump Station Electrician
Maintenance	17-3098	Calibration Technologists and Technicians	Calibration Technician, Engineering Technician, Instrumentation Technician
	49-9041	Industrial Machinery Mechanics	Plant Machinery Maintenance Mechanic, Water Systems Mechanic, Water Treatment Plant Repairer
	49-9071	Maintenance and Repair Workers, General	Maintenance Worker, Maintenance Services Worker, Building Maintenance Technician, Repair Technician
Operational	47-2073	Operating Engineers and Other Construction Equipment Operators	Back Hoe Operator, Heavy Equipment Operator, Water Equipment Operator
	51-4041	Machinists	Machinist, CNC Machinist
	51-8031	Water and Wastewater Treatment Plant and System Operators	Plant Operator, Wastewater Operator, Wastewater Technician, Wastewater Lead Operator

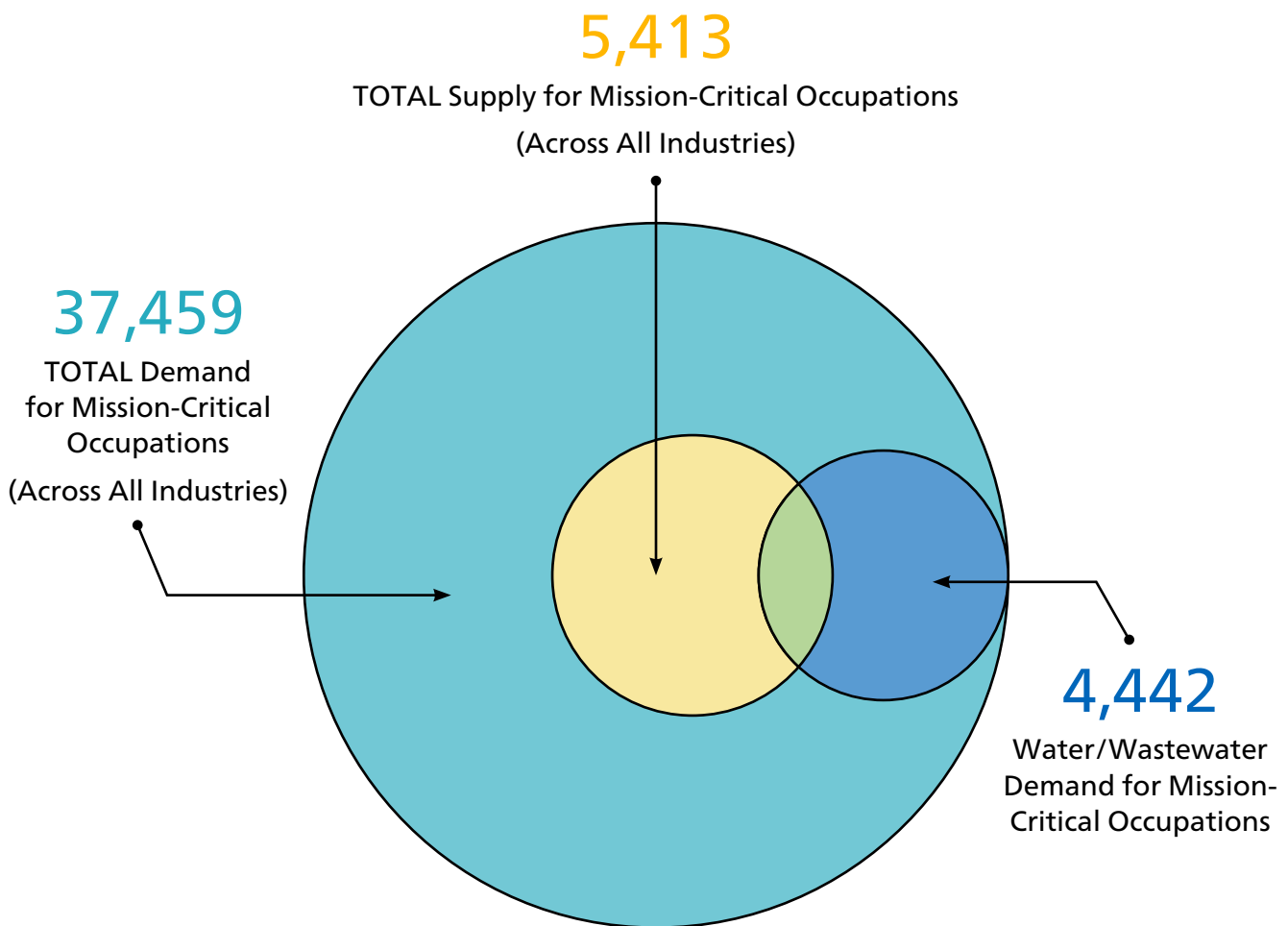
LABOR MARKET ANALYSIS

This section analyzes labor market information (LMI) throughout California for the water/wastewater industry as a whole and individually for the eight mission-critical occupations. Demographic data for each occupation is included to address the diversity of these occupations and identify areas of inequity and opportunities for engagement with potential workers that may have previously been unaware of employment opportunities in the water/wastewater sector. An analysis of online job postings is also included.

In addition to statewide data, regional information for three subregions, Southern, Central, and Northern California, is analyzed to understand regional differences. The counties included in each region are listed in Appendix A.

Exhibit 3 shows the total demand, water/wastewater demand, and educational supply for these mission-critical occupations. A detailed table with the occupational, demand, supply, wages, and typical entry-level education for each occupation is included in Appendix D.

Exhibit 3. Demand and Supply Summary



Water/Wastewater Industry

Exhibit 4 shows employment within the water/wastewater industry from 2006 and projected employment through 2026. Recession years are denoted in gray. Following the Great Recession in 2008-2009, water/wastewater industry employment declined, hitting a low of 968,547 jobs in 2013. Employment began to recover the following year and peaked in 2019 before another recession due to the COVID-19 Pandemic in 2020. As of 2021, there were 1,037,902 jobs in the water/wastewater industry, which accounted for 5% of all jobs in California. Water/wastewater industry employment is projected to increase each year through 2026, with a high of 1,069,256 jobs.

Exhibit 4. Water/Wastewater Industry Employment in California, 2006-2026

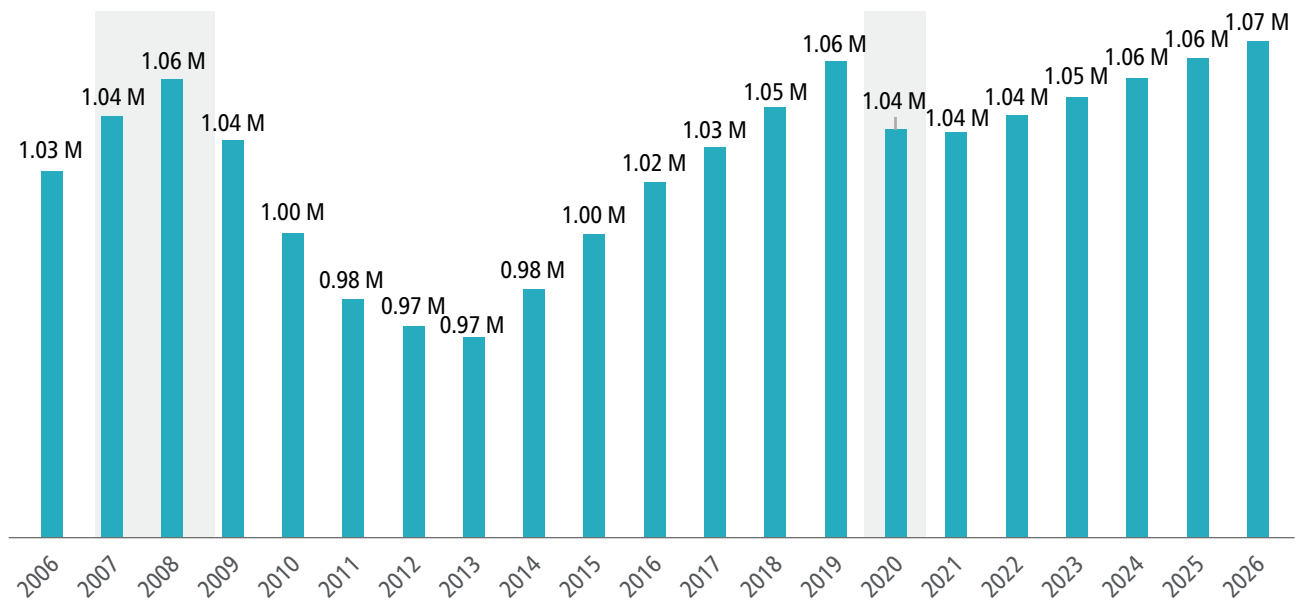


Exhibit 5 shows the number of establishments (individual companies), jobs, and average hourly earnings in the water/wastewater industry in 2021 by California subregion. Though Northern California had the highest number of establishments (9,715), it had the second highest number of jobs (387,876). Southern California had the highest number of jobs (484,180) and the highest average hourly earnings (\$45.91). This is potentially because Southern California is more densely populated and can be served by a smaller number of establishments – for example, the Los Angeles Department of Water and Power serves nearly 4 million residents within the City of Los Angeles.

Exhibit 5. Water/Wastewater Industry by Region, 2021

Region	Number of Establishments	Number of Jobs	Average Hourly Earnings
Central	3,701	163,253	\$38.77
Northern	9,715	387,876	\$39.66
Southern	5,413	484,180	\$45.91
Total, California	18,828	1,035,309	\$40.11

Mission-Critical Occupations

Within the labor market, water/wastewater entry-level jobs tend to have high wages and are considered middle-skill, meaning they typically require at least a high school diploma but less than a bachelor's degree. This makes the water/wastewater industry an ideal area of focus for California Community College Career Technical Education (CTE) programs. This section analyzes traditional labor market information and demand for the set of eight mission-critical water/wastewater occupations throughout California and its three subregions. Demand is defined by the number of annual job openings that are the result of new job growth and employee turnover.

Statewide and Regional Demand

Across all industries in California, there were 343,641 jobs in 2021 for these mission-critical occupations. Of those, 13% (44,072) were within the water/wastewater industry. Through 2026, there is projected to be significant demand, with 37,549 annual job openings throughout the state for these mission-critical occupations; 12% (4,381) are projected to be within the water/wastewater industry. Exhibit 6 shows the number of jobs in 2021, projected number of jobs in 2026, change expressed as a number and percentage, and the demand for these mission-critical occupations.

Exhibit 6. Employment for Mission-Critical Occupations in California, 2021-2026

Industry	2021 Jobs	2026 Jobs	2021-2026 Change	2021-2026 % Change	Demand (Annual Openings)
Water/Wastewater Industry	44,072	44,957	884	2%	4,442
All Industries	343,641	359,554	15,913	5%	37,459
Water/Wastewater as % of Total	13%	13%	6%	N/A	12%

To capture geographic variance in demand for mission-critical water/wastewater occupations, Exhibit 7 shows the number of jobs in 2021, projected number of jobs in 2026, the change expressed as a number and percentage, and the demand for these mission-critical occupations for the three California subregions. There is projected to be a 2% increase in the number of jobs for these mission-critical occupations. Of the 4,442 projected annual job openings, 47% (2,074) are projected to be in Southern California, 35% (1,567) are projected to be in Northern California, and 18% (802) are projected to be in Central California.

Exhibit 7. Water/Wastewater Employment for Mission-Critical Occupations by Subregion, 2021-2026

Region	2021 Jobs	2026 Jobs	2021-2026 Change	2021-2026 % Change	Demand (Annual Openings)
Central	7,907	8,103	196	2%	802
Northern	15,461	15,756	295	2%	1,567
Southern	20,704	21,098	393	2%	2,074
Total	44,169	45,139	970	2%	4,442

Exhibit 8 shows the distribution of jobs within the water/wastewater industry by mission-critical occupation group. The operational group of occupations accounted for 50% (22,197) of water/wastewater mission-critical jobs in 2021 and are projected to have the highest demand (2,335) of all three groups. Though there is projected to be growth in the number of jobs for the electrical and operational groups, employment for the maintenance group is projected to contract by 0.1%, indicating that all demand for these occupations will be created by employee turnover.

Exhibit 8. Water/Wastewater Employment for Mission-Critical Occupations by Group, 2021-2026

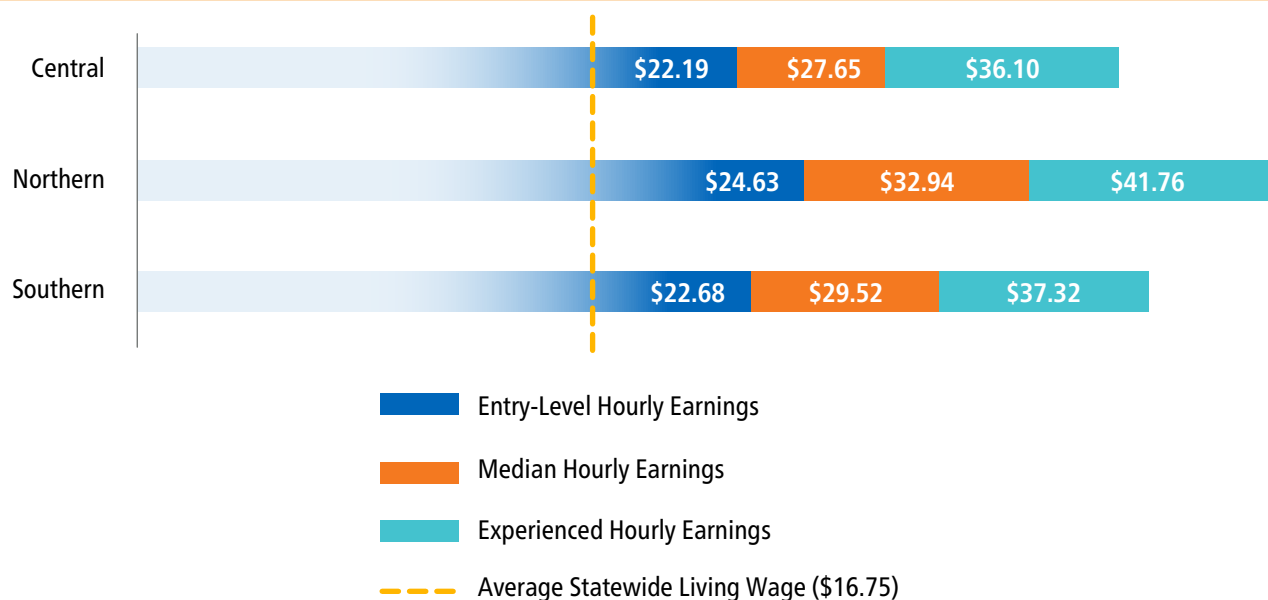
Occupation Group	2021 Jobs	2026 Jobs	2021-2026 Change	2021-2026 % Change	Demand (Annual Openings)
Electrical	3,325	3,453	128	4%	359
Maintenance	18,550	18,541	(10)	(0.1%)	1,748
Operational	22,197	22,963	766	3%	2,335
Total	44,072	44,957	884	2%	4,442

Wages

Wages for these mission-critical occupations vary throughout the state, with Northern California having the highest entry-level (\$24.76), median (\$32.94), and experienced (\$41.76) hourly earnings. Entry-level wages for these mission-critical occupations in Central California (\$22.19) and Southern California (\$22.68) are similar, with Southern California having slightly higher median (\$29.52), and experienced (\$37.32) hourly earnings. Notably, Southern California has the highest wages when considering all jobs in the industry, but the second highest for the mission-critical occupations.

Exhibit 9 shows the wage range for these mission-critical occupations by region and compares it to the statewide living wage of \$16.75 per hour. This living wage measures the cost of housing, food, child care, health care, transportation, and taxes to understand the minimum income necessary for an individual.²² However, it is important to note that costs and wages vary widely throughout the state. The living wage for individual counties throughout the state ranges from \$8.74 in Modoc County to \$29.43 in San Mateo County – both of which are in Northern California.

Exhibit 9. Wages for Mission-Critical Occupations by Region



²² Family Needs Calculator, " Insight Center, last modified May 20, 2021, <https://insightccd.org/family-needs-calculator/>.

Exhibit 10 shows the wage range for these mission-critical occupations by occupational group in California. Though all three groups have entry-level hourly earnings above the statewide living wage, the maintenance group has significantly lower entry-level earnings (\$17.91) than both the electrical (\$23.26) and operational (\$28.47) groups.

Exhibit 10. Wages by Mission-Critical Occupation Group in California

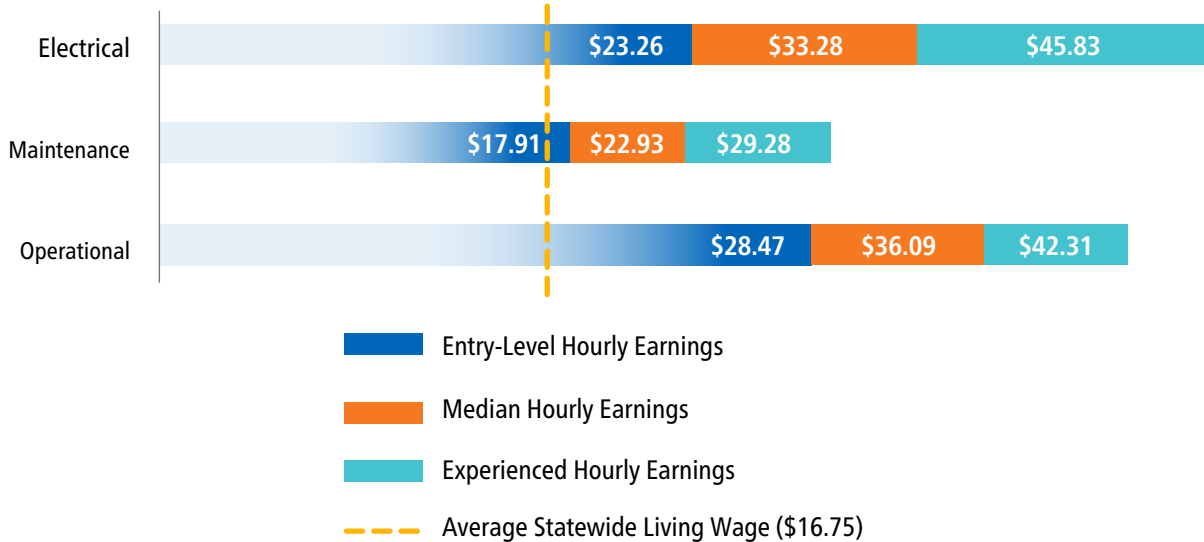
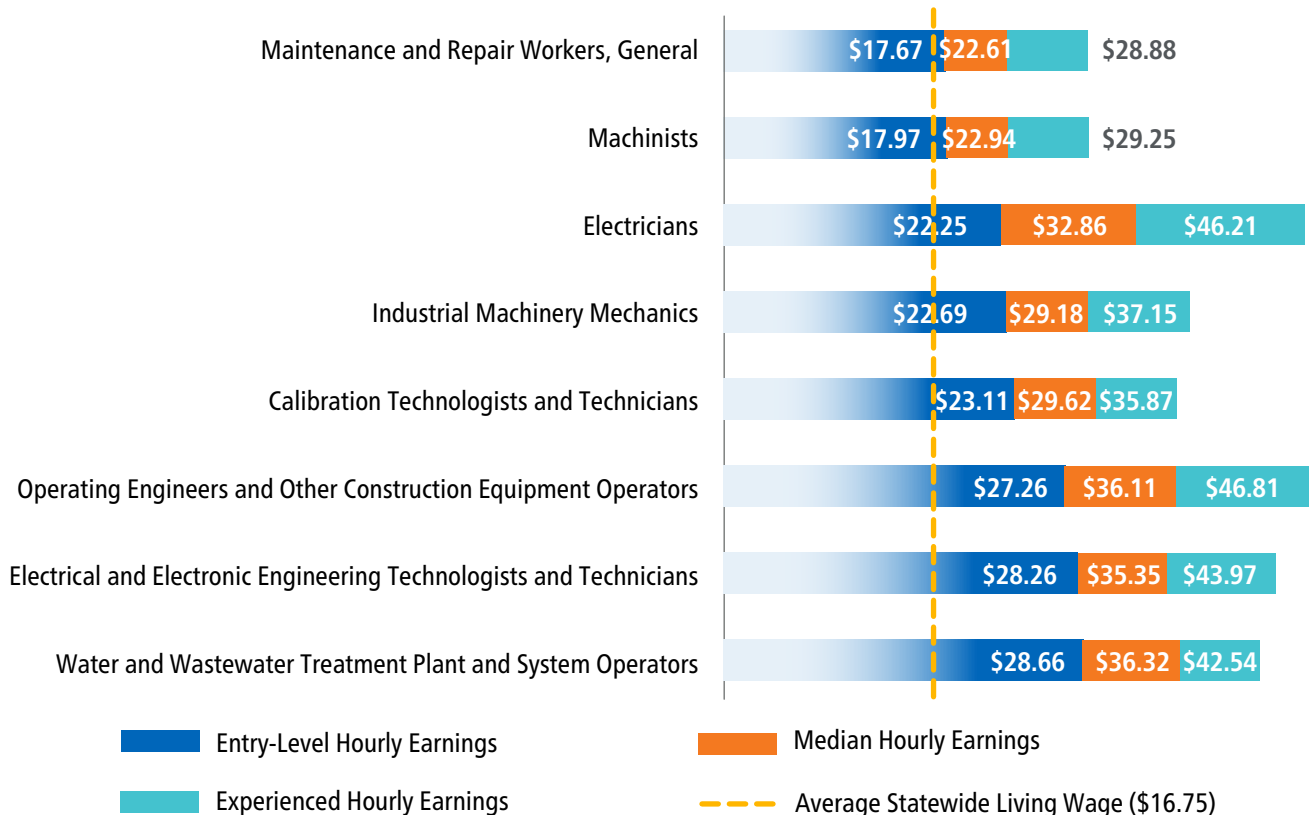


Exhibit 11 shows the wage range for each mission-critical occupation in California, sorted from lowest to highest entry-level wage. Though all eight mission-critical occupations have entry-level wages above the statewide living wage, these wages vary significantly. Maintenance and Repair Workers, General has the lowest entry-level wages (\$17.67) and Water and Wastewater Treatment Plant and System Operators have the highest (\$28.66).

Exhibit 11. Wages by Mission-Critical Occupation in California



Education and Training Requirements

These mission-critical occupations are considered middle-skill, meaning that they typically require at least a high school diploma or equivalent, but no more than an associate degree. Though none of these occupations typically require previous work experience, five typically require moderate or long-term on-the-job training and one (Electricians) typically requires an apprenticeship.

Additionally, certifications from the State Water Resources Control Board’s Drinking Water Operator Certification program are required for water treatment and distribution operators. There are five levels of certification – all of which require an examination. To become eligible for each examination after the first level, applicants must complete specialized training and/or obtain additional experience. Training requirements are demonstrated through the completion of courses in drinking water treatment, distribution, or wastewater treatment.²³ Exhibit 12 shows the typical education and training requirements for these mission-critical occupations.

Exhibit 12. Typical Education and Training Requirements for Mission-Critical Occupations

Functional Group	Occupation (SOC)	Typical Entry-Level Education	Work Experience Required	Typical On-the-Job Training
Electrical	Electrical and Electronic Engineering Technologists and Technicians (17-3023)	Associate degree	None	None
	Electricians (47-2111)	High school diploma or equivalent	None	Apprenticeship
Maintenance	Calibration Technologists and Technicians (17-3028)	Associate degree	None	None
	Industrial Machinery Mechanics (49-9041)	High school diploma or equivalent	None	Long-term on-the-job training
	Maintenance and Repair Workers, General (49-9071)	High school diploma or equivalent	None	Moderate-term on-the-job training
Operational	Operating Engineers and Other Construction Equipment Operators (47-2073)	High school diploma or equivalent	None	Moderate-term on-the-job training
	Machinists (51-4041)	High school diploma or equivalent	None	Long-term on-the-job training
	Water and Wastewater Treatment Plant and System Operators (51-8031)	High school diploma or equivalent	None	Long-term on-the-job training

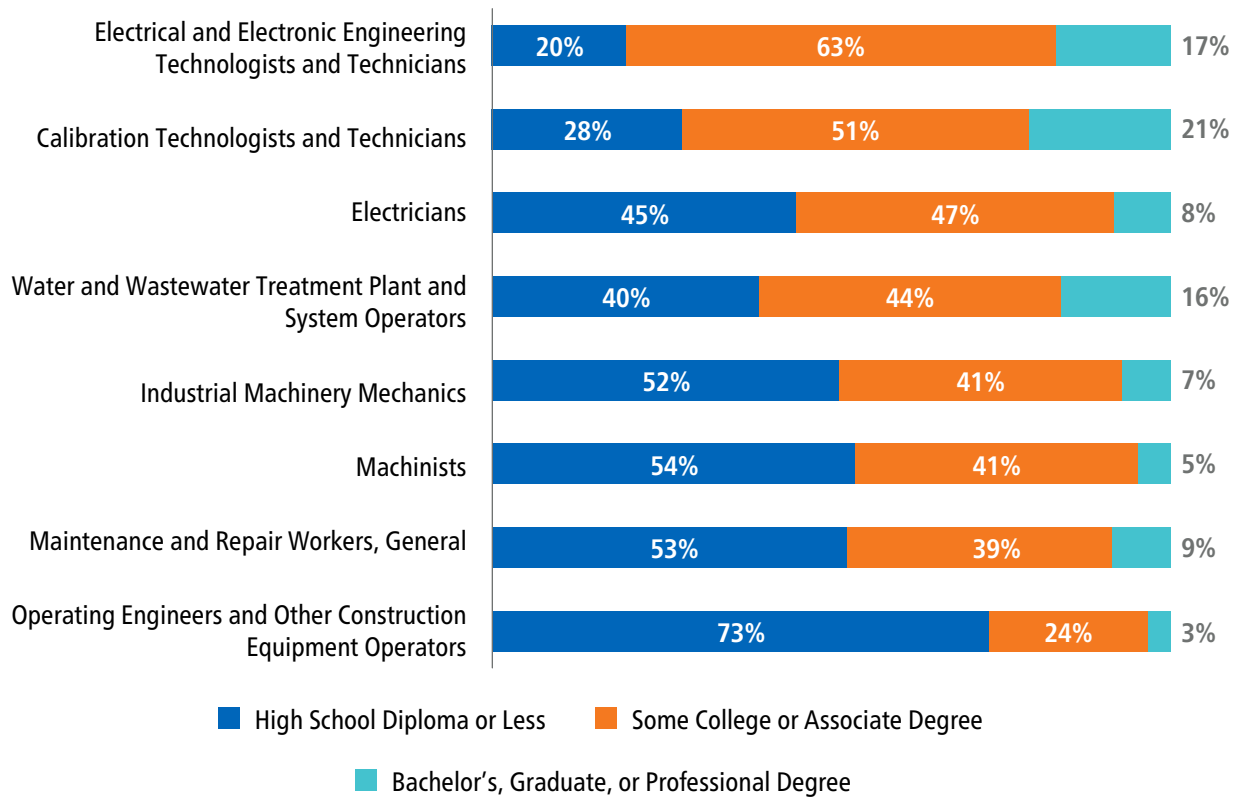


²³ California State Water Resources Control Board, “Drinking Water Treatment and Distribution System Operators,” California State Water Resources Control Board, accessed October 30, 2022, https://www.waterboards.ca.gov/drinking_water/certlic/occupations/DWopcert.html.

In addition to typical education and training requirements, it is important to consider educational attainment, which reflects the highest level of education received, for current workers in the field. The percentage of workers in these mission-critical occupations that have completed some college or an associate degree ranges from 24% for Operating Engineers and Other Construction Equipment Operators to 63% for Electrical and Electronic Technologists and Technicians.

Notably, less than 10% of mission-critical workers in five of these eight occupations have completed a bachelor's, master's, or doctoral degree as their highest level of education. Exhibit 13 shows the educational attainment of incumbent workers for these mission-critical occupations, sorted from highest community college attainment to lowest.

Exhibit 13. Educational Attainment for Mission-Critical Occupations



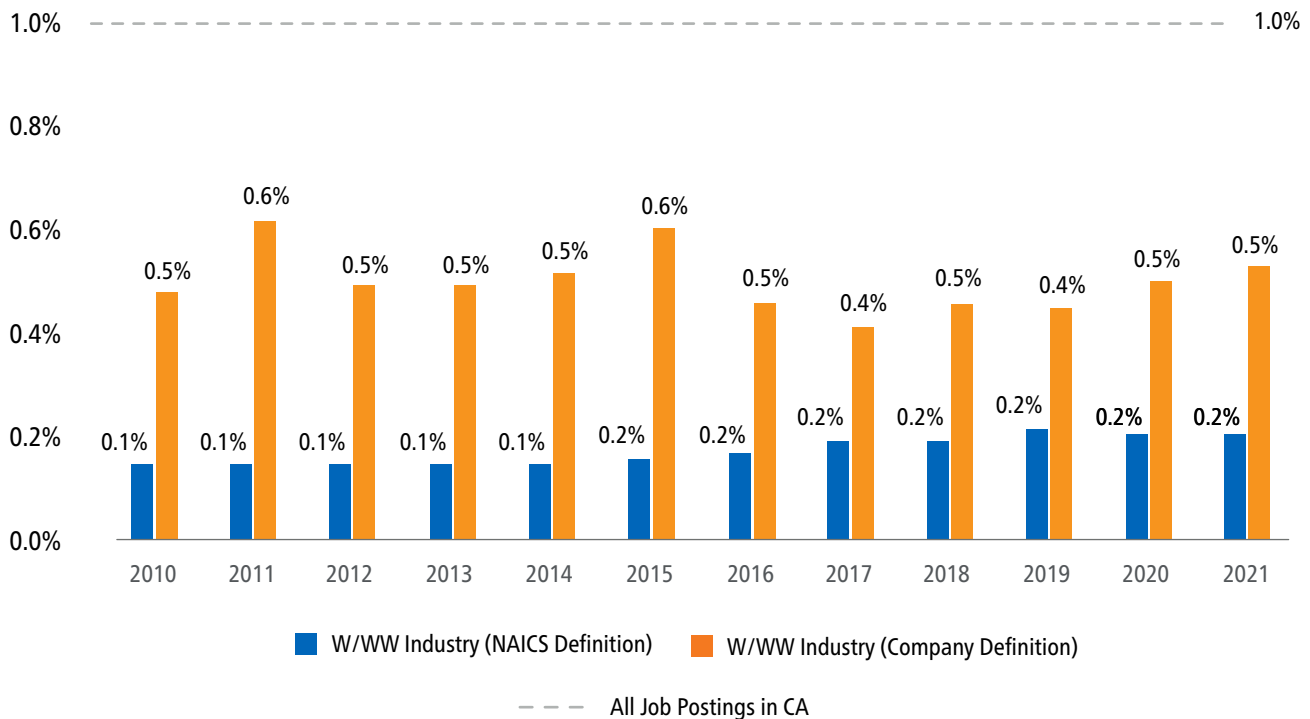
Job Postings Analysis

Online job postings can be used to better understand the real-time labor market for these mission-critical occupations, including the number of job postings, companies, job titles, skills, and education requirements listed by employers. However, it is important to note that there are several limitations when analyzing job postings. A single job posting may not represent a single job opening, as employers may be creating a pool of candidates for future openings or hiring for multiple positions with a single posting. Additionally, not all jobs are posted online, and jobs may be filled through other methods such as internal promotion, word-of-mouth advertising, physical job boards, or a variety of other channels.

Online job postings data is sourced from Lightcast, a labor market analytics firm that scrapes, collects, and organizes data from online job boards such as LinkedIn, Indeed, Glassdoor, Monster, GovernmentJobs.com, and thousands more. Lightcast uses natural language processing (NLP) to determine the related company, industry, occupation, and other information for each job posting. However, NLP has limitations that include understanding contextual words or phrases; determining differences in words that can be used as nouns, verbs, and/or adjectives; and misspellings or grammatical errors.²⁴ For these reasons, job postings could be assigned to the wrong employer or industry within Lightcast’s database. For example, the San Diego County Water Authority – a public water supply agency - is assigned to the industry All Other Professional, Scientific, and Technical Services (NAICS Code 541990) in Lightcast’s database. There were similar industry assignments for several water/wastewater companies.

To address the challenges mentioned above, this section analyzes online job postings using the NAICS definition of the water/wastewater industry, as well as by using water/wastewater company names. Of the 2,342 water/wastewater companies identified throughout California, 43% (1,004) were included in the Lightcast database, indicating that the remaining 57% have not posted an online job posting within the last ten years or did not post to one of the 45,000 websites included in Lightcast’s data. Exhibit 14 shows the percentage of total job postings in California that the water/wastewater industry has accounted for from 2010 to 2021. Notably, the water/wastewater industry has consistently made up less than 1% of all job postings in California. Additionally, defining the water/wastewater industry by company names in lieu of industry codes results in a higher number of job postings in Lightcast’s database.

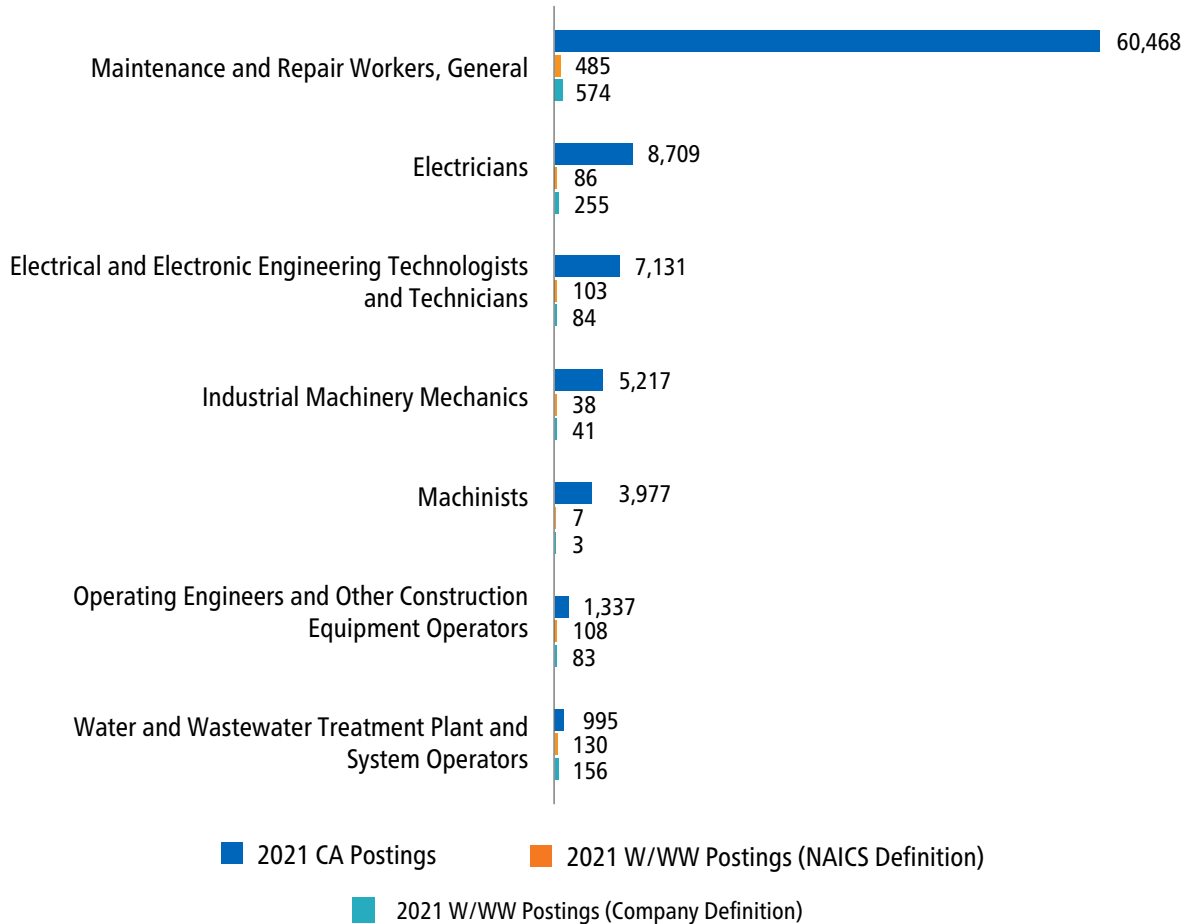
Exhibit 14. Water/Wastewater Industry Job Postings as Percentage of Total Postings in California, 2010 – 2021



²⁴ https://link.springer.com/chapter/10.1007/978-81-322-3972-7_19

Exhibit 15 shows the number of job postings for each mission-critical occupation in California in 2021, as well as the number of postings within the water/wastewater industry as defined by NAICS codes and the 1,004 water/wastewater companies in Lightcast’s database; it is important to note that there is duplication of the companies in each list because some companies are correctly assigned to a water/wastewater industry NAICS code while other are not. There were 87,838 total postings for these mission-critical occupations throughout the state in 2021. Of those, only 1% were within the water/wastewater industry.

Exhibit 15. Online Job Postings for Mission Critical Occupations, 2021



Skills

Exhibit 16 shows the top skills requested in online job postings for each mission-critical occupation throughout California across all industries, as well as specifically within the water/wastewater industry (using the company definition outlined in the section above). There is considerable overlap in the types of skills requested across all industries as well as the water/wastewater industry. This suggests that skills for mission-critical occupations are highly transferable across all industries. However, the skills profiles for two occupations differ significantly when comparing all industries to the water/wastewater industry.

The occupations with the most significant differences in the top skills, which are defined as the top 10 most frequently requested skills by employers in online job postings, are Electrical and Electronics Engineering Technicians as well as Industrial Machinery Mechanics. For Electrical and Electronics Engineering Technicians, the skills that are requested relatively more by water/wastewater companies are high voltage, calibration, electrical systems, electrical equipment, and transformers (electrical). The skills that are requested relatively more by water/wastewater companies for Industrial Machinery Mechanics include equipment repair, construction, diesel engines, fabrication, and Metal Inert Gas (MIG) welding.

Exhibit 16. Top Skills in Online Job Postings for Mission-Critical Occupations in California, 2021

Group	Occupation	Top Skills, All Industry Postings in California	Top Skills, W/WW Postings in California
Electrical	Electrical and Electronics Engineering Technicians (Total postings: 7,131 W/WW Postings: 84)	Electronics (1,729)	High Voltage (32)
		Test Equipment (1,685)	Calibration (24)
		Hand Tools (1,238)	Electrical Systems (23)
		Soldering (1,166)	Electrical Wiring (23)
		Electrical Wiring (1,125)	Low Voltage (23)
		Oscilloscope (1,104)	Electronics (22)
		Electromechanics (1,054)	Electrical Equipment (21)
		Low Voltage (1,054)	Transformers (Electrical) (21)
		Power Tool Operation (746)	Collective Bargaining (20)
		Electronic Components (723)	Automation (18)
	Electricians (Total postings: 8,709 W/WW Postings: 255)	Electrical Wiring (3,096)	Power Tool Operation (149)
		Electrical Systems (2,848)	Network Switches (145)
		Blueprinting (2,018)	Transformers (Electrical) (131)
		Hand Tools (1,909)	High Voltage (116)
		Electrical Equipment (1,692)	Electrical Systems (101)
		Power Tool Operation (1,252)	Construction (96)
		Transformers (Electrical) (1,244)	Electric Power Distribution (95)
		Network Switches (1,225)	Hand Tools (92)
Electronic Components (984)	Asset Management (91)		
Construction (813)	Business Planning (91)		

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Group	Occupation	Top Skills, All Industry Postings in California	Top Skills, W/WW Postings in California
Maintenance	Calibration Technologists and Technicians (Total postings: 4 W/WW Postings: 0)	Calibration (3)	Insufficient Data
		Medical Devices (2)	
		Optics (2)	
		Pharmaceuticals (2)	
		Automation (1)	
		Computing Platforms (1)	
		Data Collection (1)	
		Electrical Engineering (1)	
		Electronic Oscillator (1)	
	Equipment Calibration (1)		
	Industrial Machinery Mechanics (Total postings: 5,217 W/WW Postings: 41)	Machinery (1,609)	Equipment Repair (21)
		Preventive Maintenance (1,246)	Construction (20)
		Hand Tools (1,119)	Diesel Engines (18)
		Hydraulics (1,051)	Welding (18)
		Mechanics (952)	Fabrication (17)
		Welding (773)	Equipment Maintenance (15)
		Plumbing (715)	Mechanics (13)
		Power Tool Operation (672)	Metal Inert Gas (MIG) Welding (13)
		Programmable Logic Controllers (663)	Technical Training (13)
	Production Equipment (634)	Equipment Service Management and Rental (12)	
	Maintenance and Repair Workers, General (Total postings: 60,468 W/WW Postings: 574)	Plumbing (24,099)	Plumbing (172)
		Painting (17,138)	Construction (162)
		HVAC (16,865)	Painting (158)
		Carpentry (14,058)	Power Tool Operation (123)
		Preventive Maintenance (8,965)	Landscaping (122)
		Field Service Management (7,775)	Irrigation (Landscaping and Agriculture) (107)
		Power Tool Operation (7,062)	Carpentry (102)
		Construction (6,611)	Hand Tools (83)
Hand Tools (6,036)		Mowing (81)	
Drywall (Installation and Repair) (5,778)	HVAC (72)		

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Group	Occupation	Top Skills, All Industry Postings in California	Top Skills, W/WW Postings in California
Operational	Machinists (Total postings: 3,977 W/WW Postings: 41)	Machining (2,721)	Blueprinting (3)
		Lathes (2,253)	Grinding Machine (3)
		Mills (1,530)	Machine Tools (3)
		Computer Numerical Control (CNC) (1,316)	Machinery (3)
		Tooling (1,198)	Mechanical Systems (3)
		Micrometer (1,007)	Metal Inert Gas (MIG) Welding (3)
		Calipers (956)	Abrasion (2)
		Blueprinting (866)	Accounting Information Systems (2)
		Machine Tools (801)	Aerial Work Platforms (2)
		CNC Machining (759)	Collective Bargaining (2)
	Operating Engineers and Other Construction Equipment Operators (Total postings: 1,337 W/WW Postings: 83)	Heavy Equipment (485)	Backhoes (52)
		Backhoes (387)	Heavy Equipment (48)
		Construction (329)	Construction (30)
		Excavation (205)	Excavation (26)
		Grading (Landscape) (179)	Oil And Gas (23)
		Dozer (170)	Demolition (19)
		Front End Loaders (157)	Trenching (17)
		Equipment Inspection (143)	Grading (Landscape) (16)
		Trenching (127)	Soil Science (16)
		Machinery (125)	Machinery (14)
	Water and Wastewater Treatment Plant and System Operators (Total postings: 995 W/WW Postings: 156)	Wastewater (490)	Water Treatment (88)
		Sewage Treatments (366)	Water Resources (71)
		Water Treatment (344)	Water Distribution (62)
		Valves (Piping) (287)	Valves (Piping) (61)
		Water Resources (216)	Supervisory Control and Data Acquisition (SCADA) (59)
		Wastewater Treatment Plant (206)	Wastewater (59)
		Water Distribution (175)	Sewage Treatments (48)
		Supervisory Control and Data Acquisition (SCADA) (173)	Wastewater Treatment Plant (40)
		Laboratory Testing (153)	Control Systems (39)
		Housekeeping (144)	Water Supply (39)

Educational Supply for Mission Critical Occupations

Labor market supply, also known as educational supply, is defined as the average annual number of awards conferred over the past three years in programs associated with the selected mission-critical occupations.

Exhibit 17, presented below, shows the California Community College Taxonomy of Programs (TOP) codes and Classification of Instructional (CIP Codes) program codes that define the labor supply for the eight mission-critical occupations. Note that TOP codes are used exclusively within the California Community College System while CIP codes are used nationwide by educational institutions that receive federal funding.

Notably, no educational programs specifically train for one occupation: Maintenance and Repair Workers, General. Because there are not any specific programs, educational supply for this occupation is zero. It is important to note that the supply figures throughout this section include educational supply only from educational institutions that receive federal funding and do not include supply from other training providers such as unions, internal training provided by employers, or not-for-credit programs where students or employers pay for training but do not receive college credit. Additionally, students in other programs may gain skills to obtain employment in the Maintenance and Repair Workers, General occupation.

Exhibit 17. Educational Training Programs for Mission-Critical Occupations

Occupation Group	Occupation (SOC)	Community College Program (TOP Code)	Non-Community College Program (CIP Code)
Electrical	Electrical and Electronic Engineering Technologists and Technicians (17-3023)	Electronics and Electric Technology (0934.00)	Electrical/Electronic Engineering Technologies/Technicians, Other (15.0399)
			Power Plant Technology/Technician (15.1702)
			Solar Energy Technology/Technician (15.1703)
		Engineering Technology, General (requires Trigonometry) (0924.00)	Engineering Technologies/Technicians, General (15.0000)
		Applied Engineering Technologies/Technicians (15.0001)	
	Electricians (47-2111)	Electrical (0952.20)	Electrician (46.0302)
Maintenance	Calibration Technologists and Technicians (17-3028)	Instrumentation Technology (0943.00)	Instrumentation Technology/Technician (15.0404)
	Industrial Machinery Mechanics (49-9041)	Energy Systems Technology (0946.10)	Hydroelectric Energy Technology/Technician (15.1705)
			Energy Systems Installation and Repair Technology/Technician (47.0701)
			Hydroelectric Energy System Installation and Repair Technology/Technician (47.0705)
			Geothermal Energy System Installation and Repair Technology/Technician (47.0706)
	Industrial Systems Technology and Maintenance (0945.00)	Industrial Mechanics and Maintenance Technology/Technician (47.0303)	
Maintenance and Repair Workers, General (49-9071)	No Programs	No Programs	

continued next page

Occupation Group	Occupation (SOC)	Community College Program (TOP Code)	Non-Community College Program (CIP Code)
Operational	Operating Engineers and Other Construction Equipment Operators (47-2073)	Diesel Technology (0947.00)	Construction/Heavy Equipment/Earthmoving Equipment Operation (49.0202)
		Heavy Equipment Operation (0947.30)	
	Machinists (51-4041)	Machining and Machine Tools (0956.30)	Machine Tool Technology/Machinist (48.0501)
	Water and Wastewater Treatment Plant and System Operators (51-8031)	Environmental Technology (0303.00)	Environmental/Environmental Engineering Technology/Technician (15.0507)
		Environmental Technology (0303.00)	Hazardous Materials Management and Waste Technology/Technician (15.0508)
		Water and Wastewater Technology (0958.00)	Water Quality and Wastewater Treatment Management and Recycling Technology/Technician (15.0506)

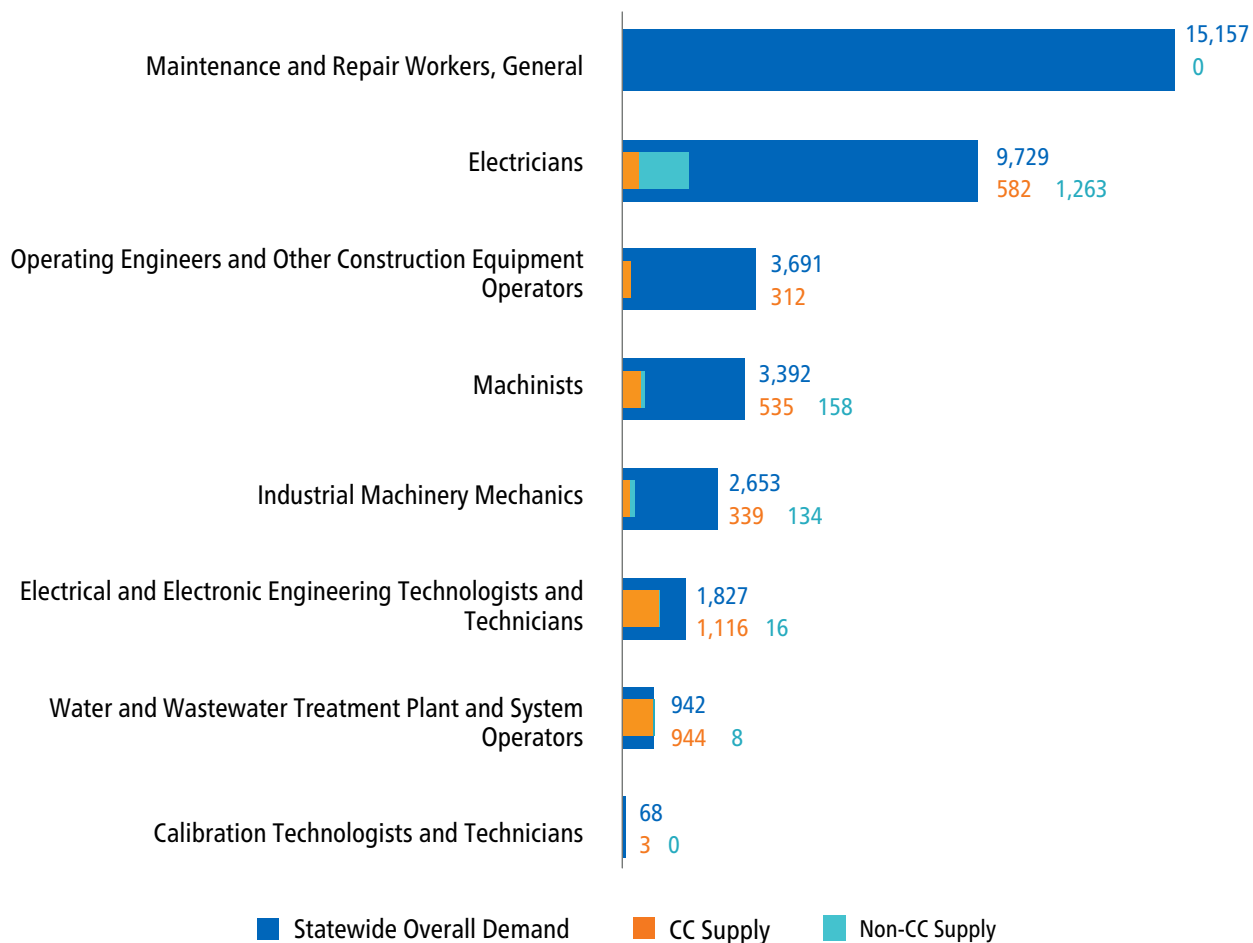


Statewide Supply for Mission-Critical Occupations

Total Supply

Exhibit 18 shows the total demand and supply throughout the state for these mission-critical occupations. Notably, there is a significant supply gap for all but one occupation: Water and Wastewater Treatment Plant and System Operators. However, one college in Orange County – Santiago Canyon – automatically conferred 819 local, low-unit certificates to students that previously completed course requirements for a newly established certificate in the 2018-19 academic year. Though these awards were conferred in 2018-19, students completed the course requirements within the previous five years. Therefore, supply is overstated for this occupation.

Exhibit 18. Statewide Demand and Supply for Mission-Critical Occupations, All Industries



Community College Supply

Exhibit 19 shows the number of awards conferred by California Community Colleges in each of the TOP codes associated with the eight mission-critical occupations by group. The operational group has the largest community college supply (1,791), followed by electrical (1,698), and maintenance (342).

The specific corresponding programs with the highest number of annual awards conferred between 2017 and 2020 are Electronics and Electric Technology (095200), Water and Wastewater Technology (095800), and Machining and Machining Tools (095630). A detailed inventory of institutions that confer awards in these programs is included in Appendix D.

As discussed in the previous section, there is significant demand for these occupations across all industries and within the water/wastewater industry, suggesting that community colleges could develop new programs or expand existing programs to meet both overall demand and water/wastewater industry demand.

Exhibit 19. Community College Supply by Mission-Critical Group and Occupation

Group	Occupation	TOP Code	2018-2019	2019-2020	2020-2021	Supply (Latest 3-Year Avg.)
Electrical	Electrical and Electronic Engineering Technologists and Technicians	Engineering Technology, General (requires Trigonometry) (0924.00)	268	283	317	288
		Electronics and Electric Technology (0934.00)	943	861	692	828
	Subtotal		1,211	1,144	1,009	1,116
	Electricians	Electrical (0952.20)	631	564	550	582
	Subtotal		631	564	550	582
Electrical Total			1,842	1,708	1,559	1,698
Maintenance	Calibration Technologists and Technicians	Instrumentation Technology (0943.00)	6	1	3	3
		Subtotal		6	1	3
	Industrial Machinery Mechanics	Industrial Systems Technology and Maintenance (0945.00)	358	295	190	279
		Energy Systems Technology (0946.10)	73	67	44	60
	Subtotal		437	363	237	339
	Maintenance and Repair Workers, General	No Programs	-	-	-	-
Subtotal		-	-	-	-	
Maintenance Total			437	363	237	342
Operational	Machinists	Machining and Machine Tools (0956.30)	753	563	300	535
		Subtotal		753	563	300
	Operating Engineers and Other Construction Equipment Operators	Diesel Technology (0947.00)	337	187	167	231
		Heavy Equipment Operation (0947.30)	71	79	91	81
	Subtotal		408	266	258	312
	Water and Wastewater Treatment Plant and System Operators	Environmental Technology (0303.00)	175	148	161	160
Water and Wastewater Technology (0958.00)		1,211	425	718	784	
Subtotal		1,386	573	879	944	
Operational Total			2,547	1,402	1,437	1,791
Total Community College Supply			4,826	3,473	3,233	3,831



Non-Community College Supply

Exhibit 20 shows the number of awards conferred by non-community college institutions in each of the CIP codes associated with the eight mission-critical occupations. The programs with the highest number of annual awards conferred between 2017 and 2020 are Electrician (46.0302) and Machine Tool Technology/Machinist (48.0501). Supply for Electricians accounts for 81% of all non-community college supply.

Notably, the supply from non-community college institutions is less than half of the supply from community colleges.

Exhibit 20. Non-Community College Supply by Mission-Critical Group and Occupation

Group	Occupation	CIP Code	2017-2018	2018-2019	2019-2020	Supply (Latest 3-Year Avg.)
Electrical	Electrical and Electronic Engineering Technologists and Technicians	Engineering Technologies/ Technicians, General (15.0000)	2	6	2	3
		Electrical/Electronic Engineering Technologies/ Technicians, Other (15.0399)	12	13	13	13
		Subtotal	14	19	15	16
	Electricians	Electrician (46.0302)	1,137	1,404	1,247	1,263
		Subtotal	1,137	1,404	1,247	1,263
		Electrical Total	1,151	1,423	1,262	1,279

Group	Occupation	CIP Code	2017-2018	2018-2019	2019-2020	Supply (Latest 3-Year Avg.)
Maintenance	Calibration Technologists and Technicians	Applied Engineering Technologies/Technicians (15.1001)	-	-	-	-
		Instrumentation Technology/Technician (15.0404)	-	-	-	-
		Power Plant Technology/Technician (15.1702)	-	-	-	-
		Solar Energy Technology/Technician (15.1703)	-	-	-	-
		Hydroelectric Energy Technology/Technician (15.1705)	-	-	-	-
	Subtotal		-	-	-	-
	Industrial Machinery Mechanics	Industrial Mechanics and Maintenance Technology/Technician (47.0303)	137	131	137	134
		Energy Systems Installation and Repair Technology/Technician (47.0701)	-	-	-	-
		Hydroelectric Energy System Installation and Repair Technology/Technician (47.0705)	-	-	-	-
		Geothermal Energy System Installation and Repair Technology/Technician (47.0706)	-	-	-	-
	Subtotal		137	131	137	134
	Maintenance and Repair Workers, General	No Programs	-	-	-	-
	Subtotal		137	131	137	134
	Maintenance Total		137	131	137	134

Group	Occupation	CIP Code	2017-2018	2018-2019	2019-2020	Supply (Latest 3-Year Avg.)
	Machinists	Machine Tool Technology/ Machinist (48.0501)	240	234	0	158
	Subtotal	240	234	0	158	
	Operating Engineers and Other Construction Equipment Operators	Construction/Heavy Equipment/Earthmoving Equipment Operation (49.0202)	-	-	-	-
	Subtotal		-	-	-	-
Operational		Water Quality and Wastewater Treatment Management and Recycling Technology/Technician (15.0506)	11	13	0	8
	Water and Wastewater Treatment Plant and System Operators	Environmental/Environmental Engineering Technology/Technician (15.0507)	1	0	0	0
		Hazardous Materials Management and Waste Technology/Technician (15.0508)	-	-	-	-
	Subtotal		12	13	0	8
	Operational Total		252	247	0	166
Total Non-Community College Supply			1,540	1,801	1,399	1,579



Demographics

Since the early 2000s, the water/wastewater industry has continually identified three major issues to address: an aging workforce and looming retirements, workforce diversity and inclusion, and industry awareness. These issues directly relate to diversity and addressing the demographic makeup – including race and ethnicity, age, and gender - of the current water/wastewater workforce. Notably, the Census Bureau collects information related to biological sex and does not currently collect information on gender, sexual orientation, or sex at birth. Conversely, the California Community College LaunchBoard reports the number of students in gender categories that include female, male, and non-binary. To align with the definition in LaunchBoard, gender is used when referring to both sex and gender throughout this section.

To better understand the demographics of workers within the mission-critical occupations examined in this report, this section analyzes demographic data for California Community College students enrolled in CTE programs that train for said occupations compared to the overall California population and compared to the existing demographics of the eight mission-critical occupations. Potentially, community college programs can mitigate the identified diversity and equity issues.

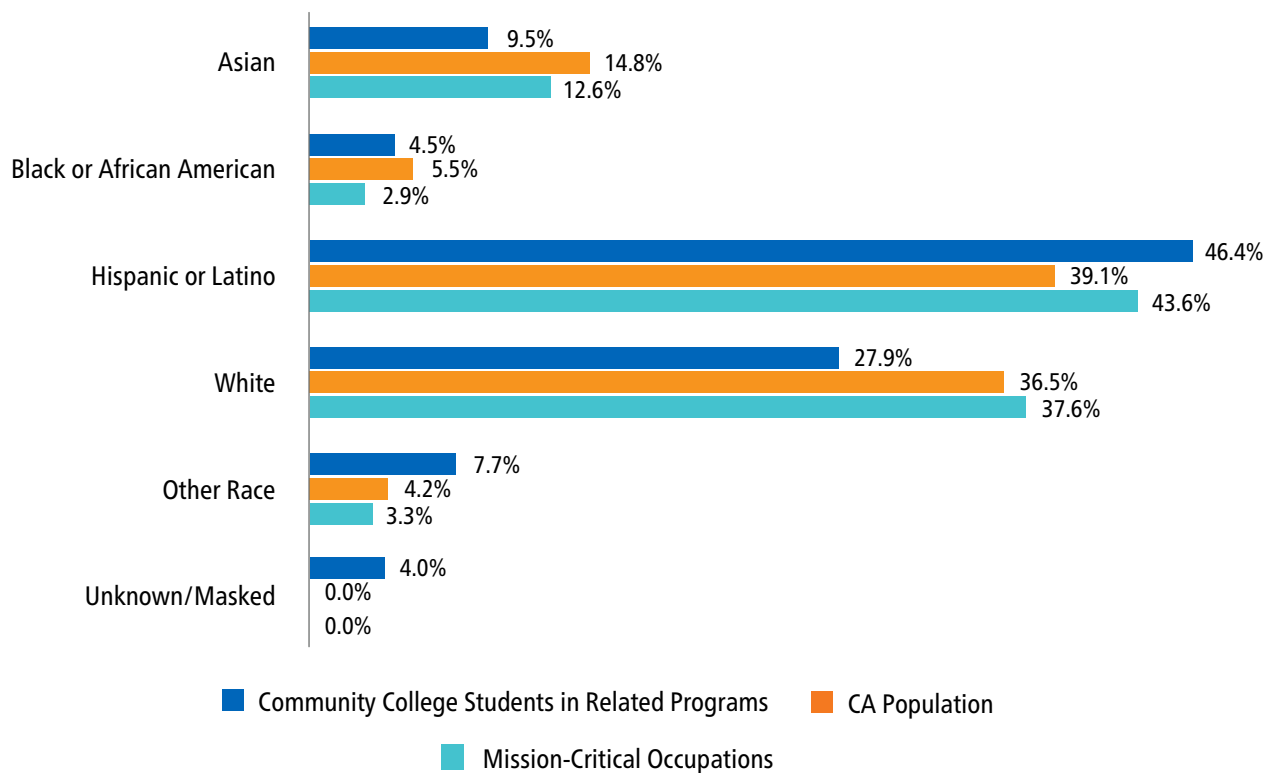
Though the differences between each group were not tested for statistical significance, there are noteworthy differences related to the numerical differences between the groups. For the purpose of this report, significance is related to these numerical differences.

Race and Ethnicity

Exhibit 21 shows the race and ethnicity of community college students enrolled in related training programs for the eight mission-critical occupations compared to the California population, as well as workers in the mission-critical water/wastewater occupations.

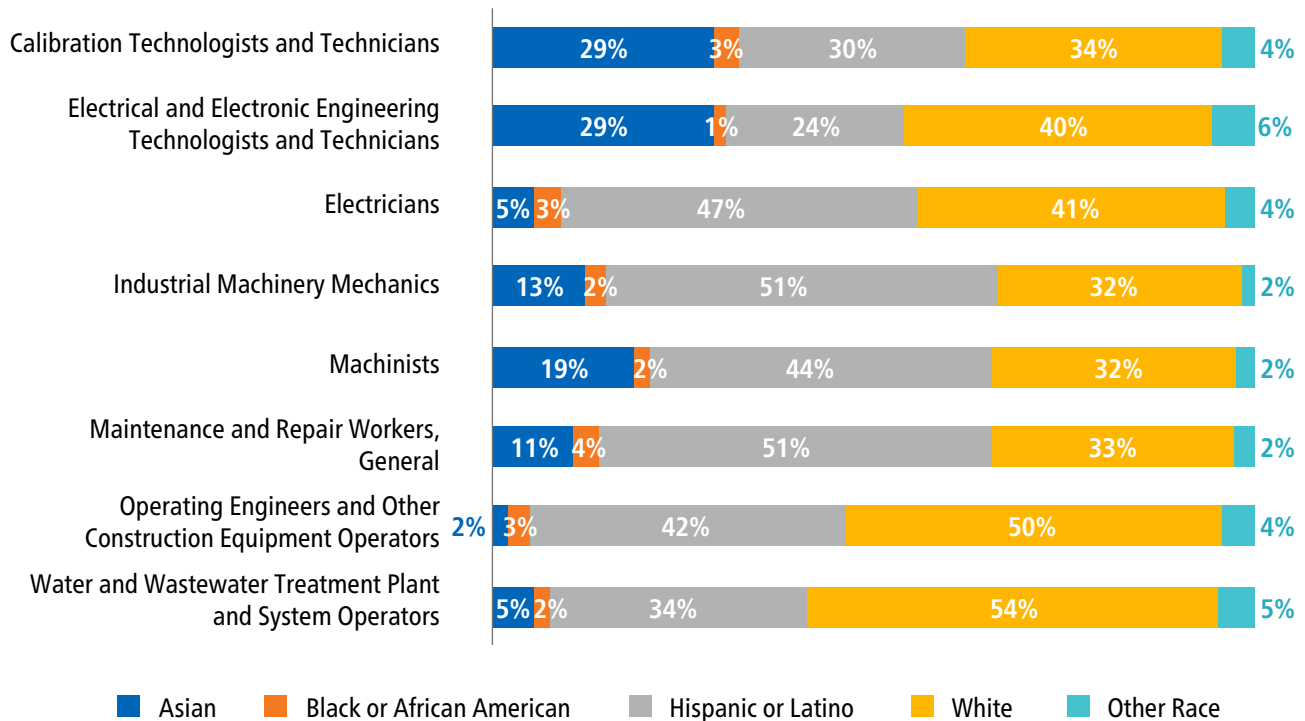
The plurality of community college students in these training programs are Hispanic or Latino (46%), which is slightly higher than mission-critical water/wastewater workers (44%), and the population (39%). Mission-critical water/wastewater workers are slightly less white (38%) than the population (37%) and significantly whiter than community college students enrolled in related training programs (28%).

Exhibit 21. Community College Program, California, and Mission-Critical Occupational Demographics by Ethnicity



Generally, the occupations with the highest entry-level hourly earnings also have the highest percentage of white workers. Exhibit 22 shows the race and ethnicity for workers in all eight mission-critical occupations. The occupation with the highest percentage of white workers (5%) is Water and Wastewater Treatment Plant and System Operators, which also has the highest entry-level hourly earnings (\$28.66) of all eight mission-critical occupations. Conversely, Maintenance and Repair Workers has the second-highest percentage of Hispanic or Latino workers (50.6%) but has the lowest entry-level wages (\$17.67) of all eight mission-critical occupations.

Exhibit 22. Mission-Critical Occupational Demographics by Ethnicity



Gender

Exhibit 23 shows the gender of community college students enrolled in related training programs for the eight mission-critical occupations compared to the California population, as well as workers in the mission-critical water/wastewater occupations.

The overwhelming majority of mission-critical water/wastewater workers (94%) and community college students (86%) are men. Both these figures are significantly higher than the statewide population, which is split evenly between men and women.

Exhibit 23. Community College Program, California, and Mission-Critical Occupational Demographics by Gender

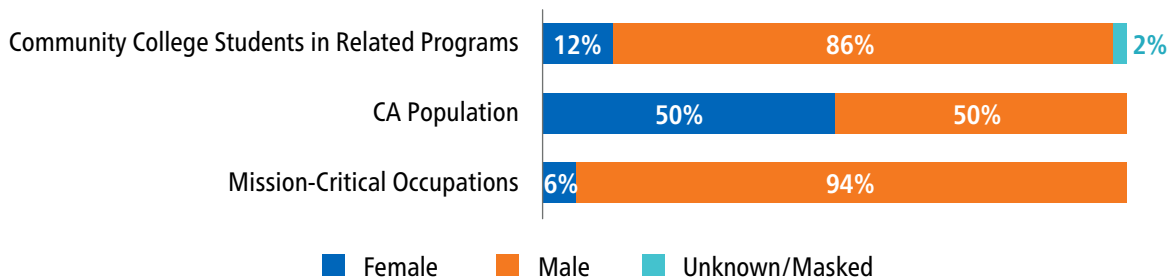
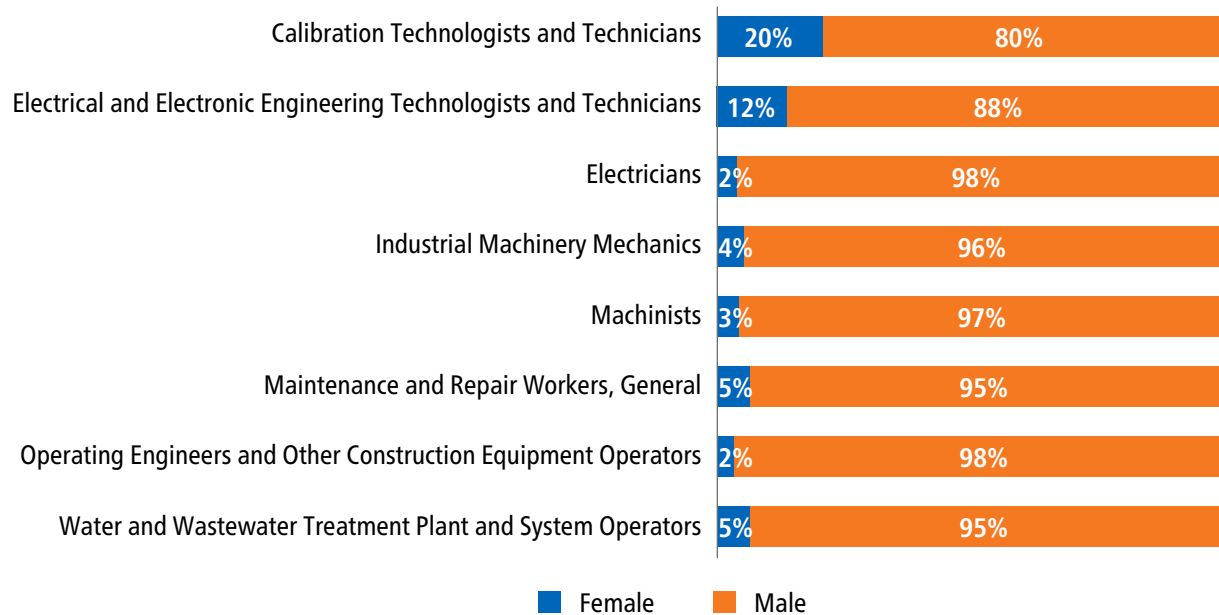


Exhibit 24 shows the split between female and male workers in these mission-critical occupations. The occupation with the highest percentage of female workers is Calibration Technologists and Technicians (20%), followed by Electrical and Electronic Engineering Technologists and Technicians (12%); both occupations have a significantly higher percentage of female workers when compared to the other mission-critical occupations.

Exhibit 24. Mission-Critical Occupational Demographics by Gender



Age

Exhibit 25 shows the age of community college students enrolled in related training programs for the eight mission-critical occupations compared to the California population, as well as workers in the mission-critical water/wastewater occupations.

Nearly 70% of mission-critical water/wastewater workers are age 35 and older and 37% are 50 and older, which is slightly higher than the California population (37%) and significantly higher than community college students in related programs (7%).

Exhibit 25. Community College Program, California, and Mission-Critical Occupational Demographics by Age

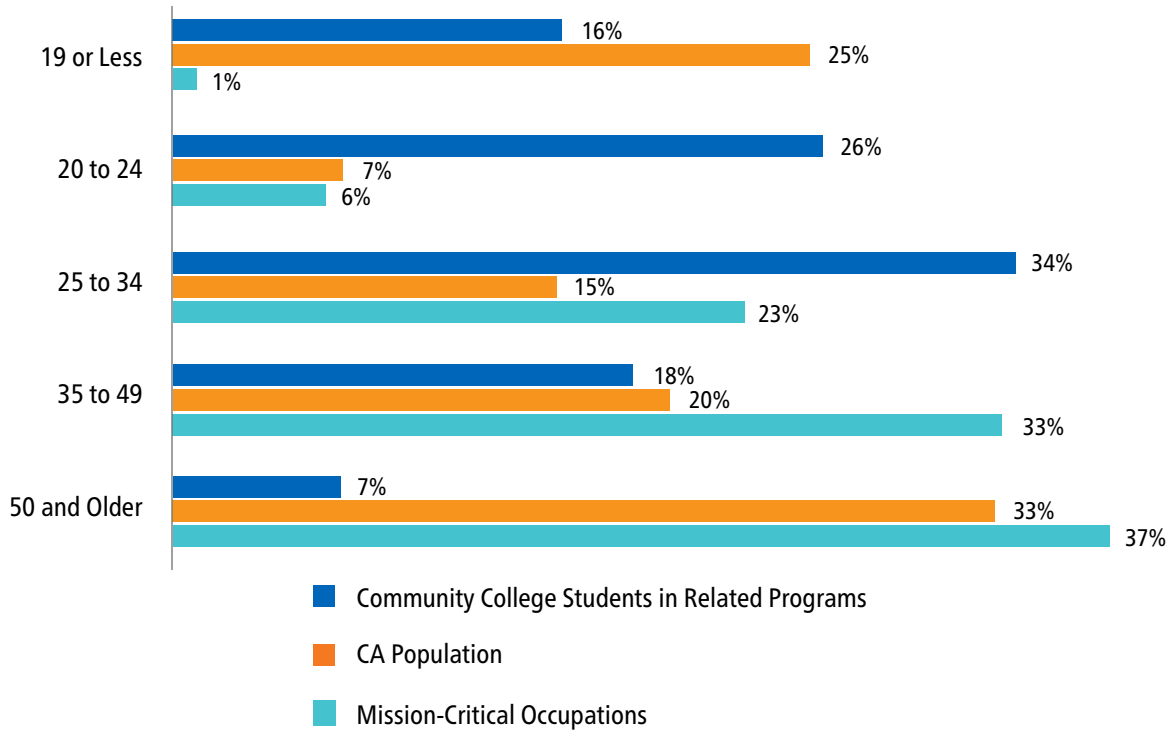
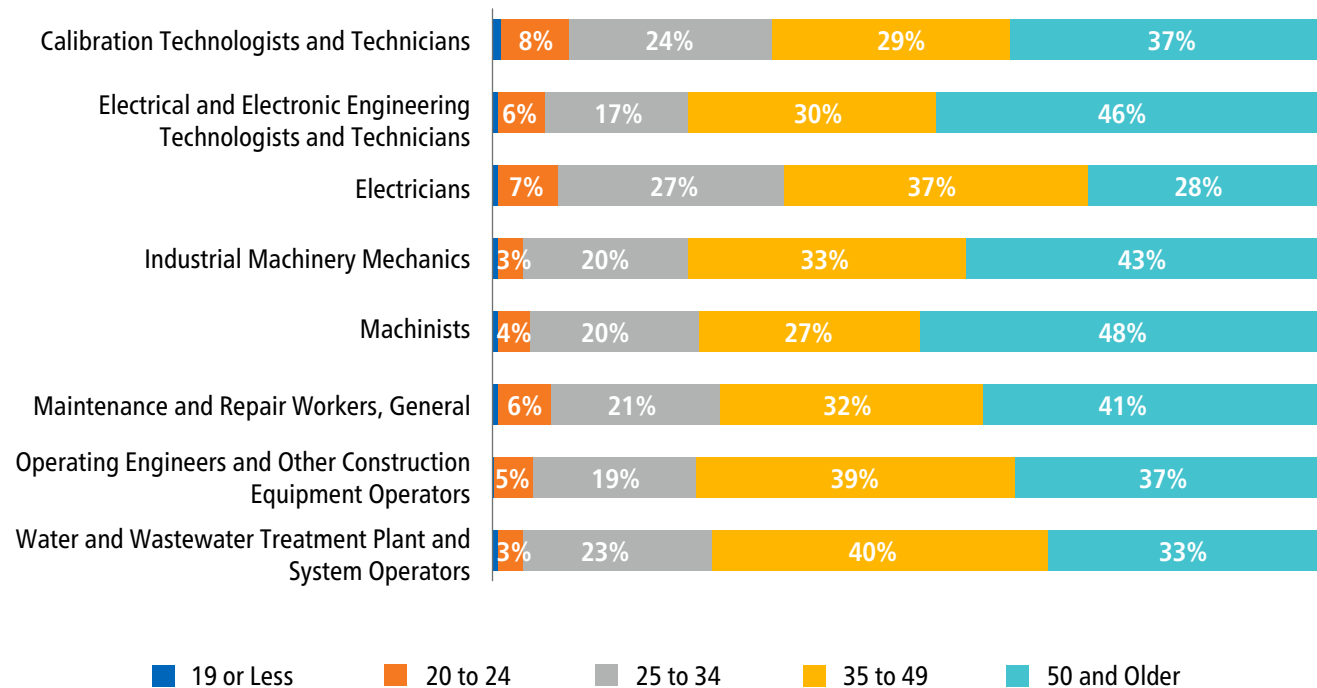


Exhibit 26 shows the age distribution for workers in all eight mission-critical occupations. The majority of the workforce for all occupations is 35 and older, but there is variation across occupations for workers that are 50 and older. Machinists (48%) has the highest percentage of workers 50 and older while Electricians (28%) has the lowest percentage.

Exhibit 26. Mission-Critical Occupational Demographics by Age



Demographic Implications

Agencies, such as the Los Angeles Department of Water and Power (LADWP) and San Diego Water Authority (SDWA), among several others, have created diversity, equity, and inclusion reports to better understand the demographics of their own workforce.²⁵ Others, such as the East Bay Municipal Utilities District (EDMBUD), have also set specific goals to increase placements for historically underrepresented groups.²⁶ The California Urban Water Agencies (CUWA), a non-profit corporation of 11 major urban water agencies, developed a Diversity, Equity, and Inclusion Toolkit to share best practices and has several examples of data assessments and action plans developed by various water districts throughout the state.²⁷

When considering the diversity of the mission-critical workforce as compared to California’s population and students in related community college programs, several trends emerge. There is general alignment between workers in these mission-critical occupations and the California population when considering race and ethnicity across all mission-critical occupations. However, the two occupations that have the highest typical entry-level hourly wages – Water and Wastewater Treatment Plant and System Operators and Operating Engineers and Other Construction Equipment Operators - also have the highest percentage of white workers, while the occupation that has the lowest typical entry-level hourly wages – Maintenance and Repair Workers, General - has the highest percentage of Hispanic or Latino workers.

²⁵ "Racial Equity Plan," Los Angeles Department of Water and Power, last modified June 2021, https://storage.googleapis.com/production-constantcontact-y1-0-9/959/123959/kr5Hz2TC/5e754f4173c74590a1f55ce01bcf567b?fileName=LADWP_REAP_Final_062121.pdf.

²⁶ "Diversity and Inclusion Master Plan," East Bay Municipal Utility District, accessed November, 2023, https://www.ebmunod.com/application/files/2115/8682/0066/041420_Leg-HR_Ctte_Presentations.pdf.

²⁷ California Urban Water Agencies, "CUWA Diversity, Equity, and Inclusion Toolkit," CUWA, last modified April 4, 2022, <https://www.cuwa.org/pubs/dei-toolkit>.

Notably, applicant data from SDWA between July 2020 and June 2021 shows that 54% of applicants for Maintenance Worker I/II positions were Hispanic or Latino while 31% were white. However, 80% of applications for Senior Maintenance Technician were white.²⁸ A review of 2021 data from Transparent California shows that, on average, the base pay for Maintenance Workers was \$61,450 while the base pay for Senior Maintenance Technicians was \$106,423 – the gap is larger when considering overtime pay.

The largest diversity and equity gap in the water/wastewater industry is between women and men. An examination of the 35 case studies on the water workforce from the EPA and the Water Environment Federation shows that the water/wastewater industry generally considers diversity through a racial and age-based lens, with little consideration for gender. Nearly all the case studies included language about recruiting and retaining a diverse workforce. However, of the 35 case studies, only three included targeted efforts to engage and retain women.

Understanding why women are underrepresented in these mission-critical occupations is essential to determining how to better diversify the water/wastewater industry. Historically, women largely entered clerical positions such as secretaries and switchboard operators as women's labor force participation increased between the 1930s and 1970s. Within areas like energy, construction, and utilities, women continue to be extremely underrepresented. The reasons why women are excluded continue to be debated, but one study shows that men in all industries may underestimate women's skills and preparation if women are underrepresented within an occupation, creating a cycle in which women continue to be excluded from that occupation.²⁹ Another study suggests that men do not discriminate against women because they think they are underqualified, but see women as a threat to the occupation's masculinity and aim to protect and maintain the stronghold men have within that occupation.³⁰

The Center for American Progress cites research that shows women can be targets of harassment when they move into historically male occupations across all industries.³¹ Additionally, the Pew Research Center found that more women experience sexual harassment in male-dominated industries compared to female-dominated industries.³² In a profile from 2020, Tonya Hicks, one of the first Black women to complete a five-year electrical apprenticeship program in Mississippi, stated that "there were many times when I would show up at a job and no man talked to me, or acknowledged my presence."³³

Due to the concern over replacing workers because of an aging workforce and retirements, the focus has been on increasing age diversity within the water/wastewater industry. A report from the federal Government Accountability Office on recruiting approaches for water plant operators noted that there is a need to create excitement around a technologically advanced drinking water workforce to attract new talent and young workers. However, representatives from both large and small utilities cited "a distaste for shift work among younger employees" as a difficulty in hiring water operators. Additionally, these representatives said that the number of young adults interested in skilled occupations is decreasing, which discourages community colleges from offering courses due to low enrollments.³⁴ While community college offerings for these programs will vary throughout the country, the vast majority of community college students in related programs in California are 34 years old or less (75%), presenting an opportunity for water/wastewater employers to engage – or expand their partnerships - with community colleges and attract young qualified workers.

²⁸ San Diego County Water Authority, "Biennial Diversity, Equity, Inclusion, & Belonging Report," San Diego County Water Authority, accessed November, 2022, <https://www.sdcwa.org/wp-content/uploads/2022/08/FY2021-22-SDCWA-DEIB-Report.pdf>.

²⁹ Will McGrew, "Gender Segregation at Work: 'Separate but Equal' or 'Inefficient and Unfair'," Equitable Growth, last modified April 22, 2019, <https://equitablegrowth.org/gender-segregation-at-work-separate-but-equal-or-inequitable-and-inefficient/>.

³⁰ *Ibid.*

³¹ The Women's Initiative, "Gender Matters," Center for American Progress, last modified August 6, 2018, <https://www.americanprogress.org/article/gender-matters/>.

³² Kim Parker, "Women in Majority-male Workplaces Report Higher Rates of Gender Discrimination," Pew Research Center, last modified August 7, 2020, <https://www.pewresearch.org/fact-tank/2018/03/07/women-in-majority-male-workplaces-report-higher-rates-of-gender-discrimination/>.

³³ Kerry Hannon, "In a Field Dominated by Men, She's in Charge," The New York Times, last modified March 5, 2020, <https://www.nytimes.com/2020/03/05/business/women-electricians.html>.

³⁴ "Water and Wastewater Workforce: Recruiting Approaches Helped Industry Hire Operators, but Additional EPA Guidance Could Help Identify Future Needs," U.S. Government Accountability Office, accessed November, 2022, <https://www.gao.gov/products/gao-18-102>.

Demographics Summary Analysis

The traditional LMI analyzed in this section shows that as of 2021, there were 1,037,902 jobs within the water/wastewater industry, representing 5% of all jobs in California. Employment is projected to increase through 2026. Additionally, the water/wastewater industry accounts for 13% of all employment for the eight mission-critical occupations throughout the state. Through 2026, there are projected to be 37,459 annual openings for these mission-critical occupations; 12% (4,381) are projected to be within the water/wastewater industry.

Though entry-level wages for these mission-critical occupations vary, all eight mission-critical occupations have entry-level wages above the statewide living wage and wages increase significantly at the median and experienced levels. These mission-critical occupations are considered middle-skill, meaning that they typically require at least a high school diploma or equivalent, but no more than an associate degree. Less than 10% of workers in five of the eight mission-critical occupations have completed a bachelor's, master's, or doctoral degree.

There are supply gaps for nearly all mission-critical occupations in California, suggesting that community colleges – which confer significantly more awards than non-community college institutions – could develop new programs or expand existing programs to meet both overall demand and water/wastewater industry demand. Additionally, there is considerable overlap in the types of skills requested by employers across all industries in online job postings and those that are typically requested by water/wastewater employers. Community college educators should ensure that CTE programs provide students with sufficient knowledge to enter employment in a variety of industries and could consider adding specialized courses to address water/wastewater industry needs or offer customized training options to water/wastewater employers. The water/wastewater industry should consider how onboarding and internal training programs can build upon foundational skills that can be applied in all industries to address water/wastewater-specific needs.

Several water/wastewater companies have implemented or are in the process of developing efforts to address diversity, equity, and inclusion within the water/wastewater industry. An analysis of demographic data for these mission-critical occupations, the California population, and community college students in related training programs reveals several equity gaps:

- Race and Ethnicity
 - Generally, there is alignment between workers in these mission-critical occupations and the California population when considering race and ethnicity across all mission-critical occupations.
 - However, occupations that have the highest typical entry-level hourly wages also have the highest percentage of white workers.
 - Conversely, Maintenance and Repair Workers, General has the lowest typical entry-level hourly wages but the highest percentage of Hispanic or Latino workers.
- Gender
 - The most significant diversity and equity gap in the water/wastewater industry is between women and men, as women are extremely underrepresented. Women are also underrepresented within community college training programs.
- Age
 - Since at least 2005, the water/wastewater industry has reported impending shortages due to demographic shifts and Baby Boomer retirements.
 - The vast majority of community college students in related programs in California are 34 years old or less (75%), presenting an opportunity for water/wastewater employers to engage – or expand their partnerships - with community colleges and attract young qualified workers.



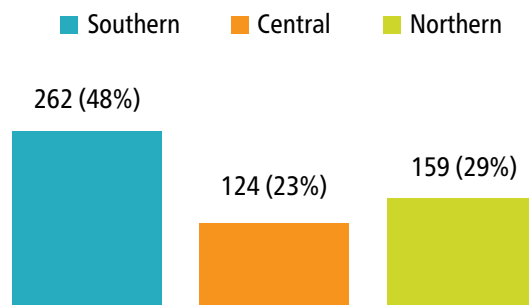
INDUSTRY SURVEY

To answer the research questions related to the current and potential challenges facing the water industry, as well as efforts to mitigate those challenges, the Centers of Excellence conducted a survey of businesses in the water/wastewater industry.

Overview of Respondents

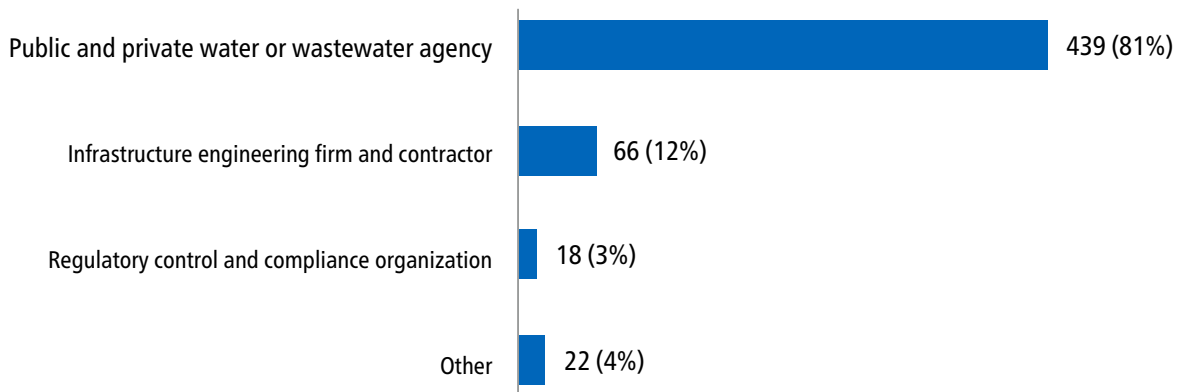
Between June and September 2022, the COE reached out to 2,216 contacts from 1,772 companies, resulting in online and phone survey responses from 581 individuals. Respondents were asked to confirm their company's role in the water/wastewater industry. In instances where a company was not in the water/wastewater industry, those responses were removed. This resulted in 545 final survey responses from California water/wastewater companies as defined by the NAICS codes listed in Appendix A. While the COE attempted to collect an even distribution of survey responses across the three subregions (Central, North, and Southern California), the most responses (48%) came from Southern California (Exhibit 27). For more information about the methodology, see Appendix C.

Exhibit 27. Survey Respondents by Subregion in California (n=545)



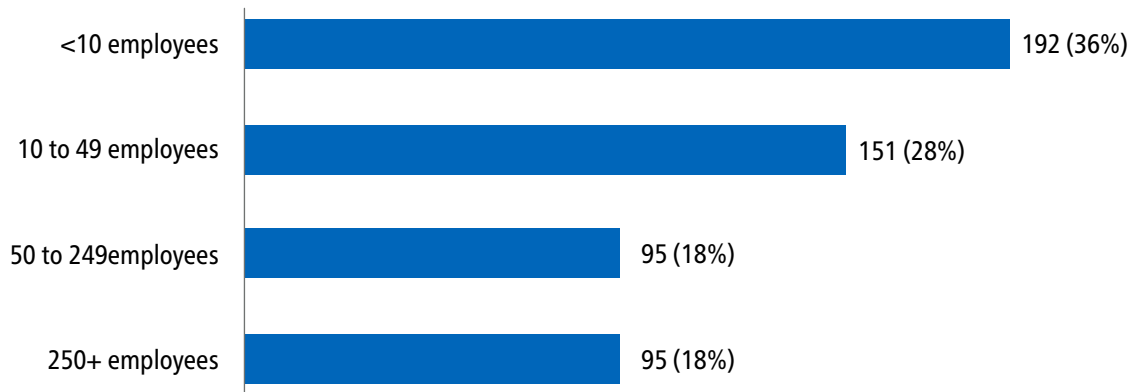
Of the 545 companies that responded to the survey, most respondents (81%) reported being from public and private water or wastewater agencies (Exhibit 28).

Exhibit 28. Company or Organization's Role in the Water/Wastewater Industry (n=545)



Most survey respondents (64%) reported having fewer than 50 employees at their companies (Exhibit 29). In total, of the 545 companies that participated, 533 responded to a question asking how many employees currently work at their organization. These companies reported that there were 82,787 full-time and part-time employees. Over one-third of these companies had fewer than 10 employees. For comparison, as previously mentioned in the labor market analysis for this study, the COE found that California’s water/wastewater industry had 18,828 establishments and more than 1 million jobs.

Exhibit 29. Number of Employees (n=533)



Of the 545 companies, 526 responded to questions regarding the number of employees that are eligible to retire in the next five years and the expected number of hires in the next 24 months. At the time of answering the survey, these organizations reported having 4,286 employees who are eligible to retire without penalty in the next five years (Exhibit 30). Additionally, these companies expected to hire 4,929 new employees in the next 24 months (Exhibit 31).

Exhibit 30. Number of Employees Eligible to Retire Without Penalty in the Next 5 Years (n=526)

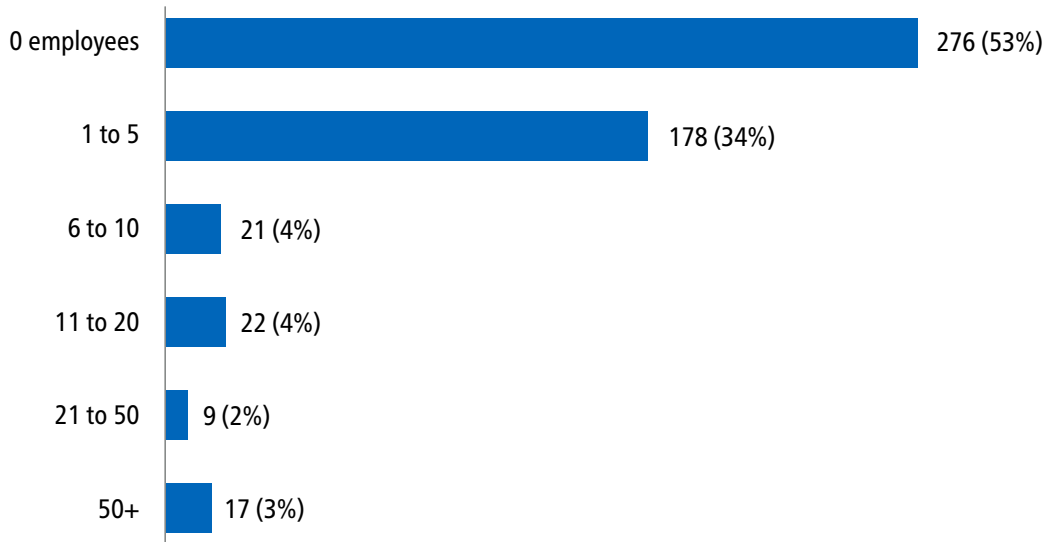
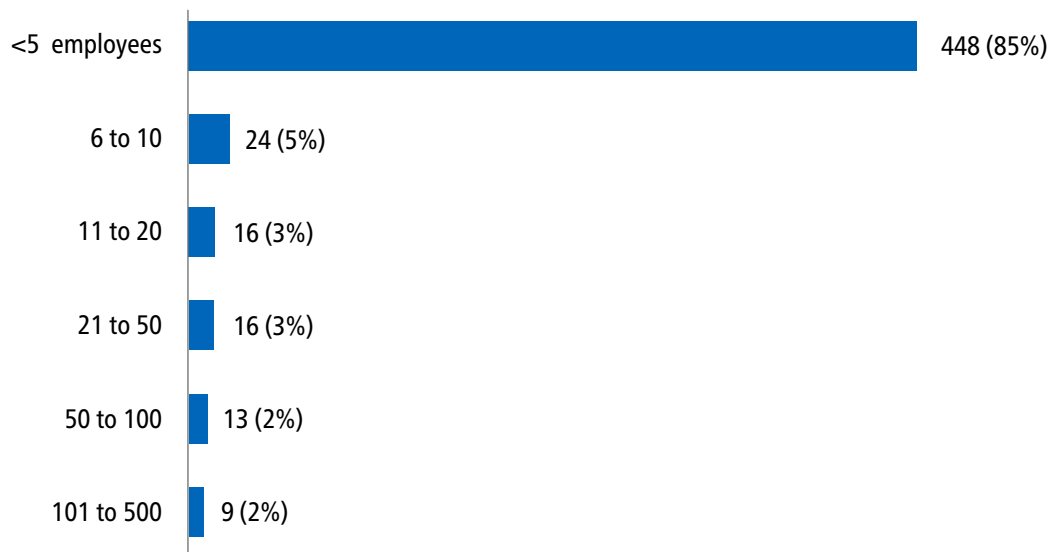


Exhibit 31. Expected Number of New Hires in the Next 24 Months (n=526)



Mission-Critical Occupations

Of the 545 organizations that participated in the survey, 360 respondents had a role in the hiring process at their organization (e.g., HR, hiring manager, business owner) and reported that their organizations employed the eight mission-critical occupations examined in this study (Exhibit 32). “Water and wastewater treatment plant and system operators” was the top mission-critical occupation with 125 organizations employing the occupation (Exhibit 33).

Exhibit 32. Respondents with a Hiring Role at their Organization (n=360)

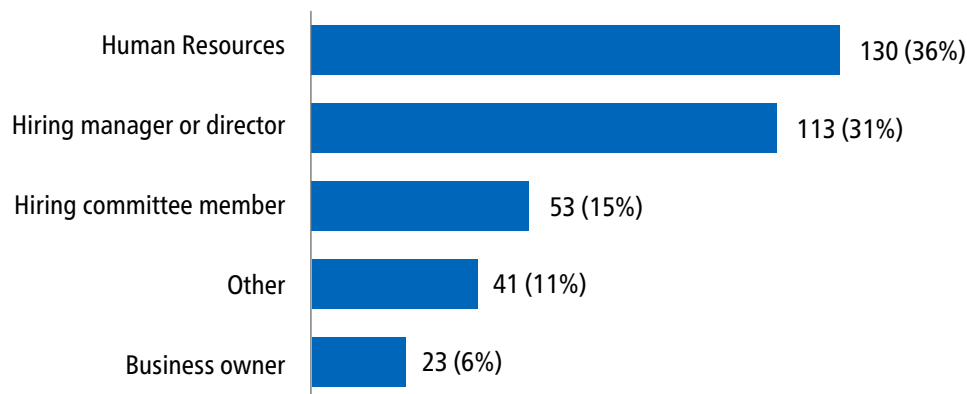
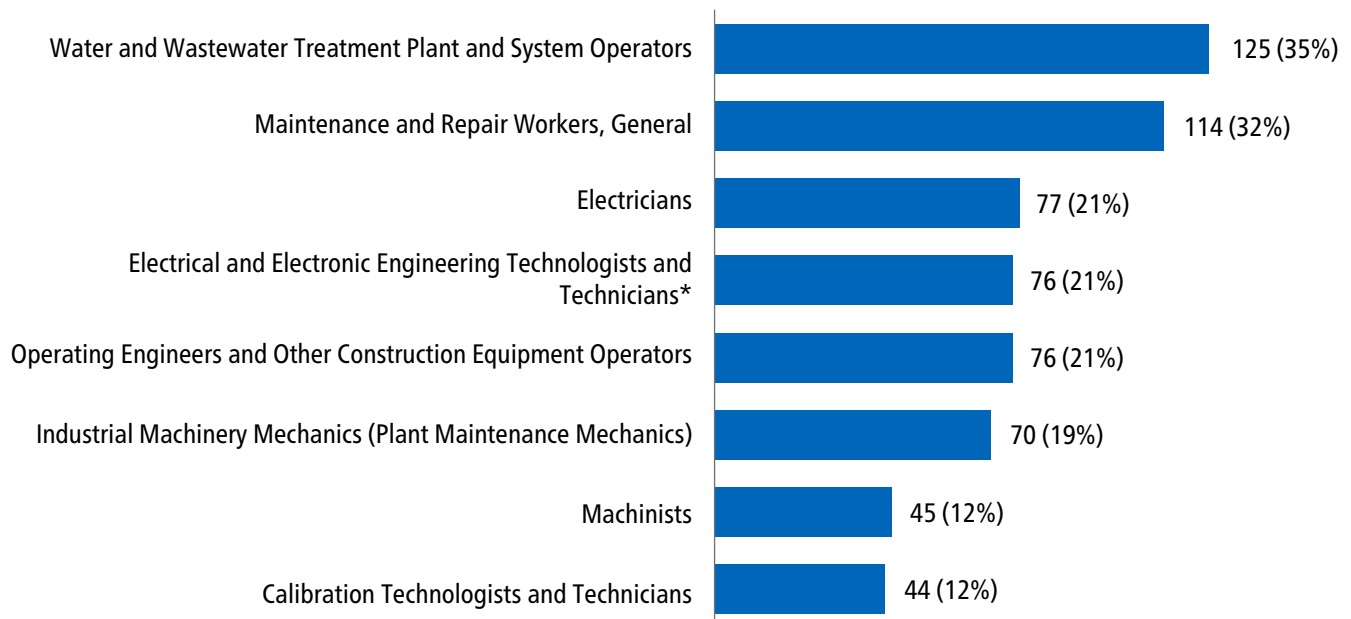


Exhibit 33. Organizations that Employ Mission-Critical Occupations (n=360)



According to survey respondents, there are 9,941 current employees in these mission-critical occupations. The current number of employees in these mission-critical occupations represents 12% of the total number of employees (82,787) within the 545 water/wastewater companies that responded to the survey.

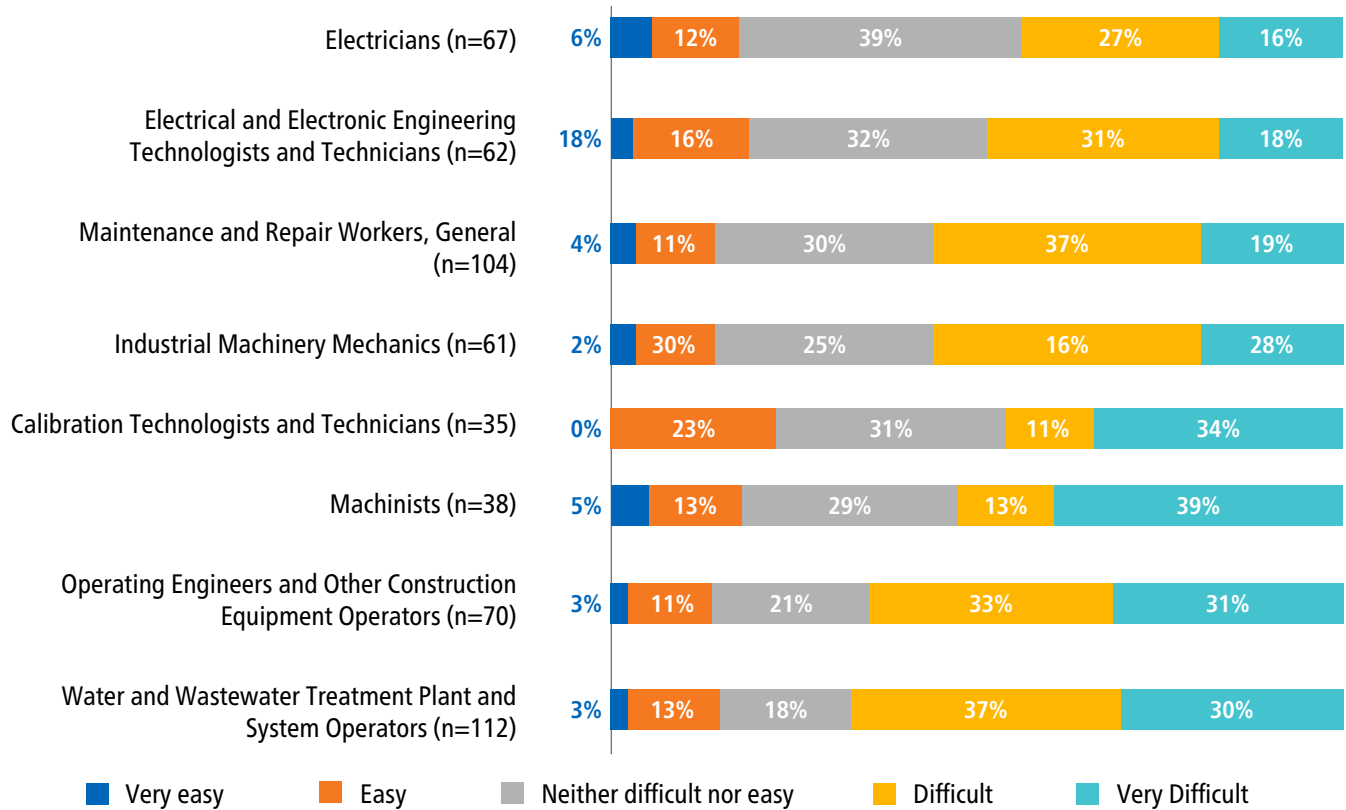
Cumulatively, survey respondents expected to hire 860 employees within 24 months of answering the survey, which equates to 9% of the current mission-critical workforce. This number of hires includes backfilling jobs due to attrition caused by voluntary resignations (turnover) and permanent withdrawal due to retirement. The three occupations with the greatest expected number of hires over the next 24 months were maintenance and repair workers (228 expected new hires), water and wastewater treatment plant and system operators (225 expected new hires), and operating engineers and other construction equipment operators (107 expected new hires), as shown in Exhibit 34. Please note that the top two occupations also had the greatest number of respondents, which may explain the higher demand.

Exhibit 34. Current and Expected Employment of Mission-Critical Occupations

Functional Group	Occupation (# of Survey Respondents)	Current # of Employees	Expected # of New Hires in 24 Months
Electrical	Electrical and Electronic Engineering Technologists and Technicians (n=76)	393	80
	Electricians (n=77)	476	76
Maintenance	Calibration Technologists and Technicians (n=44)	318	40
	Industrial Machinery Mechanics (n=70)	943	69
	Maintenance and Repair Workers, General (n=114)	1,723	228
Operational	Operating Engineers and Other Construction Equipment Operators (n=76)	2,488	107
	Machinists (n=45)	575	35
	Water and Wastewater Treatment Plant and System Operators (n=125)	3,025	225
Total		9,941	860

In addition to being the top three mission-critical occupations with the greatest demand, water wastewater treatment plant system operators, operating equipment and other construction equipment operators, and maintenance and repair workers had the greatest percentage of respondents who had difficulty hiring for those positions; 67% of survey respondents reported that it was “very difficult” or “difficult” to hire water and wastewater treatment plant and system operators, for example (Exhibit 35).

Exhibit 35. Reported Difficulty in Hiring Mission-Critical Occupations



In addition to identifying the level of difficulty their companies had in hiring mission-critical occupations, the survey also asked respondents to identify the most difficult qualifications to find in job candidates. Survey respondents ranked the following seven qualifications from most difficult to least difficult to find: 1) minimum educational requirements; 2) required licenses and certifications; 3) relevant prior work experience; 4) adequate technical skills; 5) adequate industry knowledge; 6) adequate soft skills or interpersonal skills; or 7) other qualification(s). The following exhibit marks the top three most-difficult-to-find qualifications by mission-critical occupation based on their rankings. "Relevant prior work experience" was the most-difficult-to-find qualification for all mission critical occupations, followed by adequate technical skills and required licenses or certifications (Exhibit 36).

Exhibit 36. Top Three Most Difficult Qualifications to Find in Job Candidates by Occupation

Qualification	Relevant prior work experience	Adequate technical skills	Adequate industry knowledge	Required licenses or certifications
Electrical and Electronic Engineering Technologists and Technicians (n=62)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Electricians (n=67)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Calibration Technologists and Technicians (n=35)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Industrial Machinery Mechanics (n=61)	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Maintenance and Repair Workers, General (n=104)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Operating Engineers and Other Construction Equipment Operators (n=70)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Machinists (n=38)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Water and Wastewater Treatment Plant and System Operators (n=112)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

For each water/wastewater mission-critical occupation, the survey asked respondents to select skills from a list of the top 10 skills for each mission-critical occupation based on prior studies and online job postings that are essential for community colleges to train. The skills listed for each occupation were reviewed by the Industry Advisory Group for accuracy and relevance. The following exhibits (Exhibit 37 through Exhibit 44) illustrate the percentage of respondents that determined a skill was essential to an occupation compared to skills requested by water/wastewater companies in online job postings throughout 2021. Examining these skills can help determine the most essential skills for each occupation.

Job posting skills for all eight mission-critical occupations are included for comparison, except for Calibration Technologists and Technicians, as there were no online job postings from water/wastewater companies for this occupation in 2021.

The number of responses to this survey question versus the number of postings varies significantly by occupation. Of the eight mission-critical occupations, four had a similar number of survey responses and online job postings. The percentage of survey responses and job postings that mention each skill is included to normalize for comparison.

Though there is overlap in some of the skills selected by survey respondents and those requested in online job postings, there are significant differences for most of the mission-critical occupations. Additionally, for the skills that were identified by both survey respondents and included in online job postings, there is misalignment in how frequently each skill is requested. For example, of the 111 respondents that selected skills for Water and Wastewater Treatment Plant and System Operators, 55% selected SCADA as an essential skill while 38% of online job postings requested SCADA. For Maintenance and Repair Workers, General, 77% of the 101 survey respondents selected hand and power tools, which was requested in 35% of online job postings (21% for power tools and 14% for hand tools).

These discrepancies suggest there is a potential misalignment between the types of skills being advertised to jobseekers in online job postings compared to those requested by hiring managers in the water/wastewater industry. This possible misalignment could impact applicant and resume screening which could ultimately contribute to the difficulty of hiring qualified candidates as stated in the previous survey question. Potential misalignment could also affect the skills taught in community college programs, as community college programs utilize skills from online job postings to review and develop curricula.

Exhibit 37. Essential Skills for Water and Wastewater Treatment Plant and System Operators

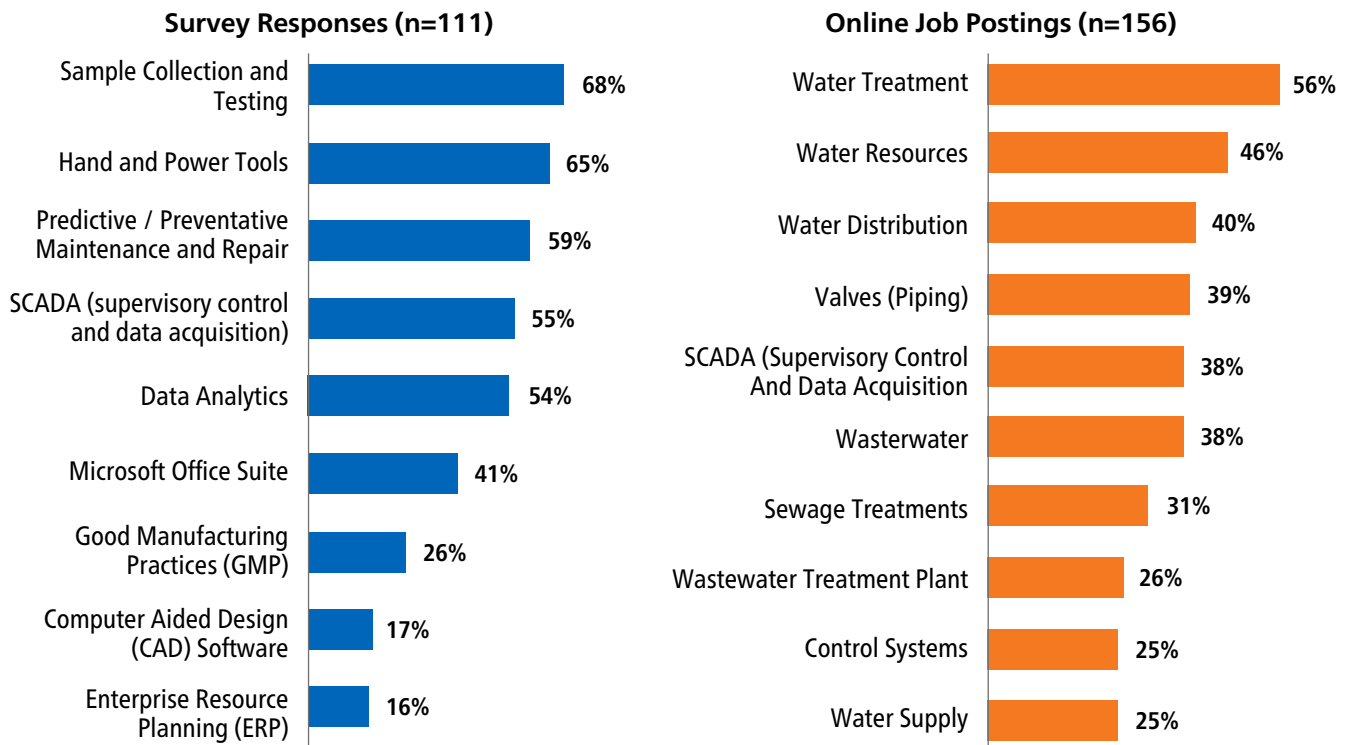


Exhibit 38. Essential Skills for Maintenance and Repair Workers, General

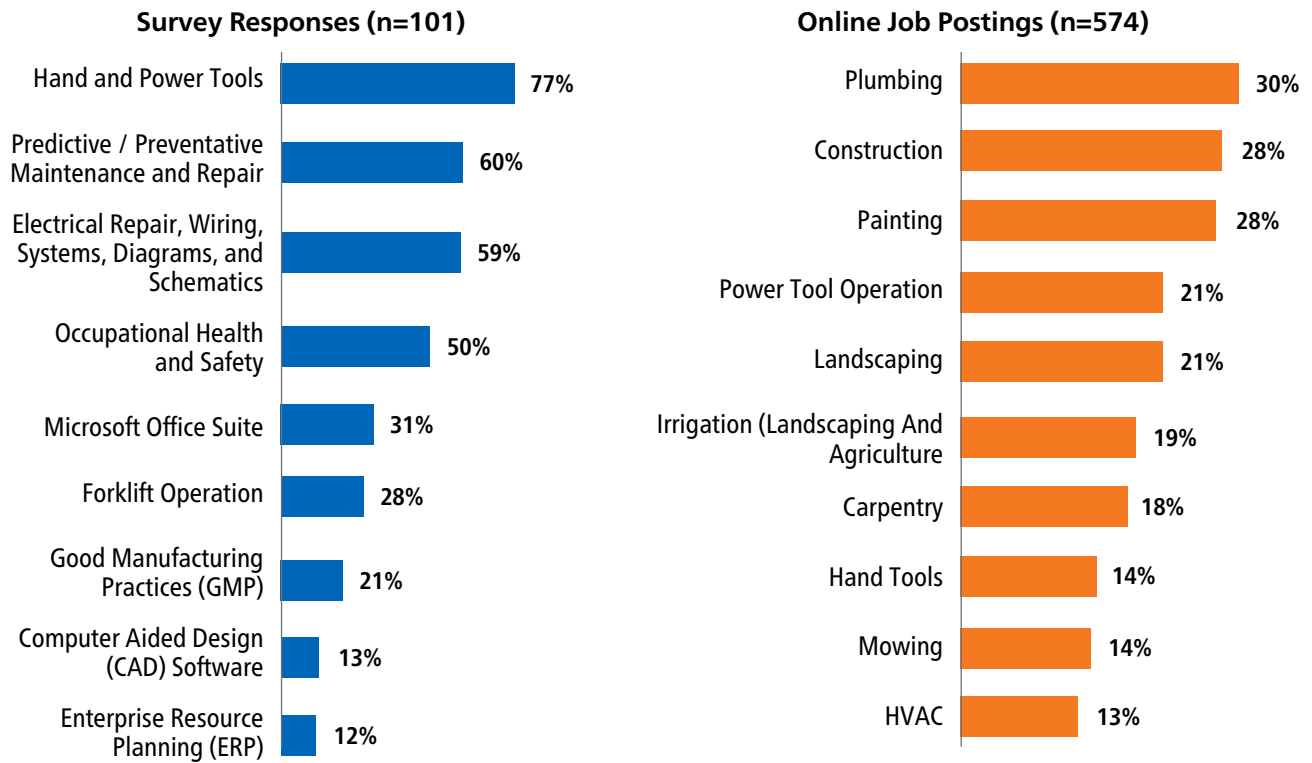


Exhibit 39. Essential Skills for Electricians

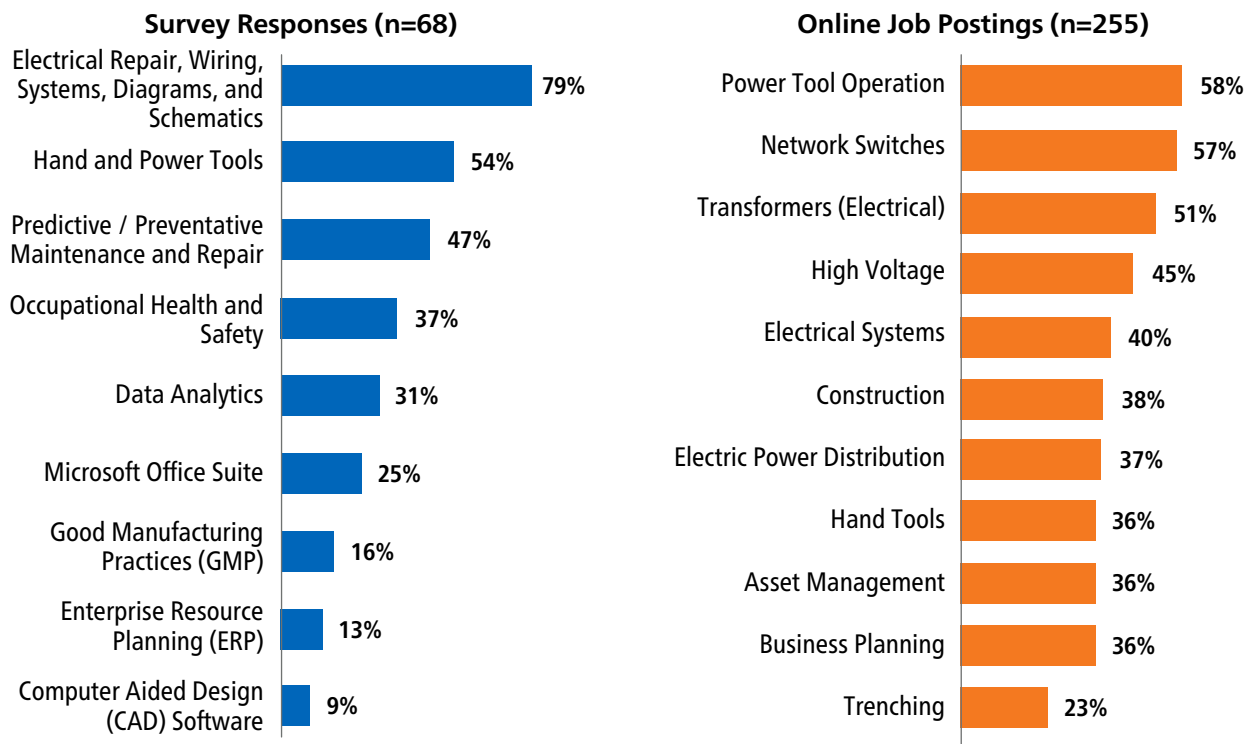


Exhibit 40. Essential Skills for Electrical and Electronic Engineering Technologists and Technicians

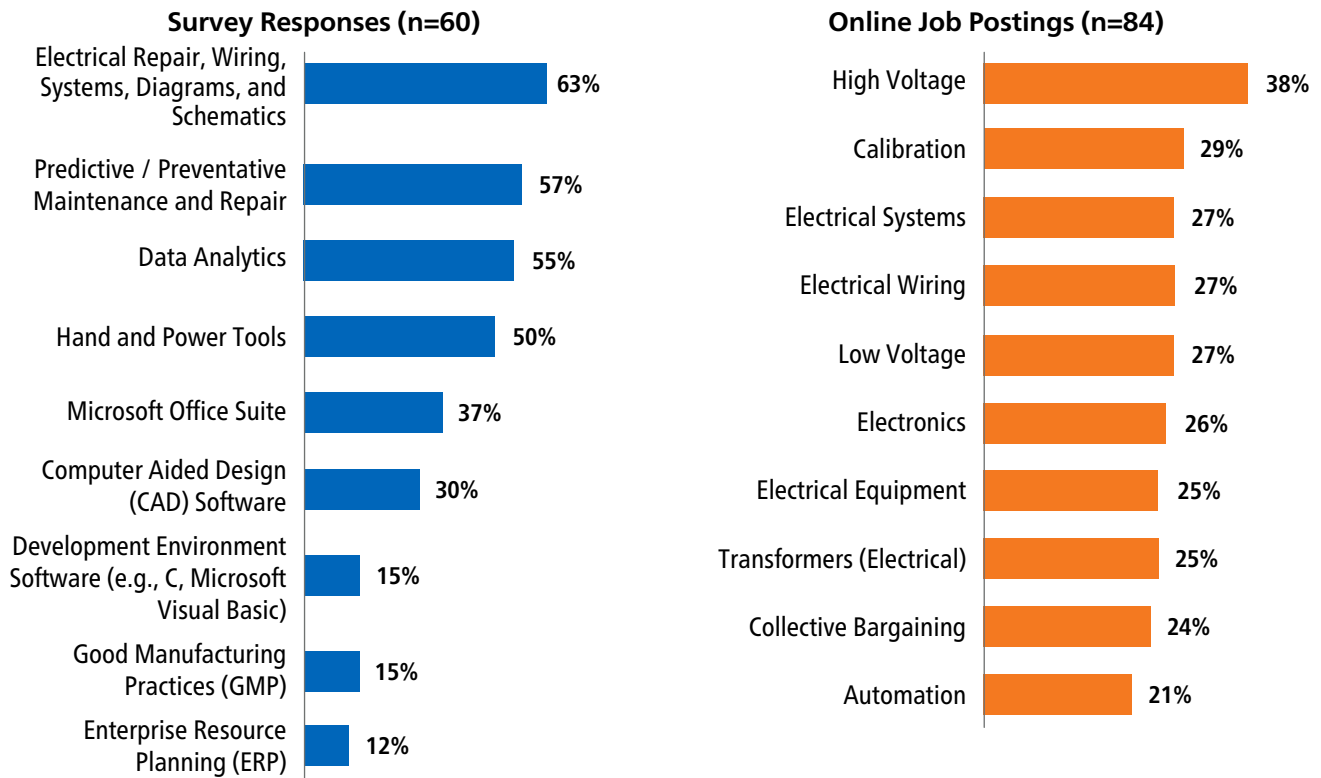


Exhibit 41. Essential Skills for Operating Engineers and Other Construction Equipment Operators

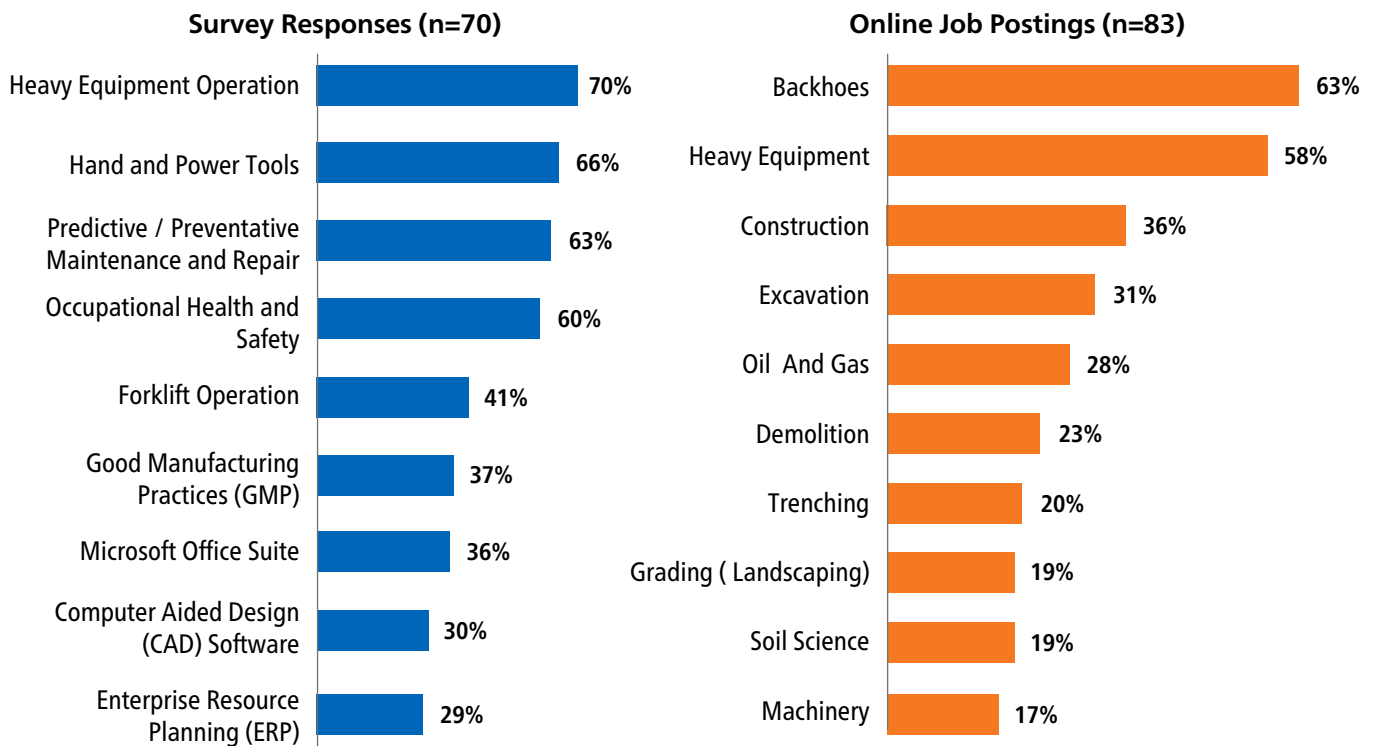


Exhibit 42. Essential Skills for Industrial Machinery Mechanics

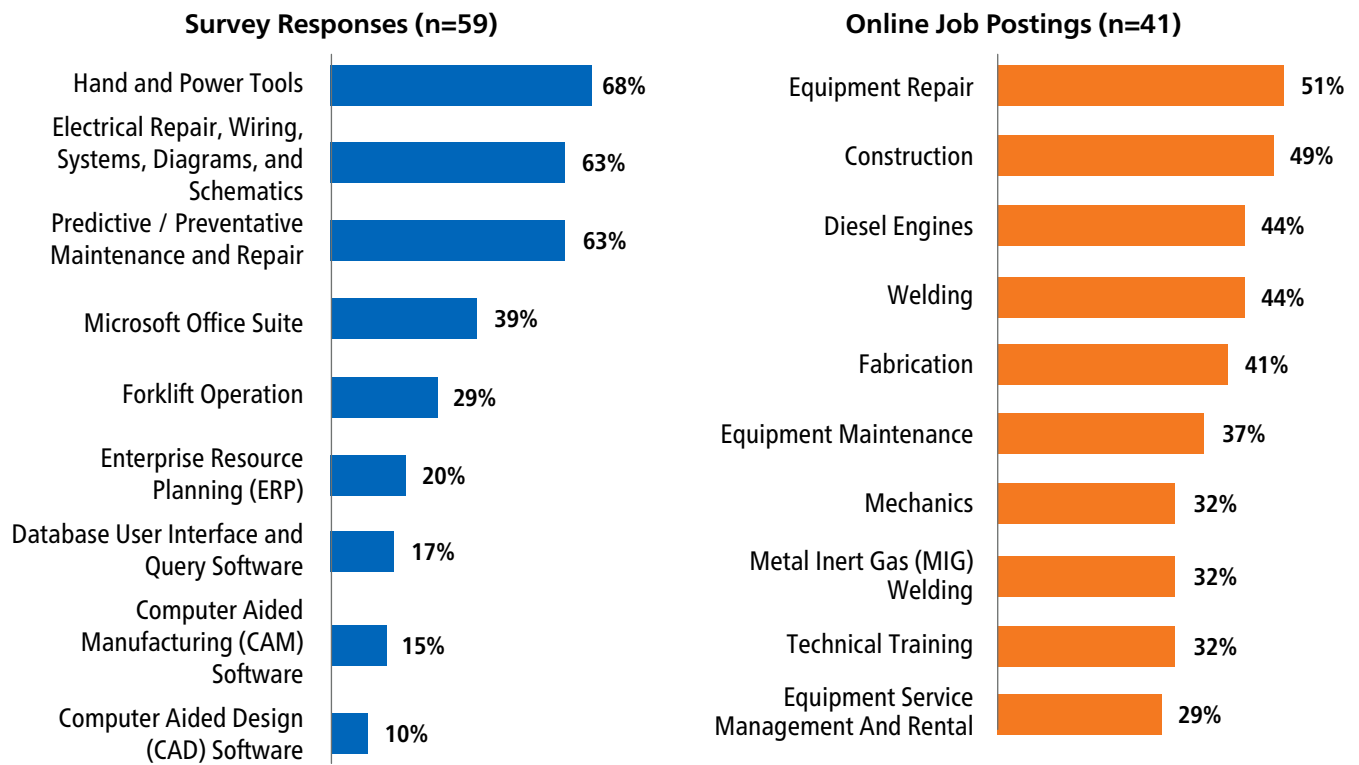


Exhibit 43. Essential Skills for Machinists

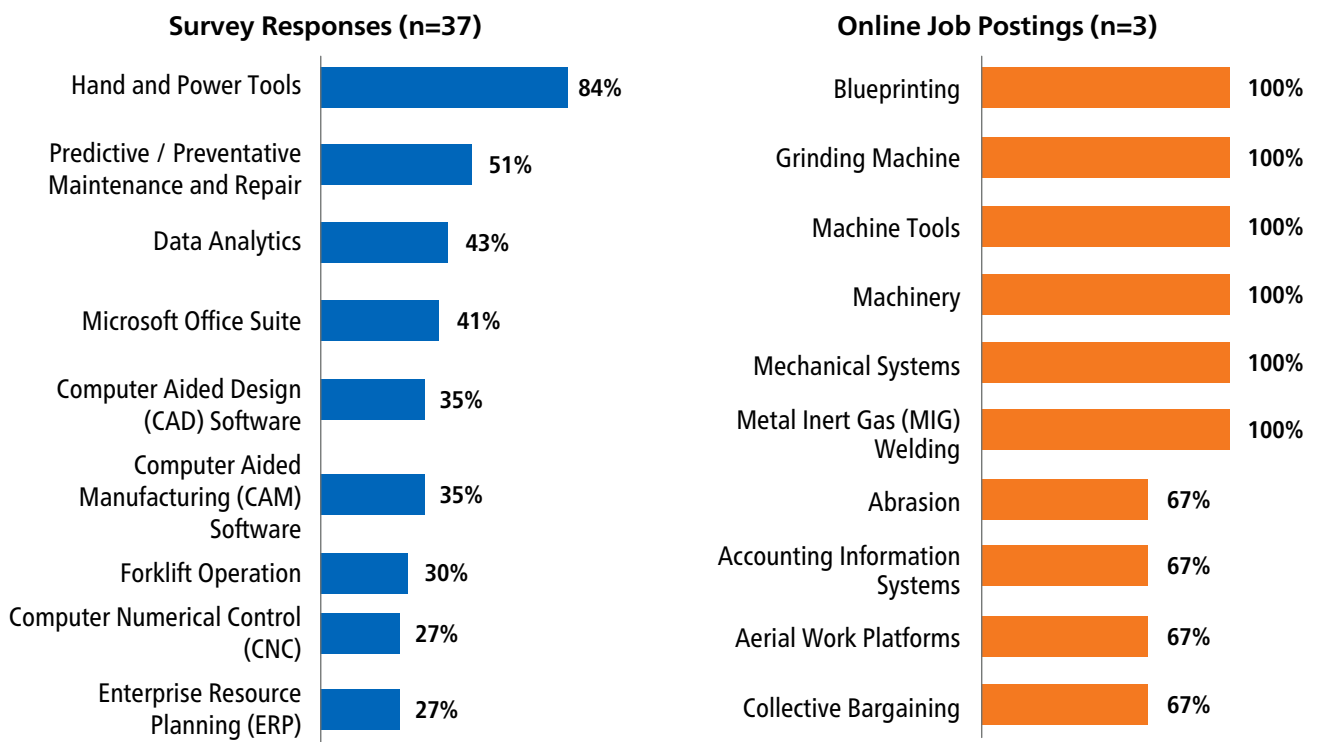
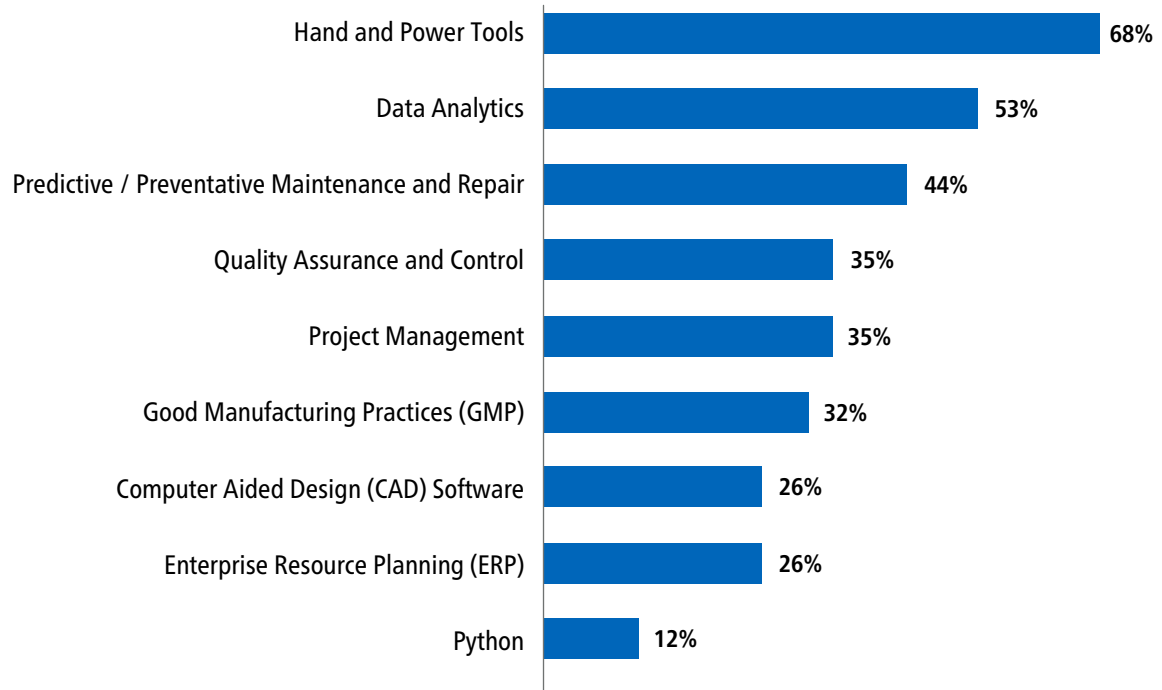


Exhibit 44. Essential Skills for Calibration Technologists and Technicians (n=34)



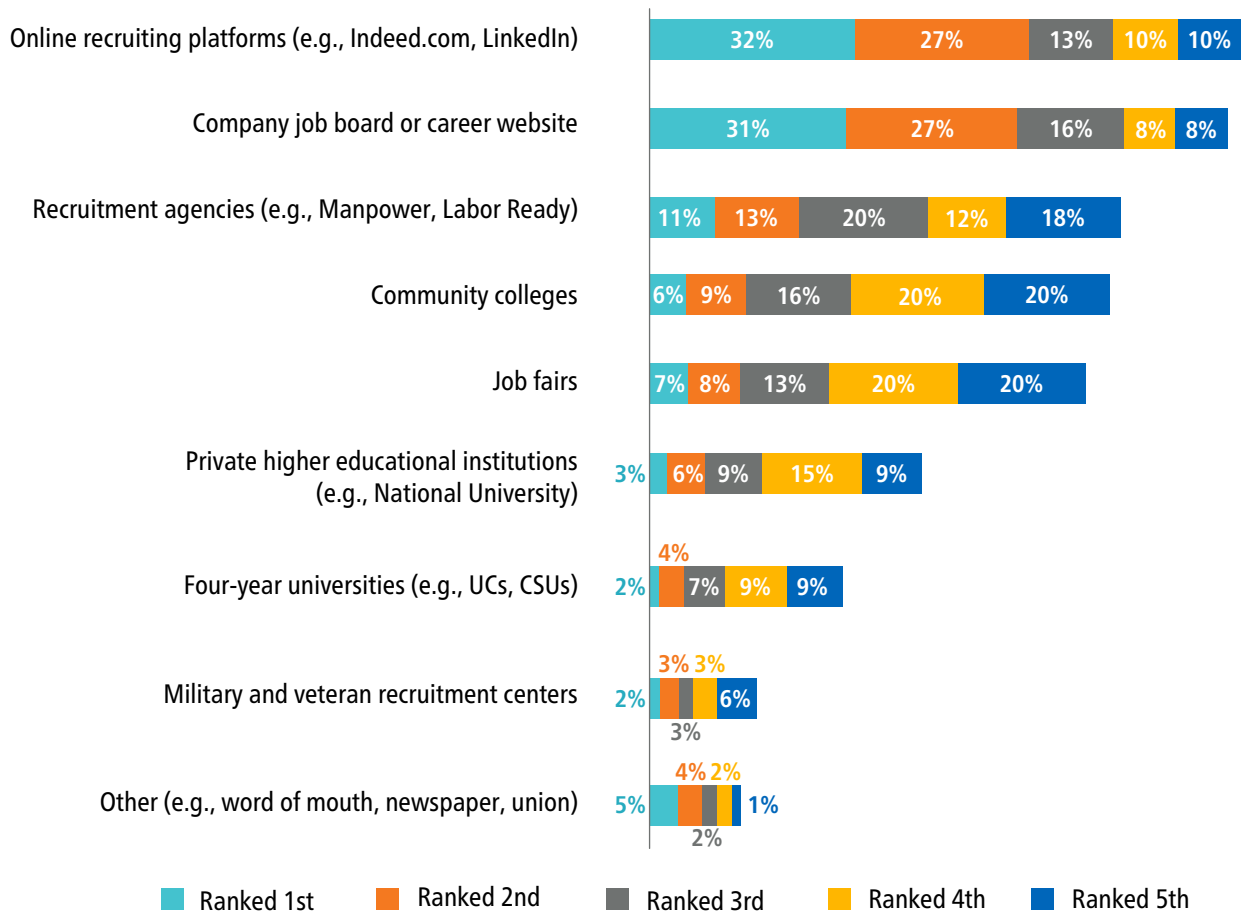
Other Workforce Trends

Beyond obtaining labor market information for mission-critical occupations to help community colleges with program development, the survey also asked water/wastewater companies about entry-level recruitment preferences, current (incumbent) worker training needs, and diversity, equity, and inclusion efforts.

When hiring entry-level workers, survey respondents indicated that their top resource or avenue for doing so was online recruiting platforms such as Indeed.com or LinkedIn, which ranked first or second for 59% of respondents. Additionally, 58% of respondents indicated that a company job board or career site was their first or second top resource for hiring entry-level employees.

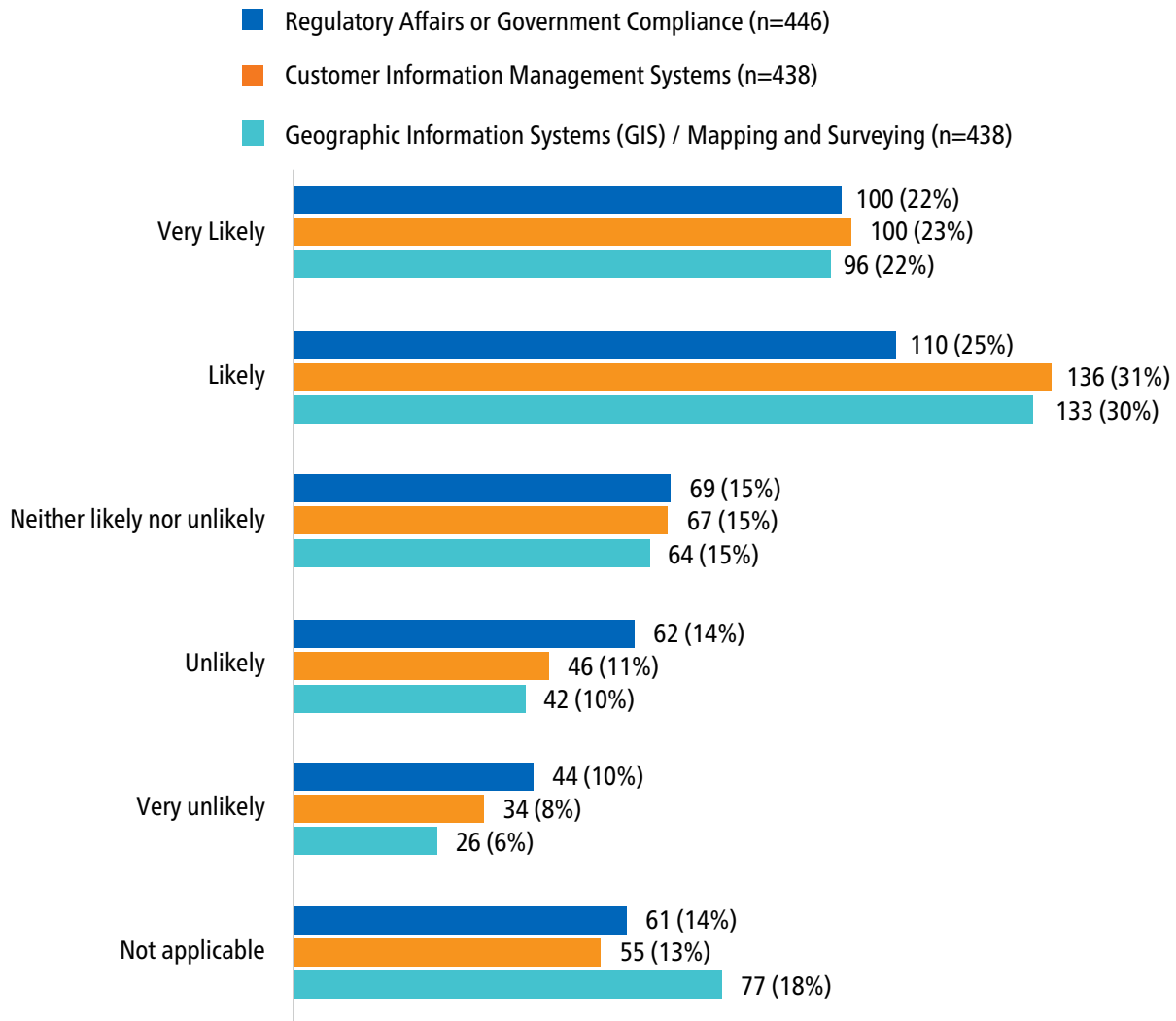
On average, the community colleges ranked fourth on the list, with 15% of respondents ranking community colleges as the first and second top resource for hiring entry-level employees; 40% of respondents indicated that community colleges were their fourth or fifth top resource. Community colleges ranked higher than both private higher educational institutions (sixth) and four-year universities (seventh) (Exhibit 45).

Exhibit 45. Water/Wastewater Companies' Top Resources for Hiring Entry-Level Employees (n=345)



The survey focused primarily on mission-critical occupations that the California community colleges could train for; however, water/wastewater companies also employ workers in regulatory affairs, customer information management (CIM), and geographic information systems (GIS). To determine if the community colleges could train entry-level workers for these positions, the survey asked respondents about the likelihood that their organizations would hire a community college graduate for these occupations. Most survey respondents said it was “very likely” or “likely” that they would hire community college graduates for entry-level CIM and GIS positions and 48% said it was “very likely” or “likely” for regulatory affairs or government compliance positions (Exhibit 46).

Exhibit 46. Likelihood of Hiring a Community College Graduate for Entry-level Positions

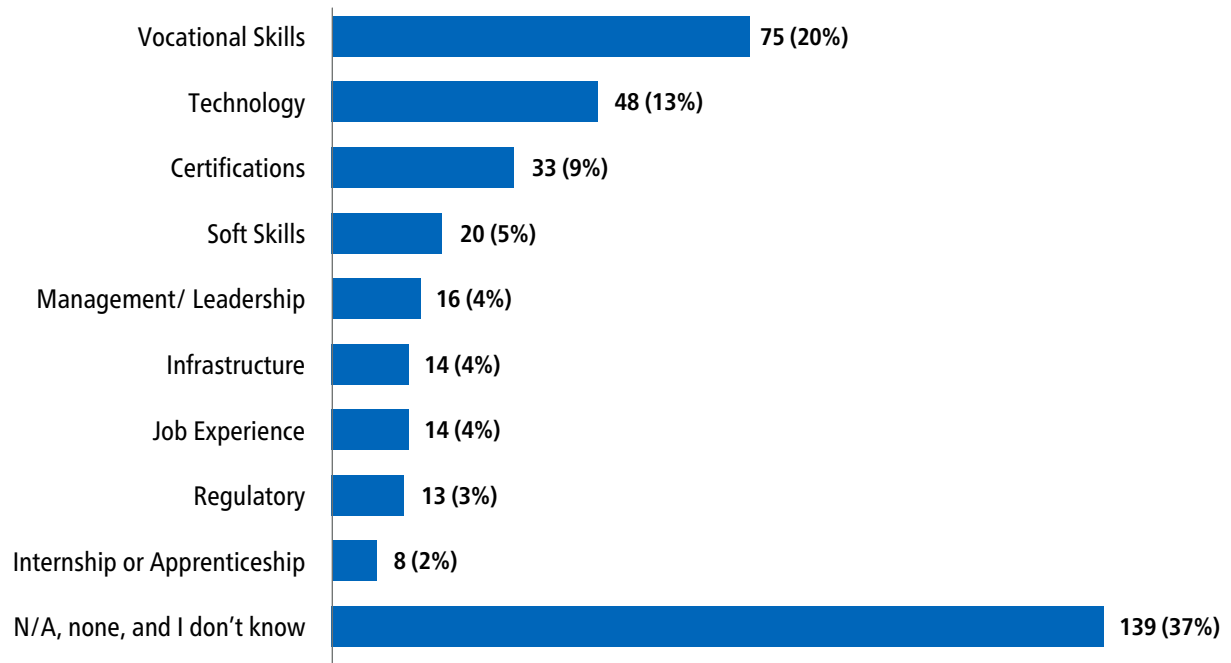


The survey asked respondents to consider upcoming changes in the industry, such as the Infrastructure Investment and Jobs Act (IIJA), technological advances, retirements, and remote work. The survey asked respondents to share what continuing education programs they think the community colleges should offer for current (incumbent) workers.

Of 380 survey respondents, 37% did not provide a suggestion or did not know what should be taught, but more than 240 respondents provided open-ended replies, with vocational skills being the top topic for continuing education (Exhibit 47). Examples of vocational skills include automation, electrical, plumbing, water treatment, and welding. The need for vocational skills may be directly related to knowledge retention challenges after long-time workers retire or leave the workforce.

Technology ranked third, with 13% (48) of respondents entering some form of technology as a suggested continuing education topic. Though most responses were general and did not include a specific type of technology, these responses – as well as those included in the previous section that analyzed skills for mission-critical occupations – suggest that there is a need for technology skills ranging from basic computer skills to data analytics and water technology automation. The IIJA established a grant program that will improve information sharing about water technology, cybersecurity technology, and stormwater control infrastructure and technology. Additionally, if future funding is available through the IIJA, the EPA would conduct a study of potential future wastewater treatment technology.³⁵

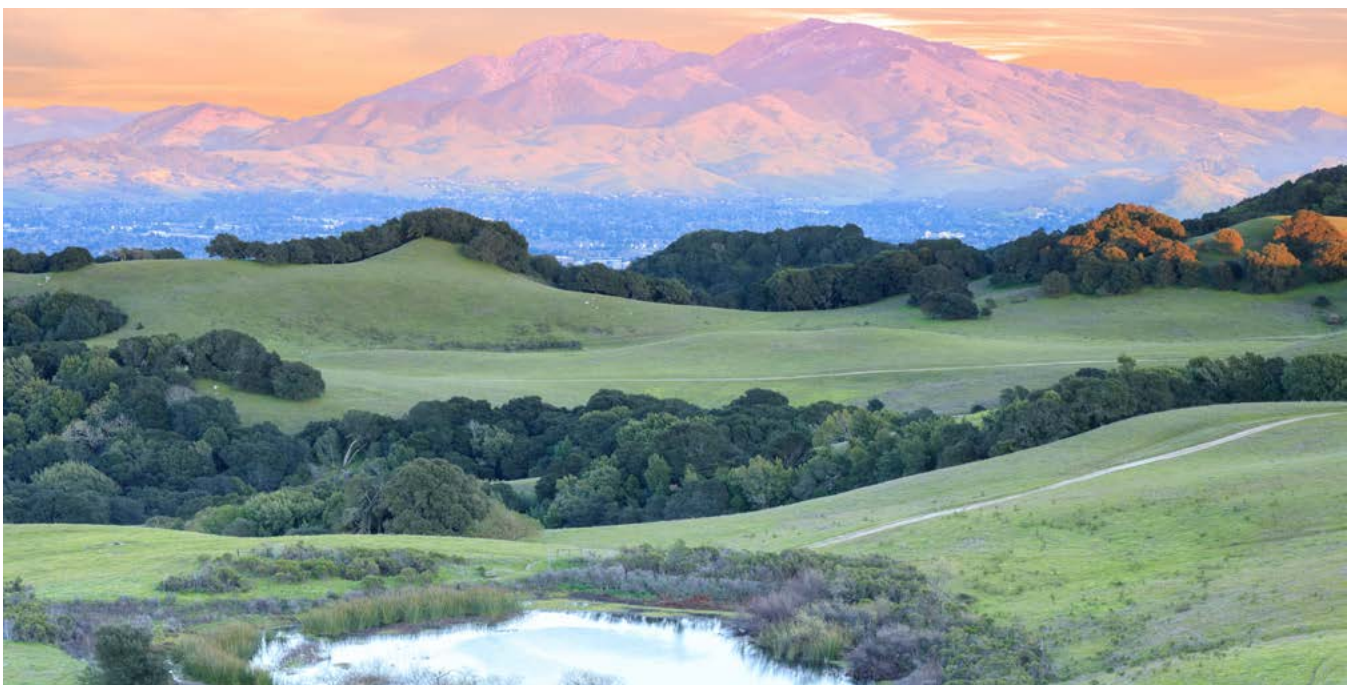
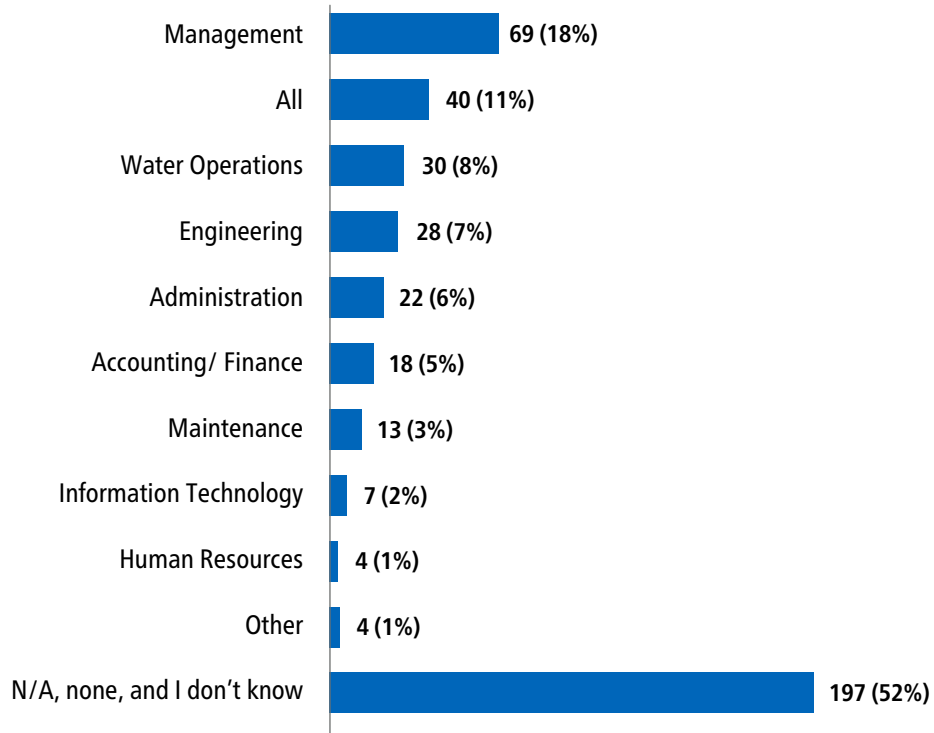
Exhibit 47. Suggested Continuing Education Topics for Incumbent Workers (n=380)



³⁵ American Water Works Association, "U.S. Infrastructure Investment & Jobs Act: Resources for the Water Sector," AWWA, accessed October 10, 2022, <https://www.awwa.org/Resources-Tools/Resource-Topics/US-Infrastructure-Investment-Jobs-Act>.

The survey also asked respondents to share what incumbent positions at their organizations currently would benefit from obtaining a bachelor’s degree offered by the community colleges. This question was open-ended and did not consider current bachelor’s degree programs offered by community colleges or the rigorous process to establish a community college bachelor’s degree. Of the 545 survey respondents, 67% (363) did not provide a suggestion or did not know what would be helpful for incumbent workers. Of the 379 people who responded to the question, 18% (69) said that they would benefit from a management bachelor’s degree program; however, California Community Colleges cannot offer a baccalaureate degree in this area, nor any area for which there are existing programs offered by California State University and University of California institutions.³⁶ (Exhibit 48).

Exhibit 48. Suggested Community College Bachelor’s Degree Programs for Incumbent Workers (n=379)

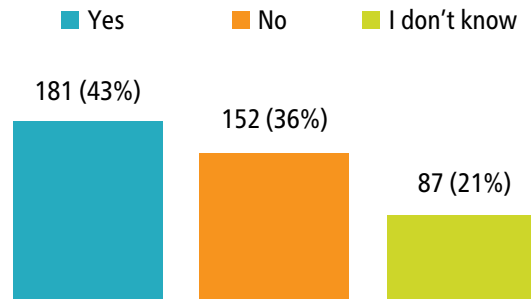


³⁶ "Assembly Bill No. 927," California State Assembly, last modified October 7, 2021, https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB927.

Diversity, Equity, and Inclusion

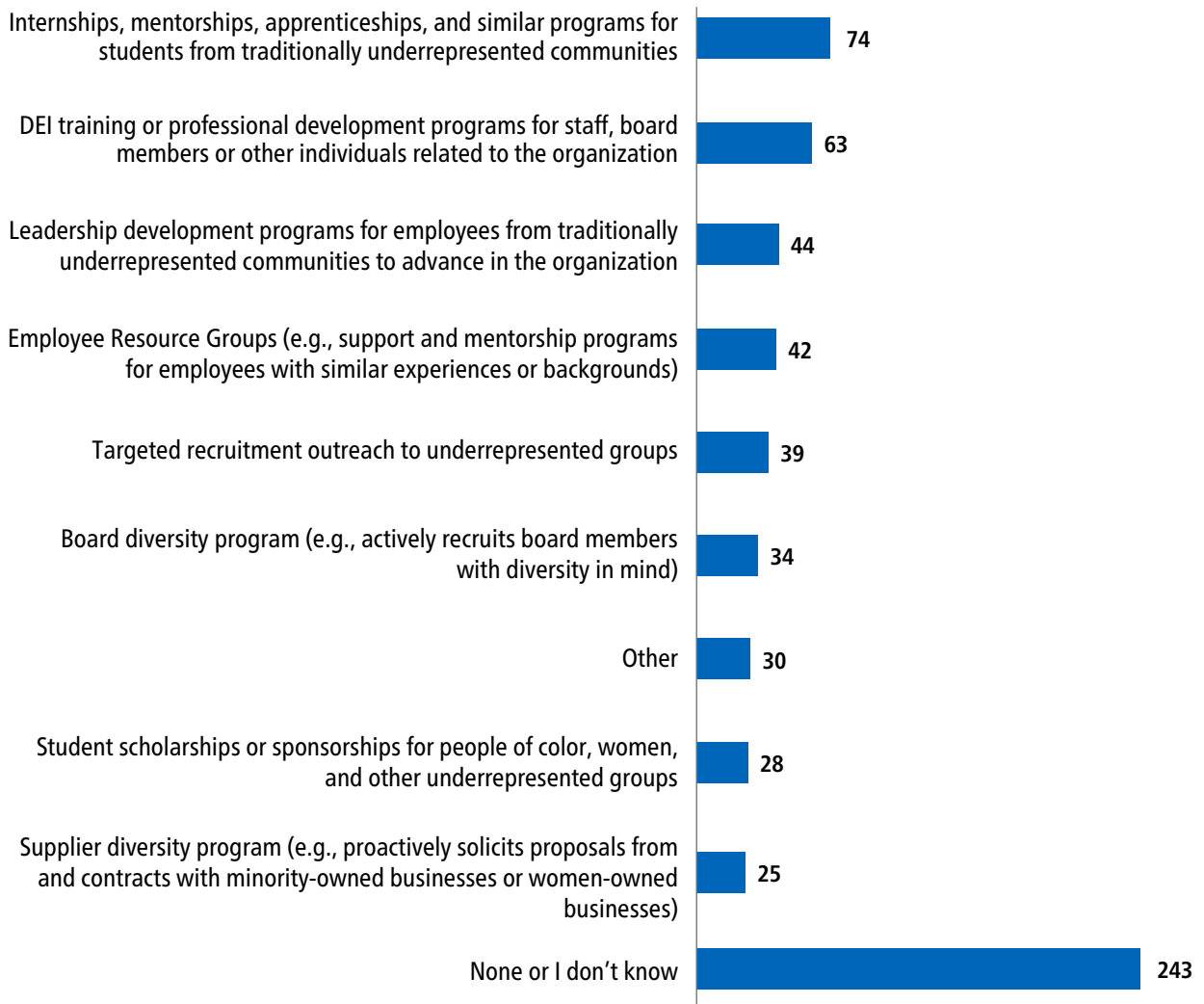
As identified in the labor market analysis of this study, the water/wastewater industry has a relatively homogenous workforce. To help the industry with its diversity, equity, and inclusion (DEI) efforts, the survey asked respondents if their organizations have a DEI strategy. Nearly half said “yes,” 36% said “no,” and 21% did not know if their organization had a DEI strategy (Exhibit 49).

Exhibit 49. Organizations with Diversity, Equity, and Inclusion Strategies (n=420)



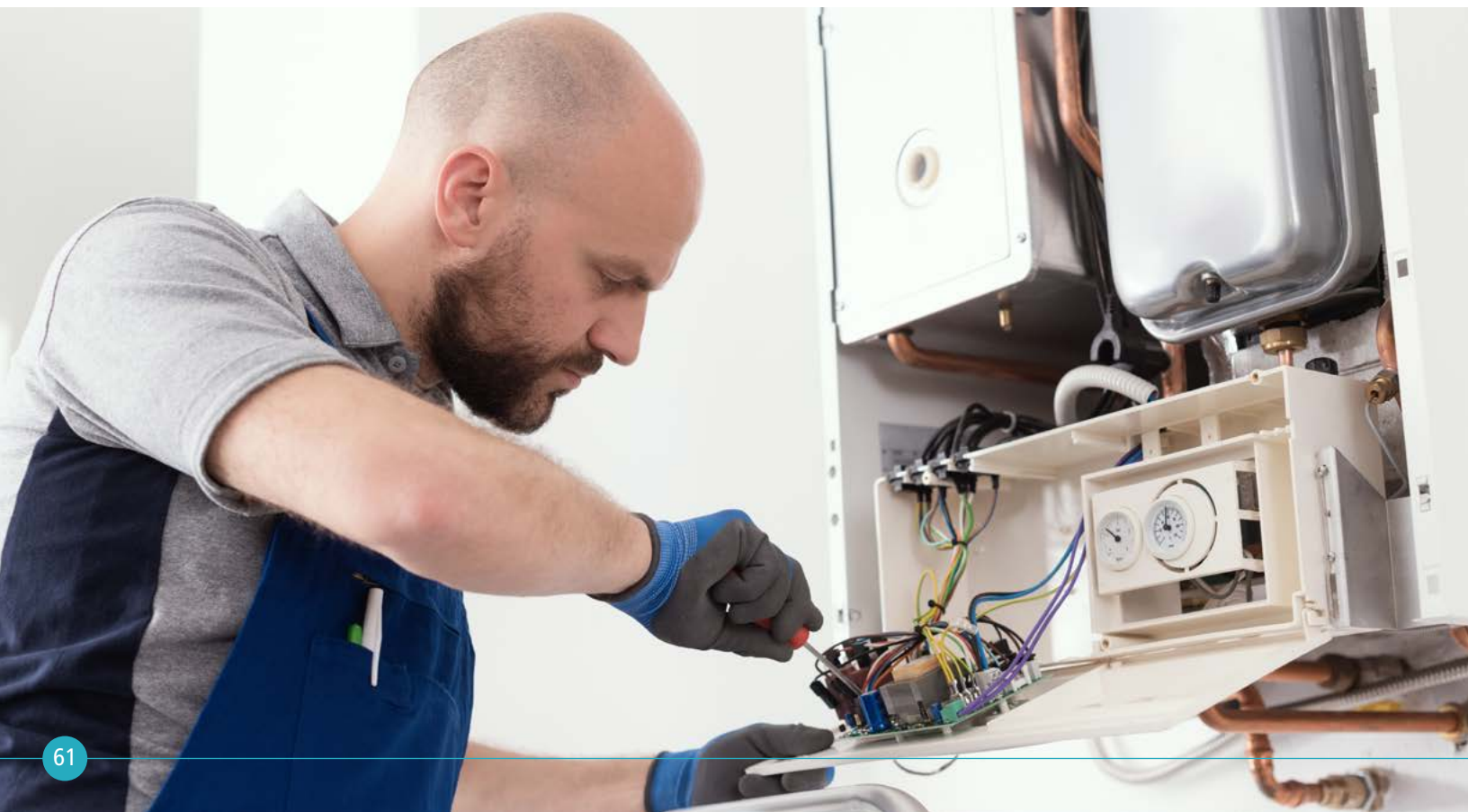
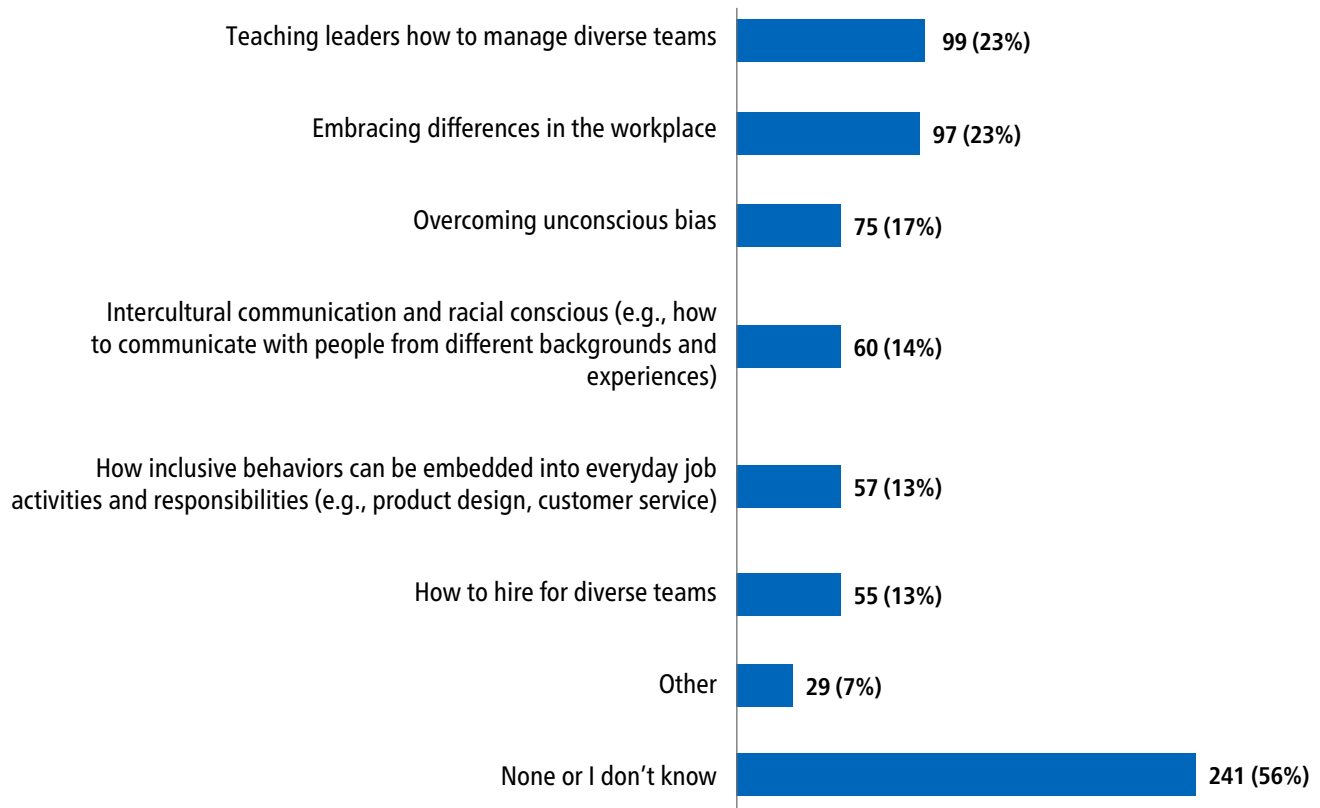
The survey also asked if companies provided at least one program related to DEI for underrepresented communities (e.g., women, and people of color). Of the 428 survey respondents, 243 said that they did not know, or their company did not have a DEI program (Exhibit 50).

Exhibit 50. Diversity, Equity, and Inclusion Programs (n=428)



Finally, to support their DEI efforts, the survey asked companies what DEI trainings they would be interested in having at their organizations. The top response was teaching leaders how to manage diverse teams (Exhibit 51).

Exhibit 51. Potential DEI Training Topics for Water/Wastewater Organizations (n=431)

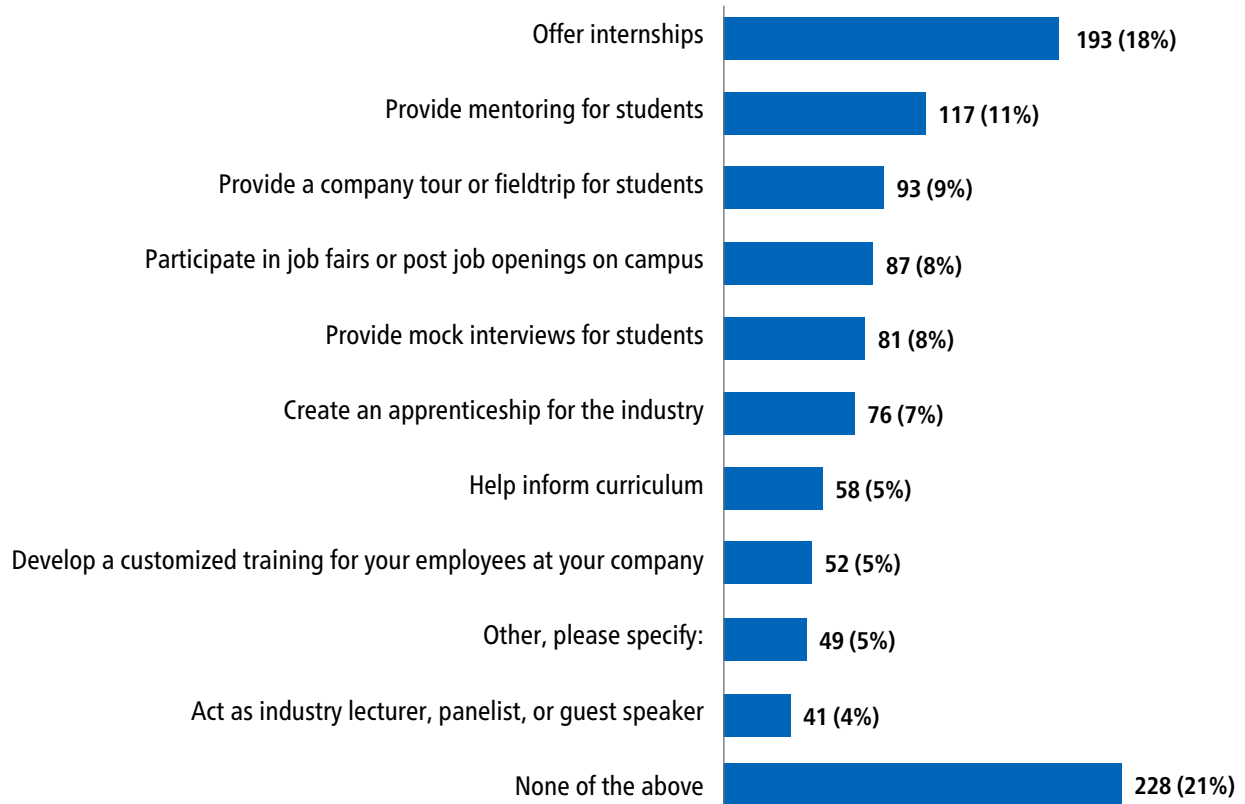




Partnership with Community Colleges

To help community colleges with employer engagement, the survey asked if companies would be interested in partnering with the colleges. Of the 320 survey respondents who expressed interest in partnering with the colleges in some capacity, 193 said they were interested in internships and 117 were interested in mentorships (Exhibit 52).

Exhibit 52. Industry Interest in Partnerships with Community Colleges (n=320)



INTERVIEWS WITH COMMUNITY COLLEGE TRAINING PROVIDERS

To address the research questions related to the existing connections between industry and community colleges, as well as how California Community Colleges support efforts to mitigate industry challenges, the COE successfully contacted 20 of the 36 colleges offering water/wastewater programs and conducted 20 in-depth interviews with community college water/wastewater faculty members (12), deans (7), and a program director (1) between August and November 2022.

As discussed in the introduction of this report, the COE previously conducted regional water/wastewater industry research. Cumulatively, these prior reports provided the following recommendations to increase educational supply for mission-critical occupations:

- Raise the public’s awareness of the industry and its mission-critical occupations
- Work with industry to develop more entry-level job opportunities for students and increase their career readiness
- Train more students for mission-critical occupations
- Keep up to date with technology (e.g., computer-based digital tools) and industry trends/changes

Community College Progress on Previous Recommendations

The following sections evaluate whether progress has been achieved on these recommendations and identify additional ways to support the industry. These sections include direct quotations from community college faculty, deans, and program directors. In the interest of anonymity, these individuals, and the colleges they represent are not identified. For more information about the qualitative research methodology, see Appendix C.

Raise the public’s awareness of the industry and its mission-critical occupations

According to interviews with community college training providers, the water/wastewater industry and related programs are still confronted with a lack of public awareness. As one participant explained, “One of our biggest challenges is awareness. A lot of people just aren’t aware of the industry. They’re not aware, aware of how rewarding and fulfilling a career pathway in water can be. So that’s been a big challenge.” This highlights the value and necessity of marketing and outreach in recruiting workers and students for the industry. Interview participants reported that some colleges implement intentional, targeted marketing for water/wastewater programs while others rely on broad marketing that promotes all programs at a college. Interviewees felt that non-targeted approaches were generally ineffective in attempts to increase enrollments of diverse students. They felt that the most effective strategies were those that leveraged relationships with businesses or industry partners.

“From a marketing perspective, we have attempted what I would call college marketing, you know, similar strategies as the college might take for other programs, right. Non-targeted, but then not surprisingly those seem to not be very fruitful. We found more response when we engage with our industry partners and related technical firms.”

“We have an outreach program at our college who will share those programs, but we’re also working on a very specific project around water and students who typically may not know about water as an opportunity, especially like, you know, low socioeconomic or folks who have been typically marginalized. So reaching out to folks of color, especially in our region, is, I think, a big part of what we should be doing and can do better.”

“We have marketed it digitally and in print, not only among current students but the community as well. We also promote the program through the water agencies who market it internally to their employees and to prospective employees.”

The community colleges implemented a variety of marketing strategies and approaches over the years, such as:

- Working with employers and industry partners to market programs directly to employees;
- Connecting with local high schools to promote the industry and community college programs;
- Using social media outreach (e.g., Facebook, LinkedIn, Instagram);
- Promoting the industry and programs to students (and recruiting students) from other related courses and programs;
- Promoting on local radio stations;
- Training community college counselors about the programs and supporting them with students' academic plans;
- Printing and posting materials about the program across campus; and
- Hosting a booth at related conferences and events.

However, some interviewees lamented that their colleges halted marketing activities due to a lack of resources. Funding for outreach is limited and fluctuates depending on the state's priorities. As one participant explained, their program received support from the state-funded Deputy Sector Navigators (DSNs), but those positions no longer exist. As a result, their college is "not currently doing any marketing," which has led to "a constant struggle and a constant battle" to recruit more students.

Work with industry to develop more entry-level job opportunities for students and increase their career readiness

Like marketing and outreach strategies, interviewees reported that community colleges have found the most success in finding job opportunities for their students by directly partnering with water/wastewater employers. Some colleges offer cooperative work experience in which students receive credit for their work at a company. These programs have been an effective way for these colleges to work with employers and for students to obtain direct work experience that helps prepare them for the industry.

"We actually have cooperative work where they're actually working for a company and then they get academic credit where they're working. And some are actually working for the company in a different capacity...but then because they're in this cooperative work, they can kind of move laterally within the company, which we highly recommend."

"We try to incorporate workplace learning into every class. So that that's [sic] definitely been something different. That's been a big push in order to implement that in the classroom setting, whether it's online or in-person."

To develop more job opportunities for students, several interview participants shared that they would like to partner with businesses to provide on-the-job training or work-based learning (WBL) opportunities (e.g., internships), which could help students meet the minimum job qualifications for mission-critical occupations. As previously identified in the industry survey, employers reported that lack of relevant prior work experience was the most difficult attribute to find in job candidates. However, interviewees noted that WBL opportunities, such as paid internships, are necessary but scarce, especially after the COVID-19 pandemic.

“There is a demand in the field for more operators to come into the field, but it’s hard to find the internships right now to get them [students] the training, to get them to that next level. So if we can break that barrier, especially for wastewater...they have requirements by the state for on-the-job training yet it’s almost impossible to find an internship.”

An unpaid internship opportunity, however, is not realistic for all students; one interviewee shared that students are unable to support their families if an internship is unpaid, and many of their program’s students are part-time, working, and have families to support.

“Many of our students are part time students that are a little bit older and they can’t work for free. That’s just not an option. They’re not supported by mom and dad, right? So some of them already have families and things. So they’re like, ‘I would love to do that, but I can’t do it for free and I can’t quit my current job to take even, you know, a minimum wage paid internship.’”

To help students with job search preparation, interview participants also reported that some programs incorporate job readiness as part of their curriculum, including interview prep, resume writing, and assistance with LinkedIn profiles.

“We’ve incorporated it into the actual curriculum in our intro class. They have to develop a resumé for us a sample water job. So we are trying to sort of incorporate things like that in into the coursework itself and it’s gone pretty well; we also try to make them develop a LinkedIn profile and then join our colleges, the department.”

“We work closely with [sic] and her job is to help facilitate jobs. And part of what we do is have our students do a mock interview and a resume review.”

Train more students for mission-critical occupations

Training students for the water/wastewater industry is a priority. Interviewees reported multiple barriers to successfully getting students into and through their water/wastewater programs. According to interviewees, many have had and/or still have trouble expanding their programs. While many water/wastewater classes are full and have waitlists, new sections are unable to be added due to the lack of faculty to accommodate waitlisted students.

Interviewees reported difficulty attracting potential faculty, primarily because water/wastewater jobs pay well and would therefore require qualified industry professionals taking a pay cut to teach.

Full-time faculty are especially important because they not only teach but are responsible for developing program curriculum and maintaining industry connections. While both full-time and adjunct (part-time) faculty are needed, there are inherent, systemic challenges in hiring full-time community college faculty beyond salary (e.g., faculty obligation numbers and college or district-wide new faculty prioritization).

The following quotes from interviewees exemplify these challenges:

- *“What I am struggling with now is finding a full-time faculty member. We have had our full-time faculty member for a water position open since last fall and it has been a failed search every single time. One [challenge] being salary. I have an adjunct right now that would be stellar for that position, but it would require him taking about a 50% pay cut, which obviously is not a realistic salary.”*
- *“I don’t know that it’s going to be really easy to find someone to teach that with the experience, you know. Well, we’re competing with the industry in terms of salary as we sometimes come out on the short end and it’s difficult to, I guess, entice someone to come and work for us instead of earning a larger salary in the industry.”*
- *“We offer six classes...but we only have instructors for some of those classes. And so a lot of the classes haven’t run for several years. And so I think obviously that was exacerbated by COVID. So anyway, we’re working to find additional instructors, you know.”*
- *“One of the things that we’ve been trying to address here at our water treatment program is it’s taught primarily full time by part-time faculty. Yes...and that has really limited the growth opportunities...The lack of a full-time faculty that can really take ownership of the program to maintain relevancy and [be] up-to-date with industry requirements.”*
- *“I’m not just a professor here. I have - I’m also an entrepreneur in the water space. I don’t have time because I’ve just started the semester and I’m just...I can’t do everything I’ve got two other full-time jobs.”*

Keep up to date with technology (e.g., computer-based digital tools) and industry trends/changes

An advantage of having adjunct faculty that are concurrently employed in industry is that they might be privy to new water/wastewater technology and could speak from on-the-job experience, which some interviewees felt was an advantage.

“All our faculty are, or the majority of them are, all in the industry currently. And so we are getting, of course, from them exactly what students need to know, what courses we should be providing, or what have you, as a result of that.”

Interviewees expressed that water/wastewater technology is constantly changing and evolving, and community colleges must rely on industry experts to establish and maintain competitive programs that are up-to-date and relevant.

“The technology over the years that I’ve worked in the field, the technology is really advanced. All the things that are happening in computers and digitizing data that’s all moved into the water and wastewater treatment technology.”

“Yeah, technology is changing. And we’re offering more classes to go along with the changing technology.”

To remain current in their curriculum, programs typically rely on advisory boards comprised of industry experts (e.g., water districts, utility companies, local government, and private agencies). However, while most colleges seemed to have well-established boards, six programs indicated that they did not have an advisory board, were unaware whether one existed, or were working to establish one.

“The advisory board that we have is all water boards. So they come in and they look over our curriculum and our facilities and they give us suggestions for upgrading to current. But most of it’s all current because we’re ahead of the game. We know what’s coming and so we purchase it to stay on track with current technology.”

“We don’t have specific advisory boards. We collaborate with utilities in the area, we bring them in as guest lecturers, we do field trips at their facilities, and we just do it for our class and have a chief operator talk to us while we tour the plants.”

“As far as the advisory board, it just happens to be the instructors in the program at this point. We’re the only ones that advise the dean and what we have and we meet, I think, annually at this point, or maybe biannual, what like once per semester. So probably twice a year and it isn’t always complete either. But we advise on the program.”

When asked about other water/wastewater programs, interview participants requested that the COE include a list of current water/wastewater programs in this report to help establish a community of practice across California.

Interview Responses Summary

These interviews demonstrate that community college stakeholders continue to share some of the same challenges as water/wastewater companies, including a lack of awareness of the water/wastewater industry and corresponding community college courses. However, there are several ongoing efforts to address these issues, including marketing to raise awareness, as well as working with industry partners to identify employment opportunities and stay up to date with current trends and technology. Two outstanding problems include attracting and hiring water/wastewater faculty, which would allow programs to serve more students, and collaborating with industry to create cooperative work experiences for students.

The following is a summary of the recommendations for California Community College water/wastewater programs from the 20 interviews with community college faculty, deans, and program directors.

- **Prioritize colleges' water/wastewater marketing and employ a variety of targeted approaches to encourage students to enroll in programs, including leveraging partnerships with employers.** Colleges that took a more active role in marketing their specific program spoke about it being an effective way to recruit students, compared to colleges that relied on broad marketing of all programs through their college or that were not currently actively marketing the program. This is especially critical as awareness of water programs were viewed by interviewees as a key limiting factor to enrollment challenges. Establishing partnerships with employers in the region and promoting upskilling or career advancement opportunities may be an effective way to encourage students to enroll. This approach may be especially effective for colleges that have cooperative work programs established where students can earn credits while working.
- **Promote and maintain existing lists of water/wastewater programs that instructors can utilize.** Interviewees commented that they had difficulty understanding the courses offered and structure of other water/wastewater programs. They stated an active program list would be useful, especially for faculty. Promoting the list of water/wastewater courses published by the State Water Resources Control Board, the most recent version is from April 2020, would begin to address this need.³⁷ Community colleges and the water/wastewater industry should work together to make stakeholders aware of this existing resource and work with the State Water Resources Control Board to ensure the list is kept up to date. This list could be used as a reference to inform educators about water/wastewater courses and the respective community colleges they can correspond with to learn more about the structure of other water/wastewater programs.
- **Increase awareness and improve effectiveness of advisory boards.** Although advisory boards, comprised of industry representatives and educators, are a statewide requirement for all programs per California Education Code (Ed Code), some interviewees stated their college advisory boards were more effective in the development and maintenance of water/wastewater programs than others. At least one interviewed instructor noted they were unaware their advisory board existed. Therefore, improved awareness for educators of when advisory boards are occurring, as well as public access to meeting agendas and minutes, would be beneficial. Colleges should build on the baseline objectives stated in Ed Code - which include review of program curricula and technological advances within industry. Looking at best practices of other water/wastewater advisory boards, such as including college counselors in advisory board meetings as a way for them to learn about and promote the program among students, could make advisory boards more effective.
- **Offer students cooperative work experiences as part of program curriculum and/or paid internships.** Some interviewees described cooperative work experiences as an important facet of their program. Furthermore, research has shown that students who are able to participate in work-based learning achieve greater student outcomes. These experiences allow students to earn college credit while on the job, which enhances job readiness. Local industry partners already serving on program advisory boards can be leveraged to create cooperative work experiences and establish new industry relationships to generate additional opportunities for water/wastewater students.

³⁷ California State Water Resources Control Board, "Specialized Training Providers," California State Water Resources Control Board, last modified April 2020, https://www.waterboards.ca.gov/drinking_water/certlic/occupations/documents/opcert/specialized_training_courses.pdf.



FINDINGS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The water/wastewater industry is a critical component of local, state, and national infrastructure that has faced challenges of an aging workforce, lack of workplace diversity, and lack of awareness of the industry. This report provides the first COE statewide analysis of traditional labor market information and qualitative data collected via a survey of water/wastewater companies and interviews with community college faculty, deans, and directors to address the research questions outlined in the introduction. These research questions, along with the corresponding findings for each question, are included below.

Findings

RQ1: What is the labor market for the water/wastewater industry?

- a) What are the mission-critical occupations?
- b) What is the supply and demand for water and wastewater treatment plant and system operators and other mission-critical occupations?
- c) What are the essential skills for these mission-critical occupations across all industries and within the water/wastewater industry?

RQ1 Findings

- a) This report identified [eight-mission critical occupations](#), which are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma.
 1. Calibration Technologists and Technicians
 2. Electrical and Electronic Engineering Technologists and Technicians
 3. Electricians
 4. Industrial Machinery Mechanics
 5. Machinists
 6. Maintenance and Repair Workers, General
 7. Operating Engineers and Other Construction Equipment Operators
 8. Water and Wastewater Treatment Plant and System Operators
 - All eight mission-critical occupations have [high entry-level wages](#) and [low typical entry-level education requirements](#) and are [relatively homogenous when considering workforce demographics](#).
 - Throughout the state, the water/wastewater industry accounts for 13% of employment in these mission-critical occupations and these occupations account for 4% of water/wastewater employment.
- b) There is significant [demand but low supply for these mission-critical occupations](#) in California, indicating a labor supply gap of 32,049 awards.
 - There is a projected labor market demand of 37,459 annual job openings statewide through 2026.
 - Of those, 12% (4,442) are projected to be in the water/wastewater industry.
 - An average of 5,410 awards (supply) have been conferred by educational institutions over the past three years.
 - [Community colleges account for 71% of the supply from educational institutions in California](#) and provide training programs for all but one mission-critical occupation.

- c) The [essential skills](#) for water/wastewater mission-critical occupations are similar across all industries, yet skills identified by survey respondents and listed in job postings vary greatly.
- This report identified the top [10 skills listed in online job postings](#) for each mission-critical occupation.
 - Essential skills are highly transferable across all industries.
 - Most skills identified by survey respondents do not align with those requested in online job postings for any of the mission-critical occupations.
 - This potential misalignment could contribute to industry's challenge of hiring qualified employees and deserves to be studied further.

RQ1 Recommendations

- The water/wastewater industry may want to conduct further research on emerging occupations developing due to technological advancements, legislation and/or regulatory requirements, or other factors to predict future mission-critical occupations in preparation for future industry needs. Though the intent of the industry survey was to identify potential emerging areas, most respondents either did not respond or said they did not know which areas were developing in the industry. It is unclear whether that is due to respondents' lack of interest in emerging occupations or lack of knowledge.
- Continue to build and improve upon awareness of the water/wastewater industry and evaluate effectiveness of existing marketing campaigns and other efforts to attract potential employees.
- Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.
- Address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnership with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly in age and gender.
- The water/wastewater industry should conduct further research to determine if there is a misalignment between the skills in online job postings and those considered essential by hiring managers and, if so, the degree of misalignment. Once essential skills for each mission-critical occupation have been identified, industry and community colleges, via advisory boards, should collaborate to refine curriculum and address these skills.
- Leverage industry and community college partnerships to develop cooperative work experiences and other work-based learning opportunities that will help students earn as they learn skills for employment in the water/wastewater industry. RQ2: What are the current and potential challenges facing the water/wastewater industry?

RQ2: What are the current and potential challenges facing the water/wastewater industry?

- a) What methods do water and wastewater agencies typically use to recruit new hires (e.g., unions, online job postings, word of mouth)?
- a) Are existing connections between industry and supply from community colleges and other training providers in place to fill demand for these occupations?

RQ2 Findings

- a) [Water/wastewater companies rely on online recruiting platforms and company job boards for recruitment](#), but report difficulty in finding qualified candidates.
 - Nearly 60% of survey respondents indicated that these platforms ranked as their top two resources for hiring; community colleges ranked fourth.
 - Survey respondents have the most difficulty finding job candidates with relevant prior work experience, adequate technical skills, and required licenses or certifications.

- b) [While some connections exist](#), improvement is required to address the high demand for water/wastewater workers.
- Community colleges have had the most success finding job opportunities for students by directly partnering with employers.
 - [Interview participants shared they would like to partner with water/wastewater companies](#) to develop on-the-job training, internship, and/or other work-based learning (WBL) opportunities, which could help students meet job qualifications for mission-critical occupations.

RQ2 Recommendations

- While most of the water/wastewater recruitment comes from online platforms, building continued awareness of the industry as a whole should attract more candidates. Utilize the opportunity of hiring new people to address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnership with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly when considering age and gender.
- Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.

RQ3: How are these industry challenges mitigated?

- a) How have water/wastewater agencies addressed challenges associated with a retiring workforce?
- b) How can the California Community Colleges support these efforts?

RQ3 Findings

- a) [Water/wastewater agencies have created opportunities for internal employees](#) to be developed, promoted in-house opportunities, and partnered with educational institutions.
 - These agencies report that [5% of their current workforce is eligible to retire](#) without penalty within the next five years.
 - [37% of workers in the eight mission-critical occupations are 50 and older](#), which is comparatively higher than all occupations throughout the state as well as the California population.
- b) [California Community Colleges offer training programs for all but one mission-critical occupation](#) and [students in those programs are generally more diverse](#) than the current water/wastewater mission-critical workforce.

RQ3 Recommendations

- Address current equity gaps in the water/wastewater workforce through targeted marketing efforts and partnership with community colleges, where the student population is more diverse than the current water/wastewater workforce – particularly in age and gender.
- The water/wastewater industry should examine their current workforce - specifically how internal training, professional development, and job promotion opportunities are offered as well as participation rates for traditionally underrepresented groups. These factors directly impact hiring and recruitment practices and may contribute to pay gaps. Improving on them may increase opportunities for underrepresented groups.
- Increase effectiveness of water/wastewater industry and community college partnerships, which will strengthen advisory boards, create more cooperative work experiences and other work-based learning opportunities for students, as well as build new and strengthen existing pipelines of qualified job candidates.
- Due to the skills transferability for these mission-critical occupations, it would behoove community colleges to provide students with sufficient knowledge to enter employment in a variety of industries thereby increasing employment opportunities for students. Community colleges could consider adding specialized courses to address water/wastewater industry-specific needs and/or offer customized training options to water/wastewater employers.

Areas for Future Water/Wastewater Research

Though this report provided a comprehensive analysis of the water/wastewater industry by analyzing labor market data, conducting the first COE statewide survey of water/wastewater companies and interviews of community college water/wastewater program representatives, there are additional areas of potential research that are beyond the scope of this report and could be beneficial to both the water/wastewater industry and community college programs.

Aging Workforce

The water/wastewater industry has continued to report challenges related to an aging workforce and looming retirements for nearly two decades. However, survey respondents stated that 5% of their current workforce is eligible to retire without penalty within the next five years, which is the lowest percentage reported of all water/wastewater studies reviewed by the COE. Notably, all previous COE surveys have asked employers to anticipate how many employees are eligible to retire, yet it is unclear how many retirements actually occur within that five-year period. Human resources departments within the water/wastewater industry should consider analyzing projected versus actual retirements from previous studies to determine the accuracy of these responses. It is possible that the lower reported percentage of employees that will be eligible to retire in the next five years could suggest that the large spike in retirements the industry anticipated may have already occurred.

Emerging Occupations and Skills

This report analyzed a specific set of mission-critical occupations that are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma. Additionally, this report did not consider emerging occupations or skills that were not captured in traditional labor market data or online job postings. Future research efforts could analyze these occupations to determine the challenges – if any – water/wastewater employers face in filling other positions and examine emerging occupations and trends.

Student Enrollment and Employment Outcomes

Though this report included data related to community college awards and student demographics, it did not consider the number of enrollments in water/wastewater programs nor outcomes for these programs. Community colleges should examine completion rates compared to students enrolled in programs related to these mission-critical occupations since the data shows that over 28,000 students took at least one course in these related programs in the 2020-2021 academic year, but only 2,392 students earned a degree or certificate. By examining this information, it may be possible to identify areas that can be addressed in order to increase student completions. Furthermore, research on student employment outcomes, including earnings data, should be considered to determine if there is alignment between the typical wages for these mission-critical occupations and what community college students are earning after exiting their program.



APPENDIX A: INDUSTRY, OCCUPATION, AND REGION DEFINITIONS

Water/Wastewater Industry Definition

For the purposes of this report, the water/wastewater industry is defined by a set of North American Industry Classification System (NAICS) codes. These codes are used by public agencies such as the Bureau of Labor Statistics (BLS) and Census Bureau to classify firms and track economic activity. NAICS codes are defined at the two, four, and six-digit levels, with more digits adding specificity within a larger sector or industry.

The NAICS codes that were used to define the water/wastewater industry, as well as the definitions of each NAICS code, are listed below.

- **Water Supply and Irrigation Systems (221310):** This industry comprises establishments primarily engaged in operating water treatment plants and/or operating water supply systems. The water supply system may include pumping stations, aqueducts, and/or distribution mains. The water may be used for drinking, irrigation, or other uses.
- **Sewage Treatment Facilities (221320):** This industry comprises establishments primarily engaged in operating sewer systems or sewage treatment facilities that collect, treat, and dispose of waste.
- **Water and Sewer Line and Related Structures Construction (237110):** This industry comprises establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this industry if they are engaged in activities primarily related to water, sewer line, and related structures construction. All structures (including buildings) that are integral parts of water and sewer networks (e.g., storage tanks, pumping stations, water treatment plants, and sewage treatment plants) are included in this industry.
- **Other Heavy and Civil Engineering Construction (237990):** This industry comprises establishments primarily engaged in heavy and civil engineering construction projects (excluding highway, street, bridge, and distribution line construction). The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this industry if they are engaged in activities primarily related to heavy and civil engineering construction projects (excluding highway, street, bridge, distribution line, oil and gas structure, and utilities building and structure construction). Construction projects involving water resources (e.g., dredging and land drainage), development of marine facilities, and projects involving open space improvement (e.g., parks and trails) are included in this industry.
- **Site Preparation Contractors (238910):** This industry comprises establishments primarily engaged in site preparation activities, such as excavating and grading, demolition of buildings and other structures, and septic system installation. Earthmoving and land clearing for all types of sites (e.g., building, nonbuilding, mining) is included in this industry. Establishments primarily engaged in construction equipment rental with operator (except cranes) are also included.
- **Local Government, excluding Education and Hospitals (902999):** This industry comprises local government establishments, including many local publicly owned water utilities.
- **State Government, excluding Education and Hospitals (903999):** This industry comprises state government establishments, including regulatory bodies.

Mission-Critical Occupation Definition

Mission critical occupations are defined as occupations that are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma. Similar to NAICS codes, these occupations are defined by a federal taxonomy of codes and descriptions. Standard Occupational Classification (SOC) codes are defined by BLS to classify workers into occupational categories for collecting and analyzing data. These mission-critical occupations fall into three groups: electrical, maintenance, and operational. The definition for each SOC code, by group, is listed below.

- **Electrical Group**

- **Electrical and Electronics Engineering Technicians (17-3023):** Apply electrical and electronic theory and related knowledge, usually under the direction of engineering staff, to design, build, repair, adjust, and modify electrical components, circuitry, controls, and machinery for subsequent evaluation and use by engineering staff in making engineering design decisions.
- **Electricians (47-2111):** Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems, or electrical control systems.

- **Maintenance Group**

- **Calibration Technologists and Technicians (17-3028):** Execute or adapt procedures and techniques for calibrating measurement devices, by applying knowledge of measurement science, mathematics, physics, chemistry, and electronics, sometimes under the direction of engineering staff. Determine measurement standard suitability for calibrating measurement devices. May perform preventive maintenance on equipment. May perform corrective actions to address identified calibration problems.
- **Maintenance and Repair Workers, General (49-9071):** Perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of a building in repair. Duties may involve pipe fitting; HVAC maintenance; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs.
- **Industrial Machinery Mechanics (49-9041):** Repair, install, adjust, or maintain industrial production and processing machinery or refinery and pipeline distribution systems. May also install, dismantle, or move machinery and heavy equipment according to plans.

- **Operational Group**

- **Operating Engineers and Other Construction Equipment Operators (47-2073):** Operate one or several types of power construction equipment, such as motor graders, bulldozers, scrapers, compressors, pumps, derricks, shovels, tractors, or front-end loaders to excavate, move, and grade earth, erect structures, or pour concrete or other hard surface pavement. May repair and maintain equipment in addition to other duties.
- **Machinists (51-4041):** Set up and operate a variety of machine tools to produce precision parts and instruments out of metal. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures.
- **Water and Wastewater Treatment Plant and System Operators (51-8031):** Operate or control an entire process or system of machines, often through the use of control boards, to transfer or treat water or wastewater.

California Regions Definitions

The counties that correspond to each subregion in this report are listed below.

Central California

- Alpine
- Amador
- Calaveras
- Fresno
- Inyo
- Kern
- Kings
- Madera
- Mariposa
- Merced
- Mono
- Monterey
- San Benito
- San Joaquin
- San Luis Obispo
- Santa Barbara
- Santa Cruz
- Stanislaus
- Tulare
- Tuolumne

Northern California

- Alameda
- Butte
- Colusa
- Contra Costa
- Del Norte
- El Dorado
- Glenn
- Humboldt
- Lake
- Lassen
- Marin
- Mendocino
- Modoc
- Napa
- Nevada
- Placer
- Plumas
- Sacramento
- San Francisco
- San Mateo
- Santa Clara
- Shasta
- Sierra
- Siskiyou
- Solano
- Sonoma
- Sutter
- Tehama
- Trinity
- Yolo
- Yuba

Southern California

- Imperial
- Los Angeles
- Orange
- Riverside
- San Bernardino
- San Diego
- Ventura



APPENDIX B: TRADITIONAL LABOR MARKET INFORMATION METHODOLOGY

Traditional Labor Market Data Methodology

The COE analyzed traditional labor market demand information, which includes job counts, projections, wages, and typical education requirements for the water/wastewater industry as well as eight mission-critical occupations. Traditional labor market demand data was sourced from Lightcast, a labor market analytics firm, that aggregates data from public statistical agencies including the Bureau of Labor Statistics, Census Bureau, and the California Employment Development Department. The COE analyzed demographic data for the eight mission-critical occupations and the California population using the Census Bureau's American Community Survey. The traditional labor market demand data analyzed in this report includes:

- **2021 Jobs:** the number of jobs by industry and occupation in 2021.
- **2026 Jobs:** the projected number of jobs by industry and occupation in 2026. Projections are based on the assumption that past trends will continue into the future, including the assumption that the economy, during the projection period, will be at approximately full employment. Projections do not consider potential recessions or labor shocks, such as natural disasters or pandemics, and are intended to capture structural change in the economy over time.
- **Change:** the projected change in the number of jobs, expressed as an actual number and a percentage.
- **Average Annual Openings (Demand):** the projected number of annual job openings. This figure is the sum of job growth and replacement jobs. Job growth is the result of job creation while replacement jobs are the result of retirements and workers leaving the field, creating the need to hire a replacement.
- **Hourly Wages:**
 - **Entry-level (25th percentile):** the typical entry-level wages for an occupation; 25% of workers earn less than this amount and 75% earn more.
 - **Median:** the median wages for an occupation; 50% of workers earn less than this amount and 50% earn more.
 - **Experienced (75th percentile):** the typical experienced-level wages for an occupation; 75% of workers earn less than this amount and 25% earn more.
- **Typical Entry-Level Education:** represents the typical education level workers need to enter an occupation.
- **Educational Attainment:** the percentage of workers employed in an occupation by their highest level of education attained.

Additionally, the COE analyzed labor market supply data that is calculated using the number of awards conferred in related training programs at community college and non-community college institutions over the past three years of available data. Community college data is sourced from the California Community College Chancellor's Office Data Mart³⁸ and non-community college data is sourced from the Integrated Postsecondary Education Data System.³⁹ Student demographic data was sourced from the LaunchBoard Community College Pipeline.⁴⁰

³⁸ California Community Colleges Chancellor's Office - Data Mart, n.d.<https://datamart.cccco.edu/>

³⁹ "The Integrated Postsecondary Education Data System," National Center for Education Statistics (NCES), n.d.<https://nces.ed.gov/ipeds/>.

⁴⁰ "Cal-PASS Plus - Community-College-Pipeline," Cal-PASS Plus, n.d.<https://www.calpassplus.org/LaunchBoard/Community-College-Pipeline.aspx>.

Job Postings Analysis Methodology

In addition to traditional labor market information, the COE analyzed real-time labor market information using online job postings data sourced from Lightcast. This data is derived from online job postings that are parsed and classified into industry and occupational groups using natural language processing (NLP) to determine the related company, industry, occupation, and other information for each job posting. While these data sources can track trends in real time, they are less methodologically and statistically robust than the traditional LMI based on data collected by federal and state statistical agencies. Additionally, a single job posting may not represent a single job opening, as employers may be creating a pool of candidates for future openings or hiring for multiple positions with a single posting. Furthermore, not all jobs are posted online, and jobs may be filled through other methods such as internal promotion, word-of-mouth advertising, physical job boards, or a variety of other channels. For these reasons, online job postings should be considered as a supplement to traditional LMI.





APPENDIX C: SURVEY AND INTERVIEW METHODOLOGY

In addition to analyzing traditional labor market information for the water/wastewater industry, the COE also examined quantitative data from an industry survey and qualitative information from interviews with community college training providers. This mixed-methods research design was decided upon in consultation with industry water/wastewater stakeholders (e.g., Water Energy Education Alliance and BAYWORK) and the California community college system. These stakeholders participated in an advisory group and provided guidance for the research.

Survey Methodology

Survey Distribution List

To develop the distribution list for the phone survey, the COE hired a contractor (Valoroo⁴¹) to data-mine for contact information from water/wastewater companies defined by NAICS codes (see Appendix A). Valoroo found more than 7,000 contacts that were either directly or tangentially related to the water/wastewater industry. The NAICS code for each company was identified and the list was cleaned and deduplicated to include only companies within the NAICS codes used to define the water/wastewater industry for this report, resulting in 2,216 contacts. Examples of these companies include public and private water agencies, public and private wastewater agencies, regulatory control and compliance organizations, and infrastructure engineering firms and contractors. Most leads came from public/private water and wastewater agencies. Valoroo then used the datamined list to conduct phone surveys.

To supplement the phone list, the advisory group sent the online version of the survey to their industry contacts, including the California Water Association (CWA), California Water Environmental Association (CWEA), California Public Utilities Commission (CPUC), California Association of Sanitary Agencies (CASA), California Municipal Utilities Association (CMUA), California Special Districts Association (CSDA), and other organizations within their networks.

Between June and September 2022, Valoroo completed 404 phone surveys and the advisory group collected 248 web surveys for a combined total of 652 surveys. After the COE cleaned the data for incomplete responses, there were 545 valid survey responses.

Survey Questions

The COE and study's advisory group developed survey questions to learn more about the mission-critical occupations and other workforce data traditionally not captured in labor market information. For example, the advisory group suggested that the survey capture information about other in-demand, water/wastewater jobs in regulatory affairs or compliance, customer information management systems, and Geographic Information Systems (GIS) surveying or mapping. As a result, the survey asked water/wastewater companies if they would hire community college graduates for these positions. The final survey included three categories comprised of the following questions:

Respondent Overview

1. What best describes your company or organization's role in the water/wastewater industry?
 - a. Public and private water or wastewater agency
 - b. Regulatory control and compliance organization
 - c. Infrastructure engineering firm and contractor

⁴¹Valoroo - Creating Growth, last modified September 14, 2019, <https://valoroo.com>.

- d. Other, please specify: _____
- e. None of the above. My company is not involved with the water/wastewater industry.
2. How many full-time and part-time employees currently work at your organization? Do not count independent contractors (e.g., 1099 workers). [open-ended]
3. How many employees does your organization expect to hire in the next 24 months? Enter "0" if none and your best estimate is fine. [open-ended]
4. How many employees are eligible to retire at your organization without penalty in the next five years? Enter "0" if none and your best estimate is fine. [open-ended]
5. What is your role in the hiring process at your organization?
- Human Resources
 - Hiring manager or director
 - Business owner
 - Hiring committee member
 - Other, please specify: _____
 - I am not involved in the hiring process at my organization
6. What are the **TOP FIVE** resources that your organization uses when hiring entry-level employees? Rank 1 as the top resource.
- Company job board or career website
 - Community colleges
 - Online recruiting platforms (e.g., Indeed.com, LinkedIn)
 - Recruitment agencies (e.g., Manpower, Labor Ready)
 - Job fairs
 - Military and veteran recruitment centers
 - Four-year universities (e.g., UCs, CSUs)
 - Private higher educational institutions (e.g., National University)
 - Other, please specify: _____

Mission-Critical Occupations

This section will ask about "mission-critical positions" at your company. Mission-critical positions are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma.

1. Which of the following mission-critical positions does your organization currently employ? When responding, please try to equate your organization's specific job titles with the general ones provided below. Select all that apply.
- Electricians
 - Electrical and Electronic Engineering Technologists and Technicians (includes SCADA Technicians, Electronic Maintenance Technicians, Instrumentation and Control Technicians)
 - Maintenance and Repair Workers, General
 - Industrial Machinery Mechanics (Plant Maintenance Mechanics)
 - Calibration Technologists and Technicians
 - Machinists
 - Operating Engineers and Other Construction Equipment Operators
 - Water and Wastewater Treatment Plant and System Operators
 - None of the above

2. How many employees are currently employed as [insert occupation selected in Q1] at your organization? [open-ended]
3. How many openings does your organization expect to fill for [insert occupation selected in Q1] in the next 24 months? Enter "0" if your organization does not expect to hire for this position in the next 24 months. [open-ended]
4. How difficult is it for your organization to find qualified job candidates for [insert occupation selected in Q1]? [select from "very difficult," "difficult," "neither difficult nor easy," "easy," or "very easy"]
5. What skills are essential for community colleges to train for [insert occupation selected in Q1]? Select all that apply. [randomized 10 top skills for each occupation from online job postings and prior studies]
6. What are the **TOP FIVE** most difficult qualifications to find in job candidates for [insert occupation selected in Q1]? Rank 1 as the most difficult.
 - a. Minimum educational requirements
 - b. Required licenses or certifications
 - c. Relevant prior work experience
 - d. Adequate technical skills
 - e. Adequate industry knowledge
 - f. Adequate soft skills or interpersonal skills
 - g. Security clearance
 - h. Other, please specify: _____
7. Based on what you know about California community colleges, how likely is your organization to hire a student who graduated from a community college for entry-level positions in the following roles? [select from "very unlikely," "unlikely," "neither likely nor unlikely," "likely," or "very likely"]
 - a. Regulatory Affairs or Government Compliance
 - b. Customer Information Management Systems
 - c. Geographic Information Systems (GIS) / Mapping and Surveying
8. Thinking about upcoming changes in the industry (e.g., Infrastructure Investment & Jobs Act, technological advances, retirements, remote work), **what continuing education programs should the community colleges offer for current (incumbent) workers?** [open-ended]
9. What current (incumbent) positions at your organization would benefit from obtaining a **bachelor's degree** offered by the community colleges? [open-ended]
10. Do you have anything else you would like to share with the California community colleges regarding your workforce needs? [open-ended]



Diversity, Equity, and Inclusion

This section will ask about diversity, equity, and inclusion (DEI) at your company. For this study, DEI is defined as:⁴²

- **Diversity:** The representation of various identities and differences (e.g., race, ethnicity, gender identity, disability, sexual orientation, tribe, caste, socio-economic status), collectively and as individuals.
- **Equity:** The assurance of unbiased treatment, equality of opportunity, and fairness in access to information and resources for all.
- **Inclusion:** The purposeful involvement and active engagement of all people, regardless of background.

11. Does your organization have a diversity, equity, and inclusion (DEI) strategy? [select from "yes," "no," or "I don't know"]

12. What **programs** does your organization provide related to diversity, equity, and inclusion (DEI) for underrepresented communities (e.g., women, people of color)? Select all that apply.

- a. Targeted recruitment outreach to underrepresented groups
- b. Student scholarships or sponsorships for people of color, women, and other underrepresented groups
- c. Internships, mentorships, apprenticeships, and similar programs for students from traditionally underrepresented communities
- d. Employee Resource Groups (e.g., support and mentorship programs for employees with similar experiences or backgrounds)
- e. Leadership development programs for employees from traditionally underrepresented communities to advance in the organization
- f. DEI training or professional development programs for staff, board members or other individuals related to the organization
- g. Supplier diversity program (e.g., proactively solicits proposals from and contracts with minority-owned businesses or women-owned businesses)
- h. Board diversity program (e.g., actively recruits board members with diversity in mind)
- i. Other, please specify: _____
- j. I don't know

⁴² Adopted from the Ford Foundation (fordfoundation.org)

13. Which of the following DEI trainings would you be interested in having at your organization? Select all that apply.
- a. Embracing differences in the workplace
 - b. Overcoming unconscious bias
 - c. Teaching leaders how to manage diverse teams
 - d. How inclusive behaviors can be embedded into everyday job activities and responsibilities (e.g., product design, customer service)
 - e. How to hire for diverse teams
 - f. Intercultural communication and racial consciousness (e.g., how to communicate with people from different backgrounds and experiences)
 - g. Other, please specify: _____
 - h. None of the above
 - i. I don't know
14. Would you be interested in partnering with the California Community Colleges in the following activities? Select all that apply.
- a. Create an apprenticeship for the industry
 - b. Develop a customized training for employees at your company
 - c. Act as industry lecturer, panelist, or guest speaker
 - d. Provide mock interviews for students
 - e. Help inform curriculum
 - f. Provide a company tour or fieldtrip for students
 - g. Offer internships
 - h. Participate in job fairs or post job openings on campus
 - i. Provide mentoring for students
 - j. Other, please specify: _____
 - k. None of the above
15. If you selected any of the activities above, please provide your contact information.

⁴³ Taft College and Victor Valley College offer courses related to wastewater technology. However, these programs do not utilize any of the TOP codes analyzed in this report and were not contacted for an interview.

Interviews with Community College Training Providers Methodology

To better understand the landscape of current training programs for mission-critical occupations, the COE conducted in-depth interviews with community college representatives between August and November 2022. Interview participants included 12 faculty members, seven deans, and one program director from 20 community colleges on this list of those that offer programs related to water/wastewater mission-critical occupations :

- | | | |
|-----------------------------|-----------------------------------|--------------------------------|
| 1. Antelope Valley College | 14. L.A. Trade-Tech | 27. Santa Ana College |
| 2. Bakersfield College | 15. Mendocino College | 28. Santa Barbara City College |
| 3. Citrus College | 16. Merced College | 29. Santa Rosa Junior College |
| 4. Clovis Community College | 17. Mesa College | 30. Santiago Canyon College |
| 5. College Of The Canyons | 18. Mt. San Antonio College | 31. Sequoias College |
| 6. Columbia College | 19. Mt. San Jacinto College | 32. Shasta College |
| 7. Cuesta College | 20. Ohlone College | 33. Solano Community College |
| 8. Cuyamaca College | 21. Palomar College | 34. Ventura College |
| 9. Evergreen Valley College | 22. Redwoods College | 35. Woodland Community College |
| 10. Folsom Lake College | 23. Reedley College | 36. Yuba College |
| 11. Gavilan College | 24. Rio Hondo College | |
| 12. Hartnell College | 25. Sacramento City College | |
| 13. Imperial Valley College | 26. San Bernardino Valley College | |

To determine what California community colleges that offer programs for mission-critical occupations, the COE used the SOC-TOP crosswalk, which matches the occupational codes (SOC) to the Taxonomy of Programs (TOP) codes. Using the TOP codes identified in the labor market analysis, the COE found 36 colleges with programs related to mission-critical occupations. These programs are also listed on the Chancellor's Office Curriculum Inventory (COCI).⁴⁴ Of note, this list was not exclusively limited to water/wastewater-specific programs, but all programs (e.g., instrumentation, industrial, and engineering technicians, etc.) that trained for mission-critical occupations. Using this program list, the COE partnered with a contractor (Infyrno⁴⁵) to data-mine the contact information of faculty members, department chairs, and administrators from these programs. The contractor conducted recruitment via email outreach to multiple representatives from each college, inviting them to participate in one-on-one online interviews. Snowball sampling was also used to supplement recruitment efforts (i.e., interviewees made referrals to other prospective participants). Each interview lasted between 30 minutes to an hour, was conducted via Zoom, and audio-recorded. After the interview, participants were sent a \$20 digital gift card as a "thank you" for their time.

During each interview, the interview facilitator wrote detailed notes and identified notable themes. The COE analyzed key insights across interviews and identified representative quotes for each theme to include as part of this study.

⁴⁴ California Community Colleges Chancellor's Office, "The Chancellor's Office Curriculum Inventory System (COCI)," n.d. <https://coci2.ccctechcenter.org>.

⁴⁵ Infyrno, n.d. <https://Infyrno.com>.

Interview Questions

The COE, in collaboration with the project’s advisory group, developed the following interview questions:

1. If you did not do so already, could you please confirm if the related programs still exist at your college? Do the award types (e.g., degrees, certificates) look accurate?
 - a. Yes, the information on the list looks accurate.
 - b. No, please make the following changes: _____
2. What mission-critical positions does your program train for? For this study, “mission-critical positions” are essential to water and wastewater operations, difficult to fill, and typically require at least a high school diploma.
 - a. Electricians
 - b. Electrical and Electronic Engineering Technologists and Technicians (includes SCADA Technicians, Electronic Maintenance Technicians, Instrumentation and Control Technicians)
 - c. Maintenance and Repair Workers, General
 - d. Industrial Machinery Mechanics (Plant Maintenance Mechanics)
 - e. Calibration Technologists and Technicians
 - f. Machinists
 - g. Operating Engineers and Other Construction Equipment Operators
 - h. Water and Wastewater Treatment Plant and System Operators
 - i. Other, please specify: _____
3. What knowledge, skills, and abilities do your students develop after completing a Water and Wastewater Technology program at your college?
 - a. ASQ (American Society for Quality) Certification
 - b. Computer Aided Design (CAD) Software
 - c. Computer Aided Manufacturing (CAM) Software
 - d. Computer Numerical Control (CNC)
 - e. Data Analytics
 - f. Database User Interface and Query Software
 - g. Development Environment Software (e.g., C, Microsoft Visual Basic)
 - h. Electrical Repair, Wiring, Systems, Diagrams, and Schematics
 - i. Enterprise Resource Planning (ERP)
 - j. Forklift Operation
 - k. Heavy Equipment Operation
 - l. Good Manufacturing Practices (GMP)
 - m. Hand and Power Tools
 - n. Quality Assurance and Control
 - o. Microsoft Office Suite
 - p. Occupational Health and Safety
 - q. Predictive / Preventative Maintenance and Repair
 - r. Project Management
 - s. Python
 - t. Sample Collection and Testing

- u. SCADA (Supervisory Control and Data Acquisition)
 - v. Six Sigma Certification
 - w. Technical Mathematics
 - x. Water/Wastewater Treatment, Distribution, and Quality
 - y. Other, please specify: _____
4. What public and private water or wastewater agencies participate in your advisory boards to inform curriculum?
5. We previously completed labor market research studies for the water/wastewater industry, and in each of those reports, we provided recommendations for the community colleges to address the workforce needs of the industry. The purpose of this interview is to get a better understanding of how much progress we made in the past few years. The following questions will be specific to those recommendations. How has your college...
- a. Increased awareness of the industry and its mission-critical occupations? In other words, what marketing efforts has your college made to promote the water/wastewater industry and training program?
 - b. Increased the readiness of jobseekers (i.e., your students) for mission-critical occupations?
 - c. Increased classroom capacity (i.e., train more students) for your water/wastewater program(s)?
 - d. Worked with the industry to increase entry-level jobs for mission-critical occupations?
 - e. Partnered with businesses to help students meet the minimum qualifications for mission-critical occupations?
 - f. Partnered with businesses to provide on-the-job training or work-based learning opportunities (e.g., internships, cooperative work experience) for students?
 - g. Addressed barriers (e.g., financial challenges) to grow your training programs for mission-critical occupations?
 - h. Kept up to date with technology (e.g., computer-based digital tools) in the industry?
 - i. What challenges are you experiencing (or have you experienced) in completing the aforementioned activities (Q5a through Q5i)?

APPENDIX D: CALIFORNIA WATER/ WASTEWATER LABOR MARKET SUMMARY

Mission-Critical Group	Occupation (SOC)	Overall Demand (Annual Openings)	W/WW Demand (Annual Openings)	Overall 2021-2026 % Change	2021-2026 W/WW % Change	Supply (CC and Non-CC)	Entry-Level Hourly Earnings (25th Percentile)	Typical Entry-Level Education
Electrical	Electrical and Electronic Engineering Technologists and Technicians (17-3023)	1,827	55	(1%)	3%	1,132	\$28.26	Associate degree
	Electricians (47-2111)	9,729	304	10%	4%	1,845	\$22.25	High school diploma or equivalent
Electrical Total		11,556	359	8%	4%	2,977	N/A	N/A
Maintenance	Calibration Technologists and Technicians (17-3098)	68	1	3%	2%	3	\$23.11	High school diploma or equivalent
	Industrial Machinery Mechanics (49-9041)	2,653	85	9%	5%	473	\$22.69	High school diploma or equivalent
	Maintenance and Repair Workers, General (49-9071)	15,157	1,662	3%	(0.3%)	0	\$17.67	High school diploma or equivalent
Maintenance Total		17,878	1,747	4%	(0.1%)	476	N/A	N/A
Operational	Operating Engineers and Other Construction Equipment Operators (47-2073)	3,691	1,491	5%	6%	312	\$27.26	High school diploma or equivalent
	Machinists (51-4041)	3,392	17	1%	3%	693	\$17.97	High school diploma or equivalent
	Water and Wastewater Treatment Plant and System Operators (51-8031)	942	827	0.1%	0.2%	952	\$28.66	High school diploma or equivalent
Operational Total		8,025	2,335	3%	3%	1,957	N/A	N/A
Mission-Critical Total		37,459	4,442	5%	2%	5,413	N/A	N/A

APPENDIX E: DEMAND AND SUPPLY BY COMMUNITY COLLEGE REGION

Bay Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	3,321	Supply Gap	0	No Programs	No Programs	0
Electricians	2,422	Supply Gap	407	0952.20 (Electrical)	Foothill	92
					San Francisco	2
				46.0302 (Electrician.)	CET-San Jose	58
					CET-Soledad	32
					Institute for Business and Technology	188
					InterCoast Colleges-Fairfield	35
Machinists	858	Supply Gap	150	0956.30 (Machining and Machine Tools)	Chabot Hayward	9
					De Anza	50
					Laney	14
					Marin	1
					Napa	4
					San Francisco	1
					San Jose City	25
				Santa Rosa	46	
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
Operating Engineers and Other Construction Equipment Operators	739	Supply Gap	32	0947.00 (Diesel Technology)	Alameda	9
					Hartnell	0
					Santa Rosa	23
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	710	Supply Gap	179	0924.00 (Engineering Technology, General (requires Trigonometry))	Cabrillo	17
					Las Positas	11
					San Francisco	2
					San Mateo	0
				0934.00 (Electronics and Electric Technology)	Chabot Hayward	12
					Contra Costa	0
					Diablo Valley	13
					Laney	40
					Los Medanos	32
					Ohlone	0
					San Francisco	20
					San Mateo	15
				Santa Rosa	16	
				Skyline	1	
				15.0000 (Engineering Technologies/ Technicians, General.)	No Programs	0
15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	No Programs	0				



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	601	Supply Gap	59	0945.00 (Industrial Systems Technology and Maintenance)	Diablo Valley	1
					Hartnell	3
					Laney	3
					Los Medanos	26
					San Jose City	7
				0946.10 (Energy Systems Technology)	Cabrillo	1
					De Anza	15
					Diablo Valley	2
					Skyline	1
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	Aviation Institute of Maintenance-Freemont	0
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
				47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Water and Wastewater Treatment Plant and System Operators	176	Supply Gap	85	0303.00 (Environmental Technology)	De Anza	25
				0924.00 (Engineering Technology, General <i>(requires trigonometry)</i>)	Skyline	1
				0958.00 (Water and Wastewater Technology)	Gavilan	17
				2102.10 (Public Works)	Santa Rosa	27
					Solano	15
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	No Programs	0
15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0				



Calibration Technologists and Technicians	19	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Cabrillo	Already accounted for
				0934.00 (Electronics and Electric Technology)	Las Positas	Already accounted for
					San Francisco	Already accounted for
					San Mateo	Already accounted for
					Chabot Hayward	Already accounted for
					Contra Costa	Already accounted for
					Diablo Valley	Already accounted for
					Laney	Already accounted for
					Los Medanos	Already accounted for
					Ohlone	Already accounted for
					San Francisco	Already accounted for
					San Mateo	Already accounted for
					Santa Rosa	Already accounted for
				Skyline	Already accounted for	
				0946.10 (Energy Systems Technology)	Cabrillo	Already accounted for
					De Anza	Already accounted for
					Diablo Valley	Already accounted for
					Skyline	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
15.1703 (Solar Energy Technology/ Technician.)	No Programs	0				
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				

Central Valley/Mother Lode Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,666	Supply Gap	0	No Programs	No Programs	0
Electricians	843	Supply Gap	249	0952.20 (Electrical)	Bakersfield	12
					Merced	26
					Modesto	3
					San Joaquin Delta	28
					Sequoias	41
				46.0302 (Electrician.)	Milan Institute-Bakersfield West	38
					San Joaquin Valley College-Bakersfield	0
					San Joaquin Valley College-Fresno Aviation	0
					San Joaquin Valley College-Modesto	30
					San Joaquin Valley College-Visalia	71
Operating Engineers and Other Construction Equipment Operators	476	Supply Gap	18	0947.00 (Diesel Technology)	San Joaquin Delta	11
				0947.30 (Heavy Equipment Operation.)	West Hills Coalinga	7
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	474	Supply Gap	246	0945.00 (Industrial Systems Technology and Maintenance)	Bakersfield	1
					Clovis	2
					Fresno City	31
					Merced	2
					San Joaquin Delta	2
					Sequoias	83
					West Hills Lemoore	2
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	San Joaquin Valley College-Bakersfield	3
					San Joaquin Valley College-Fresno	5
					San Joaquin Valley College-Modesto	16
San Joaquin Valley College-Visalia	99					
Machinists	208	Supply Gap	67	0956.30 (Machining and Machine Tools)	Bakersfield	37
					Modesto	6
					Reedley College	21
					San Joaquin Delta	3
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
Water and Wastewater Treatment Plant and System Operators	153	Supply Gap	13	0958.00 (Water and Wastewater Technology)	Clovis	5
					Columbia	7
					Sequoias	1
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
					No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	98	Supply Met	113	0924.00 (Engineering Technology, General (requires Trigonometry))	Bakersfield	1
					Merced	1
				0934.00 (Electronics and Electric Technology)	Bakersfield	53
					Fresno City	53
					Merced	2
					San Joaquin Delta	2
				Sequoias	1	
				15.0000 (Engineering Technologies/ Technicians, General.)	No Programs	0
15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	No Programs	0				
Calibration Technologists and Technicians	19	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Bakersfield	Already accounted for
					Merced	Already accounted for
				0934.00 (Electronics and Electric Technology)	Bakersfield	Already accounted for
					Fresno City	Already accounted for
					Merced	Already accounted for
					San Joaquin Delta	Already accounted for
					Sequoias	Already accounted for
				0943.00 (Instrumentation Technology)	Merced	3
					Modesto	0
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				

Far North Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	390	Supply Gap	0	No Programs	No Programs	0
Operating Engineers and Other Construction Equipment Operators	182	Supply Gap	38	0947.00 (Diesel Technology)	Butte	2
					Shasta	5
				0947.30 (Heavy Equipment Operation)	Butte	27
					Shasta	4
			49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0	
Electricians	177	Supply Gap	4	0952.20 (Electrical)	Redwoods	4
				46.0302 (Electrician.)	No Programs	0
Industrial Machinery Mechanics	65	Supply Gap	2	0945.00 (Industrial Systems Technology and Maintenance)	Shasta	0
				0946.10 (Energy Systems Technology)	Mendocino	0
					Redwoods	2
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	No Programs	0
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0				

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Water and Wastewater Treatment Plant and System Operators	56	Supply Gap	3	0958.00 (Water and Wastewater Technology)	Shasta	3
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
Machinists	42	Supply Gap	10	0956.30 (Machining and Machine Tools)	Redwoods	5
					Shasta	5
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
Electrical and Electronic Engineering Technologists and Technicians	15	Supply Gap	4	0924.00 (Engineering Technology, General <i>(requires Trigonometry)</i>)	Butte	4
				15.0000 (Engineering Technologies/ Technicians, General.)	No Programs	0
Calibration Technologists and Technicians	19	Supply Gap	0	0924.00 (Engineering Technology, General <i>(requires Trigonometry)</i>)	Butte	Already accounted for
				0946.10 (Energy Systems Technology)	Mendocino	Already accounted for
					Redwoods	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
				15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0

Inland Empire/Desert Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,733	Supply Gap	0	No Programs	No Programs	0
Electricians	1,178	Supply Gap	298	0952.20 (Electrical)	Norco College	67
					Victor Valley	0
				46.0302 (Electrician.)	InterCoast Colleges-Riverside	38
					San Joaquin Valley College-Ontario	46
					San Joaquin Valley College-Rancho Mirage	0
					San Joaquin Valley College-Temecula	24
					Summit College	123
Operating Engineers and Other Construction Equipment Operators	479	Supply Gap	26	0947.00 (Diesel Technology)	Barstow	12
					San Bernardino	14
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0
Machinists	328	Supply Gap	17	0956.30 (Machining and Machine Tools)	Norco College	11
					San Bernardino	6
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	292	Supply Gap	30	0945.00 (Industrial Systems Technology and Maintenance)	Barstow	17
					San Bernardino	0
				0946.10 (Energy Systems Technology)	Desert	2
					Victor Valley	0
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	San Joaquin Valley College-Ontario	11
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0				
Water and Wastewater Treatment Plant and System Operators	153	Supply Gap	13	0303.00 (Environmental Technology)	Palo Verde	2
				0958.00 (Water and Wastewater Technology)	Mt. San Jacinto	37
					San Bernardino	21
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	No Programs	0
15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0				

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	78	Supply Gap	34	0924.00 (Engineering Technology, General (requires Trigonometry))	Chaffey	4
					Norco College	0
				0934.00 (Electronics and Electric Technology)	Barstow	1
					Norco College	4
					San Bernardino	25
				15.0000 (Engineering Technologies/ Technicians, General.)	Victor Valley	0
					No Programs	0
15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	No Programs	0				
Calibration Technologists and Technicians	10	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Chaffey	Already accounted for
					Norco College	Already accounted for
				0934.00 (Electronics and Electric Technology)	Barstow	Already accounted for
					Norco College	Already accounted for
					San Bernardino	Already accounted for
					Victor Valley	Already accounted for
				0946.10 (Energy Systems Technology)	Desert	Already accounted for
					Victor Valley	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				

Greater Sacramento Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,092	Supply Gap	0	No Programs	No Programs	0
Electricians	1,034	Supply Gap	199	0952.20 (Electrical)	American River	19
				46.0302 (Electrician.)	Independent Training & Apprenticeship Program	48
					InterCoast Colleges-Rancho Cordova	60
					National Career Education	72
Operating Engineers and Other Construction Equipment Operators	401	Supply Gap	40	0947.00 (Diesel Technology)	American River	40
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0
Machinists	155	Supply Gap	0	0956.30 (Machining and Machine Tools)	No Programs	0
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
Industrial Machinery Mechanics	145	Supply Gap	2	0946.10 (Energy Systems Technology)	Sierra	2
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
				47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Water and Wastewater Treatment Plant and System Operators	95	Supply Gap	27	0303.00 (Environmental Technology)	Lake Tahoe	4
					Sacramento City	4
					Sierra	3
					Woodland	10
				0958.00 (Water and Wastewater Technology)	Folsom Lake	2
					Woodland	4
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	No Programs	0
15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0				
Electrical and Electronic Engineering Technologists and Technicians	74	Supply Met	75	0924.00 (Engineering Technology, General (requires Trigonometry))	American River	2
					Sierra	0
				0934.00 (Electronics and Electric Technology)	American River	70
					Sacramento City	3
				15.0000 (Engineering Technologies/ Technicians, General.)	California State University-Sacramento	0
				15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	6	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	American River	Already accounted for
					Sierra	Already accounted for
				0934.00 (Electronics and Electric Technology)	American River	Already accounted for
					Sacramento City	Already accounted for
				0946.10 (Energy Systems Technology)	Sierra	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				



Los Angeles Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	3,346	Supply Gap	0	No Programs	No Programs	0
Electricians	1,622	Supply Gap	282	0952.20 (Electrical)	LA Trade	139
				46.0302 (Electrician.)	Baldwin Park Adult & Community Education	72
					Capstone College	1
					InterCoast Colleges-West Covina	68
					United Education Institute-West Covina	2
Machinists	821	Supply Gap	242	0956.30 (Machining and Machine Tools)	Cerritos	27
					Compton	10
					El Camino	24
					Glendale	5
					LA Pierce	8
					LA Trade	6
					LA Valley	4
					Pasadena	0
				48.0501 (Machine Tool Technology/ Machinist.)	NTMA Training Centers of Southern California	153
					Pomona Unified School District Adult and Career Education	5
Operating Engineers and Other Construction Equipment Operators	575	Supply Gap	54	0947.00 (Diesel Technology)	Citrus	25
					LA Trade	29
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	511	Supply Gap	119	0945.00 (Industrial Systems Technology and Maintenance)	LA Harbor	1
					LA Southwest	3
					LA Trade	70
					West LA	12
				0946.10 (Energy Systems Technology)	LA Trade	14
					Mt San Antonio	5
					Pasadena	5
					Rio Hondo	4
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	Santa Monica	5
					No Programs	0
					No Programs	0
					No Programs	0
					No Programs	0
47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0				
47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0				
47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0				

CALIFORNIA WORKFORCE NEEDS IN THE WATER/WASTEWATER INDUSTRY

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	290	Oversupply	410	0924.00 (Engineering Technology, General (requires Trigonometry))	Cerritos	16
					East LA	1
					Glendale	12
					Mt San Antonio	1
					Pasadena	210
				0934.00 (Electronics and Electric Technology)	East LA	2
					El Camino	7
					Glendale	2
					LA City	1
					LA Pierce	11
					LA Southwest	3
					LA Valley	20
					Long Beach	49
					Mt San Antonio	44
				15.0000 (Engineering Technologies/ Technicians, General.)	Pasadena	25
					Rio Hondo	2
				15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	California State Polytechnic University-Pomona	2
					California State University-Long Beach	0
					University of Antelope Valley	2

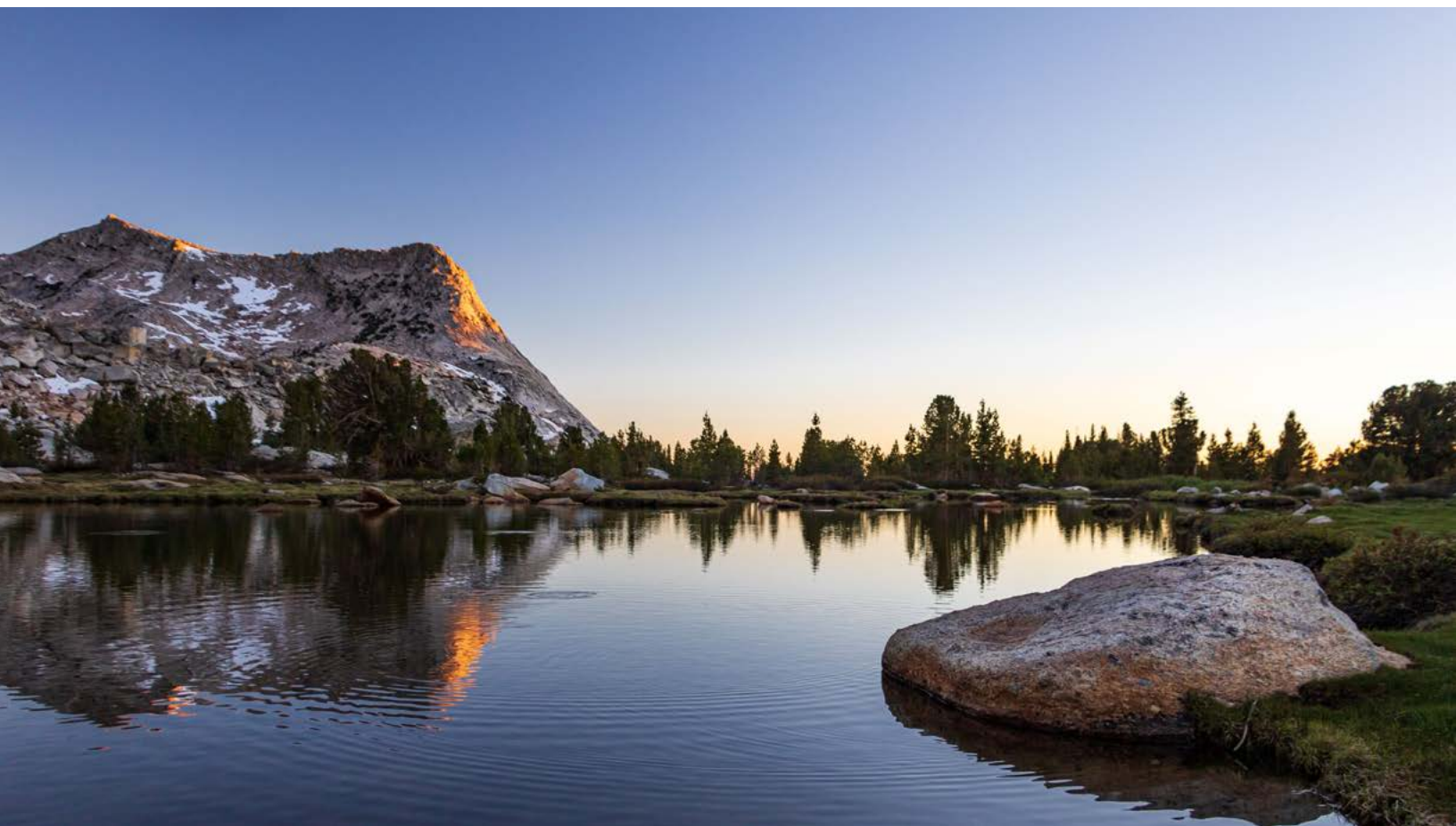


OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Water and Wastewater Treatment Plant and System Operators	147	Supply Met	125	0303.00 (Environmental Technology)	Rio Hondo	10
					Santa Monica	47
				0958.00 (Water and Wastewater Technology)	Citrus	41
					LA Trade	19
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	Hacienda La Puente Adult Education	8
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	No Programs	0
15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0				



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	19	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Cerritos	Already accounted for
					East LA	Already accounted for
					Glendale	Already accounted for
					Mt San Antonio	Already accounted for
					Pasadena	Already accounted for
				0934.00 (Electronics and Electric Technology)	East LA	Already accounted for
					El Camino	Already accounted for
					Glendale	Already accounted for
					LA City	Already accounted for
					LA Pierce	Already accounted for
					LA Southwest	Already accounted for
					LA Valley	Already accounted for
					Long Beach	Already accounted for
					Mt San Antonio	Already accounted for
Pasadena	Already accounted for					
Rio Hondo	Already accounted for					

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	19	Supply Gap	0	0946.10 (Energy Systems Technology)	LA Trade	Already accounted for
					Mt San Antonio	Already accounted for
					Pasadena	Already accounted for
					Rio Hondo	Already accounted for
					Santa Monica	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				



Orange County Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,379	Supply Gap	0	No Programs	No Programs	0
Electricians	1,062	Supply Gap	322	0952.20 (Electrical)	Irvine	15
					North Orange Adult	11
					Orange Coast	1
					Santiago Canyon	38
				46.0302 (Electrician.)	InterCoast Colleges-Santa Ana	36
					Southern California Institute of Technology	221
Machinists	455	Supply Gap	181	0956.30 (Machining and Machine Tools)	Orange Coast	77
					Santa Ana	104
				48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
Operating Engineers and Other Construction Equipment Operators	271	Supply Gap	51	0947.00 (Diesel Technology)	Santa Ana	8
				0947.30 (Heavy Equipment Operation)	Santiago Canyon	43
				49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	511	Supply Gap	119	0945.00 (Industrial Systems Technology and Maintenance)	Santiago Canyon	13
				0946.10 (Energy Systems Technology)	Golden West	0
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	No Programs	0
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
				47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	172	Supply Gap	121	0924.00 (Engineering Technology, General (requires Trigonometry))	Santa Ana	3
				0934.00 (Electronics and Electric Technology)	Coastline	66
					Irvine	21
					Orange Coast	10
					Saddleback	16
					Santa Ana	4
				15.0000 (Engineering Technologies/ Technicians, General.)	No Programs	0
15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	Southern California Institute of Technology	1				
Water and Wastewater Treatment Plant and System Operators	35	Oversupply	456	0303.00 (Environmental Technology)	Irvine	4
					Saddleback	0
					Santiago Canyon	2
				0958.00 (Water and Wastewater Technology)	Santiago Canyon	450
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	No Programs	0
				15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	19	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Santa Ana	Already accounted for
				0934.00 (Electronics and Electric Technology)	Coastline	Already accounted for
					Irvine	Already accounted for
					Orange Coast	Already accounted for
					Saddleback	Already accounted for
					Santa Ana	Already accounted for
					LA Swest	Already accounted for
				0946.10 (Energy Systems Technology)	Golden West	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
15.1703 (Solar Energy Technology/ Technician.)	No Programs	0				
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				

San Diego/Imperial Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	1,467	Supply Gap	0	No Programs	No Programs	0
Electricians	1,622	Supply Gap	282	0952.20 (Electrical)	Imperial	3
					Palomar	41
Machinists	351	Supply Gap	21	46.0302 (Electrician.)	San Diego City	0
					No Programs	0
Machinists	351	Supply Gap	21	0956.30 (Machining and Machine Tools)	San Diego City	21
					No Programs	0
Operating Engineers and Other Construction Equipment Operators	319	Supply Gap	36	48.0501 (Machine Tool Technology/ Machinist.)	Imperial	0
					Palomar	8
Operating Engineers and Other Construction Equipment Operators	319	Supply Gap	36	0947.00 (Diesel Technology)	San Diego Miramar	28
					No Programs	0
Electrical and Electronic Engineering Technologists and Technicians	293	Supply Gap	148	49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	Imperial	33
					San Diego City	1
Electrical and Electronic Engineering Technologists and Technicians	293	Supply Gap	148	0934.00 (Electronics and Electric Technology)	San Diego Continuing Education	104
					Southwestern	0
Electrical and Electronic Engineering Technologists and Technicians	293	Supply Gap	148	15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	National University	10



OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Industrial Machinery Mechanics	236	Supply Gap	2	0945.00 (Industrial Systems Technology and Maintenance)	Southwestern	0
				0946.10 (Energy Systems Technology)	Imperial	2
				47.0303 (Industrial Mechanics and Maintenance Technology/ Technician.)	No Programs	0
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
				47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0
Water and Wastewater Treatment Plant and System Operators	89	Supply Met	79	0303.00 (Environmental Technology)	Cuyamaca	20
					Southwestern	3
				0958.00 (Water and Wastewater Technology)	Cuyamaca	18
					Imperial	12
					Palomar	26
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	National University	0
				15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	7	Supply Gap	0	0934.00 (Electronics and Electric Technology)	Imperial	Already accounted for
					San Diego City	Already accounted for
					San Diego Continuing Education	Already accounted for
					Southwestern	Already accounted for
				0946.10 (Energy Systems Technology)	Imperial	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
				15.1703 (Solar Energy Technology/ Technician.)	No Programs	0
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				



South Central Coast Region

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Maintenance and Repair Workers, General	846	Supply Gap	0	No Programs	No Programs	0
Electricians	378	Supply Gap	40	0952.20 (Electrical)	Antelope Valley	27
					Canyons	1
					Cuesta	12
Operating Engineers and Other Construction Equipment Operators	251	Supply Gap	17	46.0302 (Electrician.)	No Programs	0
				0947.00 (Diesel Technology)	Ventura	17
Machinists	218	Supply Gap	5	49.0202 (Construction/ Heavy Equipment/ Earthmoving Equipment Operation.)	No Programs	0
				0956.30 (Machining and Machine Tools)	Allan Hancock	5
Industrial Machinery Mechanics	134	Supply Gap	0	48.0501 (Machine Tool Technology/ Machinist.)	No Programs	0
				0946.10 (Energy Systems Technology)	Oxnard	0
				47.0701 (Energy Systems Installation and Repair Technology/ Technician.)	No Programs	0
				47.0705 (Hydroelectric Energy System Installation and Repair Technology/ Technician.)	No Programs	0
				47.0706 (Geothermal Energy System Installation and Repair Technology/ Technician.)	No Programs	0

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Electrical and Electronic Engineering Technologists and Technicians	107	Supply Gap	47	0924.00 (Engineering Technology, General (requires Trigonometry))	Allan Hancock	2
					Antelope Valley	0
					Moorpark	1
				0934.00 (Electronics and Electric Technology)	Allan Hancock	5
					Antelope Valley	24
					Cuesta	15
					Oxnard	0
15.0000 (Engineering Technologies/ Technicians, General.)	No Programs	0				
15.0399 (Electrical/ Electronic Engineering Technologies/ Technicians, Other.)	No Programs	0				
Water and Wastewater Treatment Plant and System Operators	68	Oversupply	104	0303.00 (Environmental Technology)	Allan Hancock	25
					Moorpark	0
				0958.00 (Water and Wastewater Technology)	Canyons	29
					Santa Barbara	1
					Ventura	49
				15.0506 (Water Quality and Wastewater Treatment Management and Recycling Technology/ Technician.)	No Programs	0
				15.0507 (Environmental/ Environmental Engineering Technology/ Technician.)	National University	0
15.0508 (Hazardous Materials Management and Waste Technology/ Technician.)	No Programs	0				

OCCUPATIONAL TITLE	AVERAGE ANNUAL OPENINGS (2021-2026)	SUPPLY GAP/ SUPPLY MET/ OVERSUPPLY	AVERAGE ANNUAL AWARDS (2017-2020)	PROGRAM	COLLEGE	EDUCATIONAL SUPPLY (3-YR AVG)
Calibration Technologists and Technicians	3	Supply Gap	0	0924.00 (Engineering Technology, General (requires Trigonometry))	Allan Hancock	Already accounted for
					Antelope Valley	Already accounted for
					Moorpark	Already accounted for
				0934.00 (Electronics and Electric Technology)	Allan Hancock	Already accounted for
					Antelope Valley	Already accounted for
					Cuesta	Already accounted for
					Oxnard	Already accounted for
				0946.10 (Energy Systems Technology)	Oxnard	Already accounted for
				15.0001 (Applied Engineering Technologies/ Technicians.)	No Programs	0
				15.1702 (Power Plant Technology/ Technician.)	No Programs	0
15.1703 (Solar Energy Technology/ Technician.)	No Programs	0				
15.1705 (Hydroelectric Energy Technology/ Technician.)	No Programs	0				



CENTERS OF EXCELLENCE
FOR LABOR MARKET RESEARCH

MORE ABOUT THE CENTERS OF EXCELLENCE

The Centers of Excellence (COE) for Labor Market Research deliver regional workforce research and technical expertise to California community colleges for program decision making and resource development. This assistance has proven valuable to colleges in beginning, revising, or updating economic development and career education (CE) programs; strengthening grant applications; facilitating the accreditation process; and supporting strategic planning efforts.

The Centers of Excellence Initiative is funded in part by the Chancellor's Office, California Community Colleges, Economic and Workforce Development Program. The Centers aspire to be the leading source of regional workforce information and insight for California community colleges. More information about the Centers of Excellence is available at www.coecc.net.

For more information on this study, contact
Laura Coleman, Statewide Director



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