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# GREATER SACRAMENTO REGION TRANSPORTATION CLUSTER: WORKFORCE TRENDS AND EMERGING TECHNOLOGY



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# EXECUTIVE SUMMARY

In late 2017 and early 2018, the North/Far North Center of Excellence set out to study various facets of the Sacramento region's transportation cluster. (The Sacramento region is defined as the following seven counties: Sacramento, El Dorado, Placer, Sutter, Nevada, Yolo, Yuba.) The following report is divided into five sections. The first section examines the overall transportation cluster and high-performing subclusters. The next four sections analyze important and evolving areas within the transportation cluster: aeronautics transportation and manufacturing, rail transportation and manufacturing, alternative fuel vehicles, and emerging technology and special topics, including drones, autonomous vehicles and nondestructive testing.

The transportation cluster consists of 120 industries in 21 subclusters, spanning a wide range of activities. The cluster employs 70,000 workers in the Sacramento region, representing about 6 percent of the region's economy. The cluster grew nearly 20 percent in the past five years and is projected to grow 8.5 percent over the next five years, adding nearly 6,000 jobs.

Within the transportation cluster, automotive wholesale is the largest transportation subcluster in the region with nearly 13,000 workers, followed by logistics services, with nearly 12,000 workers.

High-performing transportation subclusters in the region include automotive wholesale, logistics services, and auto repair and maintenance. Automotive wholesale is projected to add just over 800 jobs, and logistics services is projected to add more than 1,000 jobs over the next five years. Auto repair and maintenance is expected to add nearly 1,000 jobs. Rail manufacturing has a smaller employment base, but important concentrations of employment.

Logistics and logistics services merits further research from the community colleges. The subclusters did not fit the scope of the study for occupational analysis, but the industry data suggests logistics represents a potential area of focus for the workforce development community.

Additional key findings:

**Aeronautics**—Aerospace manufacturing has employment concentrations in the Sacramento region (1,700 jobs), but the layoffs initiated by Aerojet portend the end of related subcluster activity in the region. The air transportation subcluster data indicates that the Sacramento region does not possess advantaged airports, despite the number of regional airports and an easily-accessible international airport. Employment concentrations and earnings are weak; earnings are on average \$30,000 less than California and the nation. Five-year projections show over 10 percent growth for the region's air transportation subcluster, but the starting level is quite low on other measures.

Sacramento City College is an important statewide education and training provider across a range of aeronautics areas, including technician, piloting and management programs. Many of these correspond to occupational areas that show demand at a super-regional level; occupational data measures statewide and national employment. Program graduates could find employment in other parts of the state, or elsewhere in the nation. The most in-demand aeronautics occupation in the region and the state is aircraft mechanics and service technicians. Occupational analysis suggests there is an undersupply statewide of pilots and technicians.

**Rail Transportation and Manufacturing**—Rail manufacturing, notably Siemens, merits attention from regional workforce and economic development stakeholders. The subcluster displays small but high concentrations of employment, and according to business news reports, the facility has received large contracts. The subcluster shows demand for middle-skill jobs, including machinists, welders, assemblers and electronics technicians.

# EXECUTIVE SUMMARY

Despite the encouraging news for regional rail projects, such as the average regional employment concentration and the prevalence of middle-skill jobs, the rail transportation subcluster, which employs about 1,600 workers, shows stagnant growth. Based on a review of employer job postings, the unions play a dominant role in supplying the workforce with many of the technician and operator jobs. The low number of statewide community college awards in related program areas indicates an unclear role for the community colleges moving forward.

**Alternative Fuel Vehicle (AFV) Technicians**—Automotive-related subclusters represent the top transportation industries in the region. Auto repair shops and car dealers employ 15,000 workers, with more than 1,000 new jobs projected over the next five years. Fleets employ 5,500 workers in the Sacramento region, also with about 1,000 new jobs projected.

Occupational analysis did not show a gap in the Sacramento region when comparing the number of awards in related vehicle technician training programs, but the data commonly shows this in regions across California. A private training provider, Universal Technician Institute (UTI), accounts for a large share of the awards annually in the region. The community colleges in the region demonstrate robust completion numbers. American River College (ARC) and Cosumnes River College (CRC), especially, have numerous courses related to alternative fuel vehicles. ARC has a strong heavy-duty (diesel) alternative fuel vehicle program. There was no evidence that UTI possesses similar coursework.

Market indicators from the Alternative Fuels Data Center, a project of the U.S. Department of Energy, and other sources, suggest that adoption is on the rise of electric vehicles and heavy-duty and transit vehicles that use other fuels, and that California is the dominant player nationally. Compressed natural gas (CNG) and liquefied natural gas (LNG) are dominant alternative fuels for heavy-duty and transit vehicles. Estimates using COE survey data indicate that three quarters of fleet vehicle technicians repair alternative fuel vehicles, while half of the technicians in auto shops and dealerships do so. Still, just 1 percent of households in Sacramento County have electric passenger vehicles (electric vehicles or plug-in hybrids). The extent to which the market adoption, or the technology itself, is impacting the need for specific skills training could not be determined by the research. Job posting data provided no indication that specific skills training is needed for alternative fuel technology.

**Emerging Technology and Special Topics**—Three topic areas were researched: autonomous vehicle technology, drones and nondestructive testing (NDT). Job posting data offered scant evidence that advanced driver assistance systems (ADAS) impact vehicle technicians. Current technology is widespread for collision avoidance, for example. The workforce impacts from fully autonomous vehicles could be significant for jobs that are highly routinized, like long-haul trucking. Still, widespread adoption for passenger vehicles and heavy-duty vehicles remains at the level of policy projections and could be more than a decade away, despite major investments from Silicon Valley and Detroit.

Analysis of job postings that mention drones or unmanned aircraft systems (UAS) shows employment mainly consists of engineering and software positions for research and product development, though postings for a variety of positions also come up. Employment and college and university programs appears linked to aerospace manufacturing in Southern California. No clear job category emerged from the research, though it appears that there is no shortage of statewide efforts to start drone programs in the community colleges.

While nondestructive testing (NDT) has a range of applications and is used in several industries, most of the job postings that cite NDT are in aerospace and aeronautics-related industries. Like drones, much of the activity appears concentrated in Southern California alongside aerospace. Job titles in postings requesting NDT as a skill mostly include positions that involve quality control and assurance, and inspection. Top job titles were quality engineer, manufacturing engineer and construction inspector.

# INTRODUCTION

Studying the transportation economy and workforce in the Sacramento region recalls the city's history of the railroad-tycoon-founders of the state, and looks ahead to projects that could encourage high-tech investment and linkages to the University of California-Davis, Silicon Valley and Los Angeles.

Sacramento was both the site of the groundbreaking of the transcontinental railroad and the great Pullman strike of 1894.<sup>1</sup> The region remains an important rail and transportation hub, with plans to increase local and statewide transit connectivity. Announcements of transportation investments in rail and bus services promise increased connectivity between the Sacramento region and the Bay Area. The Sacramento region's Capitol Corridor rail line provides a critical transportation link to the Bay region, and news of a Valley Rail project would bring a companion line to the Silicon Valley over Altamont Pass.<sup>2</sup>

The promising future of a dense, mixed-use redevelopment of the Railyards north of downtown Sacramento seems to symbolize a connection between the past and the future of Sacramento.<sup>3</sup> From the standpoint of manufacturing, Siemens continues its legacy as the region's major manufacturer of rail cars. Rail transportation activity continues, and the Sacramento region displays employment concentrations.

Investments from the Volkswagen settlement could fund electric bus service between Sacramento and UC Davis, a story that echoes other ventures between the city and the university.<sup>4</sup> The Volkswagen project and announcement of Sacramento as a "Green City" represent two advances contributing to the Sacramento region's leadership on electric vehicle infrastructure and other public projects, like fleet programs.<sup>5</sup>

Amazon's new distribution center near the Metro Air Park highlights the importance of distribution and logistics in the region's economy, where the region shows strong economic indicators.<sup>6</sup> The greater Sacramento area is home to a number of regional airports, and the ease of getting in and out of the Sacramento International Airport appeals to many types of travelers.

The history of the transportation economy in the region, and the flurry of activity taking place in the region and the state form the backdrop for the present study. The Los Rios Community College District asked the North/Far North Center of Excellence (COE) to conduct research into traditional industries and emerging technology in the region's transportation cluster. Several existing career education (CE) programs in automotive technology, railroad operations, aeronautics, manufacturing technology and electronics provide a touchstone for the research. The goal of the research is to help guide Strong Workforce Program investments in existing programs and to weigh opportunities for investing in new and emerging industry areas.

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<sup>1</sup> William W. Ray, "Crusade or Civil War? The Pullman Strike in California," *California History*, Spring 1979, 20-39. <http://www.militarymuseum.org/PullmanStrike.pdf>.

<sup>2</sup> Altamont Corridor Express, "Valley Rail Project Receives Major Grant Funding Today by State," news release, April 26, 2018, <http://www.acerail.com/About/News/2017/Valley-Rail-Project-Receives-Major-Grant-Funding-T>.

<sup>3</sup> Ryan Lillis, "First Major Housing Project Revealed for Sacramento's Downtown Railyard," *The Sacramento Bee*, December 4, 2017, <http://www.sacbee.com/news/local/news-columns-blogs/city-beat/article188001239.html>

<sup>4</sup> Tony Bizjak and Ryan Lillis, "How the Volkswagen Diesel Scandal Could Ease Traffic between Sacramento and Davis," *The Sacramento Bee*, February 8, 2018, <http://www.sacbee.com/news/local/news-columns-blogs/city-beat/article199183249.html>.

<sup>5</sup> Dale Kasler and Ryan Lillis, "Sacramento Is No L.A. That's Why Volkswagen Is Bringing Electric Car Program Here," *The Sacramento Bee*, June 29, 2017, <http://www.sacbee.com/news/local/transportation/article158920754.html>.

<sup>6</sup> Mark Glover and Benjy Egel, "Amazon's Sacramento Center Is Up and Shipping; Plans for Inside Home Delivery in Works," *The Sacramento Bee*, October 25, 2017, <http://www.sacbee.com/news/business/article180833111.html>.



# SECTION I: SACRAMENTO REGIONAL TRANSPORTATION CLUSTER

## TRANSPORTATION OVERVIEW

This section of the report provides an industry analysis of the transportation cluster in the greater Sacramento region, California and the United States. (The Sacramento region is defined as the following seven counties: Sacramento, El Dorado, Placer, Sutter, Nevada, Yolo, Yuba.) The transportation cluster comprises 120 industries identified by the North American Industry Classification System (NAICS), including manufacturing, wholesale and retail trade, transportation and warehousing, and maintenance and repair services.

These 120 industries were selected based on three sources of information. The first set of NAICS codes were identified in the advanced transportation study prepared by the Centers of Excellence in 2013 titled “Alternative and Renewable Fuels & Vehicle Technology Program: Overview of Advanced Transportation Industries and Occupations in California.”<sup>7</sup>

For analysis purposes, the selected industry codes are grouped into 21 subclusters. Please refer to Appendix A for a complete list of the 120 industry codes and definitions of the 21 subclusters.

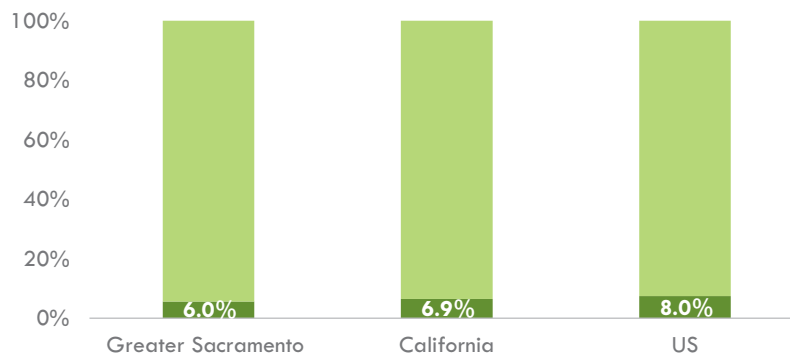


<sup>7</sup> “Alternative and Renewable Fuels & Vehicle Technology Program: Overview of Advanced Transportation Industries and Occupations in California,” Centers of Excellence, July 2013, pp. 8–9, <http://docplayer.net/43849262-Alternative-and-renewable-fuels-vehicle-technology-program.html>. Industries under waste management and remediation services were not selected for this study.

# TRANSPORTATION CLUSTER EMPLOYMENT

The transportation cluster currently employs nearly 70,000 workers in the greater Sacramento region, 1.3 million workers in the state and 12.7 million workers in the nation, exceeding 2007 pre-recession employment levels in all three geographies. The transportation cluster accounted for a smaller share of the Sacramento regional economy, compared to California and the nation (Exhibit 1).

**Exhibit 1: Transportation cluster share of the economy in the region, state and nation<sup>8</sup>**



Transportation employment experienced double-digit growth over the past five years in all three geographies (Exhibit 2). Looking ahead, transportation jobs are projected to grow at a slower pace in the region, state and nation. Currently, transportation jobs in the region and state are less concentrated than at the national level.

Generally, transportation earnings are lower in the Sacramento region than in California and the United States. Average wages for all three geographies are lower than the average earnings for all industries. There is, of course, a large variation in earnings between manufacturing and operations industries within the transportation cluster.

**Exhibit 2: Transportation industry trends in the Sacramento region, California and the nation<sup>9</sup>**

Geography	2007 Jobs	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job % Change	17-22 Job % Change	2017 LQ	2017 Avg. Earnings
Sacramento	66,465	59,138	69,617	75,532	17.7%	8.5%	0.75	\$53,919
California	1,240,775	1,114,958	1,326,185	1,428,699	18.9%	7.7%	0.87	\$64,336
U.S.	12,064,527	11,311,748	12,708,894	13,484,298	12.4%	6.1%	1.00	\$59,462

<sup>8</sup> EMSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed.

<sup>9</sup> Ibid.

# TRANSPORTATION CLUSTER EMPLOYMENT

An examination of transportation subclusters reveals that automotive wholesale represents the largest transportation subcluster in the greater Sacramento region, employing 12,711 workers or 18 percent of all transportation workers in the region (Exhibit 3).

Other large subclusters in the region include logistics services (11,684 workers and 17 percent of all transportation jobs), and auto repair and maintenance (10,531 workers and 15 percent of all transportation jobs).

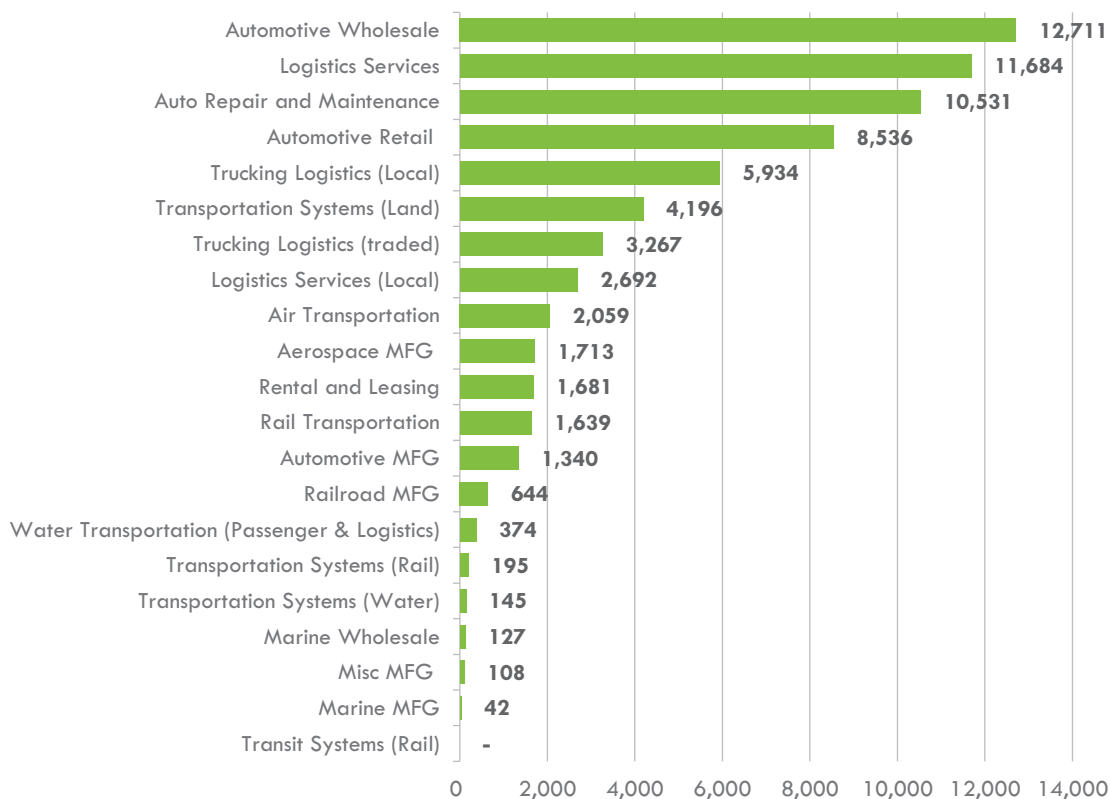
Four subclusters related to logistics appear among those categories with the most employment in the Sacramento region.

Manufacturing subclusters make up only a small portion of transportation jobs in the region. As Exhibit 3 indicates, aerospace manufacturing, automotive manufacturing and rail manufacturing combined consist of only 5 percent of all transportation jobs in the region.

This report distinguishes between subclusters that are primarily export oriented, whose products and services extend beyond the region, and locally oriented, subclusters that provide products and services within the region.

Subclusters labeled manufacturing and traded are generally export oriented. The long-haul trucking logistics subcluster is labeled “traded.” Wholesale, services, retail and transportation are other categories of activities.

**Exhibit 3: Transportation jobs by subcluster in the Sacramento region, 2017**





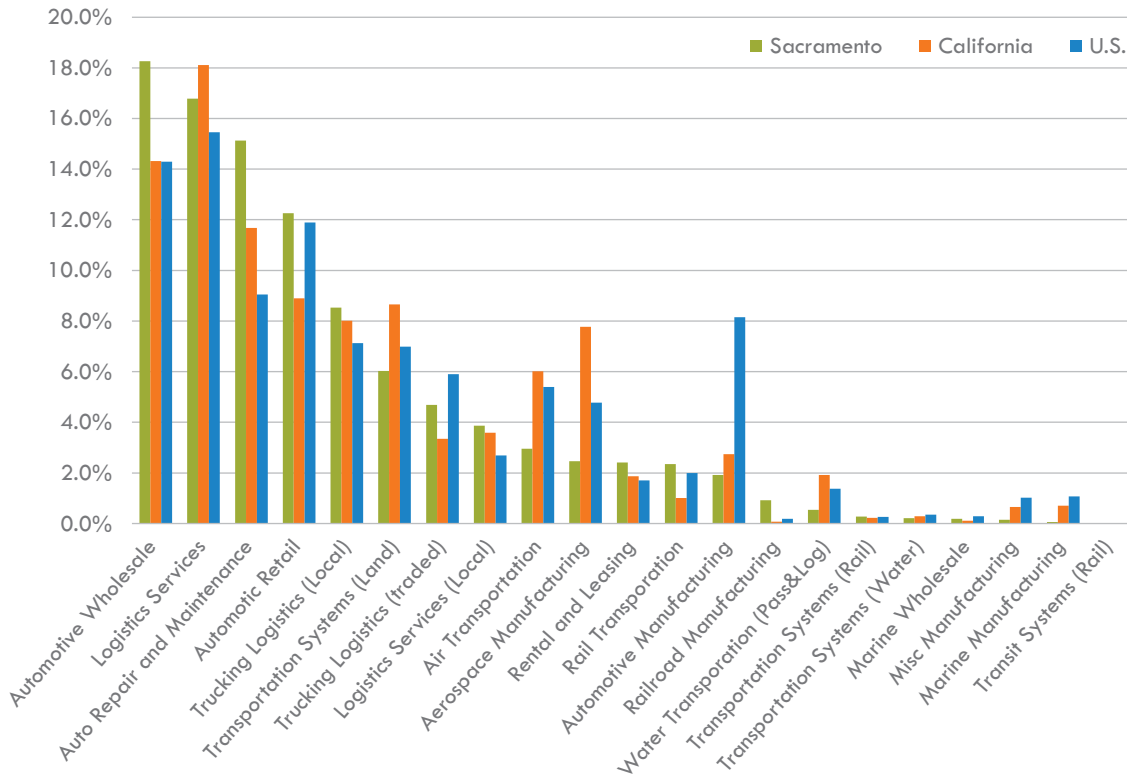
# TRANSPORTATION CLUSTER EMPLOYMENT

State and national employment data indicates the structure of the transportation cluster in the state and nation mostly resembles the Sacramento region; the rank and percentage of the categories by total employment relative to the overall cluster are similar. However, there are some important distinctions.

As Exhibit 4 shows, the Sacramento region has a larger percentage of automotive wholesale employment, and automotive repair and maintenance employment, in the transportation cluster. The region has a slightly higher percentage of trucking and rail subcluster employment.

The region has a lower share of manufacturing jobs than the state and nation. Aerospace manufacturing jobs make up 8 percent of all transportation jobs in the state, much larger than the Sacramento region, although the region does possess some important employment concentrations in that sector. Automotive manufacturing does not hold the same share of employment in the region or the state compared to the nation. The Sacramento region also has a smaller share of air transportation jobs.

**Exhibit 4: Subcluster percentages of overall transportation cluster in the Sacramento region, California and United States, 2017**



# HIGH-PERFORMING SUBCLUSTERS

Exhibits 5 and 6 show those subclusters that performed well in one or more of the following areas: total employment; five-year historical job growth; five-year projected job growth; 2017 job concentration (location quotient); and 2017 average annual earnings.

In the greater Sacramento region, high-performing subclusters include automotive wholesale, logistics services, and auto repair and maintenance. (The region has a higher concentration of employment in the last category than the state.)

These three subclusters have experienced significant growth in the past five years and are projected to increase employment through 2022. Logistics services is projected to add more than 1,000 jobs over the next five years, the largest projected growth among all transportation subclusters in the region. Rail transportation, which includes just one industry, grew modestly over the last five years, but its employment is projected to remain at about the same level over the next five years.

Aerospace and rail manufacturing, which possess strong indicators, have contracted in the last five years and are projected to continue their decline. Railroad manufacturing jobs are 3.6 times more concentrated in the region than the nation despite a small number of jobs.

Earnings are high in these industries. Aerospace manufacturing is considered high performing as it offers the highest average annual earnings, \$140,223, among all subclusters in the region.

## Exhibit 5: High-performing subclusters and study subclusters in the Sacramento region<sup>10</sup>

Subcluster	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	17-22 Job Change	2017 LQ	2017 Avg. Earnings
Automotive Wholesale	10,583	12,711	13,514	2,128	803	0.96	\$68,530
Logistics Services	8,571	11,684	12,716	3,113	1,032	0.81	\$50,823
Auto Repair and Maintenance	8,928	10,531	11,472	1,603	941	1.25	\$41,635
Trucking Logistics (Local)	4,865	5,934	6,312	1,070	377	0.90	\$54,530
Air Transportation	1,677	2,059	2,278	383	219	0.41	\$66,421
Aerospace Manufacturing	2,271	1,713	1,800	(558)	87	0.39	\$140,223
Rail Transportation	1,480	1,639	1,678	158	39	0.88	\$80,194
Railroad Manufacturing	740	644	682	(96)	39	3.58	\$110,033

<sup>10</sup> EMSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed.



## HIGH-PERFORMING SUBCLUSTERS

At the state level, high-performing subclusters that differ from the Sacramento region include air transportation, water transportation, rental and leasing, marine manufacturing and rail transportation systems (Exhibit 6).

Just as in the Sacramento region, the logistics services and automotive wholesale subclusters top the list due to high employment levels and significant historical and projected growth.

Aerospace manufacturing jobs offer the highest pay and have the highest concentration compared to all other subclusters in the state, but historic declines in employment have occurred in the last five years and are expected to continue in projections.

Water and air transportation employment owes its strong indicators to major international airports and port activities outside the Sacramento region.

**Exhibit 6: High-performing subclusters and study subclusters in California<sup>11</sup>**

Subcluster	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	17-22 Job Change	2017 LQ	2017 Avg. Earnings
Logistics Services	168,664	240,209	271,065	71,545	30,856	1.02	\$55,761
Automotive Wholesale	161,708	189,883	200,803	28,175	10,921	0.87	\$72,011
Auto Repair and Maintenance	138,734	154,847	162,691	16,113	7,844	1.12	\$40,314
Aerospace Manufacturing	103,979	103,059	99,349	(920)	(3,710)	1.41	\$134,643
Air Transportation	62,651	79,728	88,634	17,078	8,906	0.97	\$94,668
Water Transportation (Passenger & Logistics)	23,679	25,506	34,225	1,827	8,718	1.21	\$115,941
Rental and leasing	20,051	24,793	26,461	4,741	1,668	0.95	\$60,580
Rail transportation	12,147	13,297	13,605	1,150	307	0.44	\$79,901
Marine Manufacturing	7,664	9,278	10,017	1,613	739	0.57	\$82,223
Transportation Systems (Rail)	1,455	2,963	3,766	1,508	804	0.73	\$60,389

<sup>11</sup> Ibid.

# TRANSPORTATION CLUSTER SUMMARY

Overall, the analysis of transportation subclusters does not present striking evidence of opportunity areas for the Sacramento region. Just one subcluster, railroad manufacturing, has a high location quotient, but its employment has declined over the last five years.

Manufacturing subclusters have performed poorly overall; news reports concerning Sacramento's regional aerospace manufacturing industries suggest the outlook is not improving. Rail transportation has some concentration in the Sacramento region, but growth is slight.

Staple industries, such as logistics and automotive repair, represent the strongest candidates for maintaining programs. Some opportunities may exist in air transportation. Findings in this section include:

- The transportation cluster currently employs 70,000 workers in the greater Sacramento region. The transportation cluster represents 6 percent of the region's total economy, by employment, about 1 percent lower than the state, and 2 percent lower than the nation. The cluster has experienced growth in the region, the state and nation over the past five years. However, growth is uneven when examining the industries at the subcluster level. The nation, state and Sacramento region share similar strengths in certain subcluster employment: automotive wholesale, logistics services, and auto repair and maintenance. Manufacturing in transportation-related industries is not strong in the Sacramento region. Though some rail and aerospace manufacturing employment exists, neither is sufficient for program development.
- Automotive wholesale appears to be a strong area of focus for further research and employer engagement. A look at the industries in the subcluster reveals that the name is partially misleading. The subcluster includes new and used car dealers, RV dealers and motorcycle dealers. Regarding automotive technicians, Section IV examines the opportunity in detail, especially related to electric, hybrid and alternative fuel vehicles. Automotive retail, weak in earnings, represents tire shops and auto parts stores.
- Auto repair and maintenance represents a principal, locally-serving subcluster that has a healthy concentration of employment, as well as solid historic and projected employment growth. However, annual earnings are well below the regional and statewide average, calling into question the quality of the jobs in these industries.
- Despite Sacramento's international airport and several regional municipal airports, employment in air transportation is modest and projected to remain so. The international airport does not possess competitive indicators, suggesting it is not a major national or statewide hub. Some specific areas may warrant focus for the community colleges, such as this report's findings on the aeronautics subclusters. Logistics associated with the airport may warrant additional investigation. Overall earnings in the subcluster are slightly below the regional and statewide averages.
- The Sacramento region appears to have a stronger concentration of employment in the rail transportation subcluster than the state, though the concentration is lower than the national level. Employment growth in the category is tepid at best, though earnings are well above the regional average. Appendix A details research findings for rail transportation and rail manufacturing.
- Subclusters related to logistics—services, trucking—show strong recent and projected employment growth in the region, though average earnings are low. Logistics may warrant further research and consideration alongside manufacturing-related research in a separate project.
- The weak numbers for water transportation indicate the Port of West Sacramento does not present an important focus for the community colleges, especially when compared to the numbers for California. Preliminary analysis suggested that logistics near the port, possibly due to industrial zoning, not port activity, represented a stronger opportunity.
- Community colleges in the region should investigate logistics as a potential area for program development. The study scope of this report did not cover logistics, and so it is not covered in the following sections.



# SECTION II: AERONAUTICS SUBCLUSTER ANALYSIS

## AERONAUTICS OVERVIEW

The aeronautics and railroad clusters include industry activity in both transportation and operations, and manufacturing. The aeronautics and rail sections also include completion data for educational programs that target manufacturing employment, such as welding and manufacturing technology.

There are two industry subclusters related to aeronautics: 1) air transportation and 2) aerospace manufacturing. Exhibit 7 contains the complete list of industries in these subclusters.

### Exhibit 7: Industries in aeronautics-related subclusters

Aeronautics Subcluster	NAICS Code	NAICS Description
Aerospace Manufacturing	334511	Search, Detection, Navigation, Guidance, Aeronautical and Nautical System and Instrument Manufacturing
	336411	Aircraft Manufacturing
	336412	Aircraft Engine and Engine Parts Manufacturing
	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
	336414	Guided Missile and Space Vehicle Manufacturing
	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
Air Transportation	481111	Scheduled Passenger Air Transportation
	481112	Scheduled Freight Air Transportation
	481211	Nonscheduled Chartered Passenger Air Transportation
	481212	Nonscheduled Chartered Freight Air Transportation
	481219	Other Nonscheduled Air Transportation
	488111	Air Traffic Control
	488119	Other Airport Operations
	488190	Other Support Activities for Air Transportation

# AERONAUTICS EMPLOYMENT

The combined aeronautics subclusters currently employ 3,700 workers in the Sacramento region, accounting for 5 percent of the entire transportation cluster in the region (Exhibit 8).

Sacramento's aerospace manufacturing sector lost nearly one quarter of its jobs, 550 jobs overall, between 2012 and 2017. Aerospace industries in California and the nation also shed jobs, but at a lower rate.

Layoffs by Aerojet Rocketdyne likely began years ago in the region. According to multiple news reports, Aerojet Rocketdyne will move or eliminate 1,100 of the 1,400 positions at its facilities in Rancho Cordova to its Alabama location by the end of 2019. Earnings in this sector are high, over \$140,000 on average annually. The data suggests the region's aerospace manufacturing industries were an economic engine, but are now in peril.<sup>12</sup>

Air transportation has performed better in the region, growing by 23 percent since 2012. Employment concentration in the region is low, and earnings are weak, suggesting that Sacramento's airports are not competitive with other transportation hubs in California and the nation. Regional earnings in the subcluster are nearly \$30,000 lower than the state and nation on average.

## Exhibit 8: Aeronautics subcluster trends in the Sacramento region, California and United States<sup>13</sup>

Geography	Industry Sector	2007 Jobs	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job % Change	17-22 Job % Change	2017 LQ	2017 Avg. Earnings
Sacramento	Aerospace Manufacturing	1,732	2,271	1,713	1,800	(24.6%)	5.1%	0.39	\$140,223
	Air Transportation	1,822	1,677	2,059	2,278	22.8%	10.6%	0.41	\$66,421
	Aeronautics	3,554	3,948	3,772	4,078	(4.4%)	8.1%	0.40	\$99,933
California	Aerospace Manufacturing	118,744	103,979	103,059	99,349	(0.9%)	(3.6%)	1.41	\$134,643
	Air Transportation	65,439	62,651	79,728	88,634	27.3%	11.2%	0.97	\$94,668
	Aeronautics	184,184	166,630	182,788	187,983	9.7%	2.8%	1.18	\$117,207
USA	Aerospace Manufacturing	645,056	629,820	607,349	602,111	(3.6%)	(0.9%)		\$126,997
	Air Transportation	659,951	628,426	685,798	722,719	9.1%	5.4%		\$94,098
	Aeronautics	1,305,007	1,258,245	1,293,147	1,324,830	2.8%	5.4%		\$109,549

<sup>12</sup> Patton, Victor A., "Aerojet to 'relocate or eliminate' 1,100 positions in Sacramento region," Sacramento Business Journal, April 10, 2017, <https://www.bizjournals.com/sacramento/news/2017/04/10/aerojet-to-relocate-or-eliminate-1-100-positions.html>.

<sup>13</sup> EMSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed.

# AERONAUTICS EMPLOYMENT

Exhibits 9 and 10 show industries that have strong indicators in one or more of the following areas: five-year historical job growth, five-year projected job growth, 2017 job concentration (location quotient), and 2017 average annual earnings.

The detailed industry data only partly explains the trends previously described. Several industries in aerospace manufacturing posted job gains.

The Sacramento region has a special niche in guided missile and space vehicle propulsion unit and propulsion unit parts manufacturing; its jobs are 12 times more concentrated than the national level. The concentration likely reflects Aerojet's employment.

In air transportation, other airport operations underwent significant growth in the region and the state. Nonscheduled chartered passenger air transportation pays the highest wages among air transportation jobs in the region.

## Exhibit 9: High-performing aeronautics industries in the Sacramento region<sup>14</sup>

Subcluster	NAICS Code	NAICS Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job % Change	17-22 Job % Change	2017 LQ	2017 Avg. Earnings
Aerospace Manufacturing	336411	Aircraft Manufacturing	15	148	223	896.5%	50.7%	0.09	\$112,065
	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	23	80	112	243.9%	40.4%	0.10	\$75,573
	336414	Guided Missile and Space Vehicle Manufacturing	460	532	520	15.6%	(2.2%)	1.28	\$167,322
	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	1,276	907	922	(28.9%)	1.6%	12.66	\$136,329
Air Transportation	481211	Nonscheduled Chartered Passenger Air Transportation	80	66	68	(16.9%)	1.6%	0.30	\$115,781
	481212	Nonscheduled Chartered Freight Air Transportation	71	77	98	8.2%	26.9%	1.24	\$75,014
	488119	Other Airport Operations	316	567	686	79.5%	21.1%	0.86	\$31,158

<sup>14</sup> EMSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed.



# AERONAUTICS EMPLOYMENT

**Exhibit 10: High-performing aeronautics industries in California<sup>15</sup>**

Subcluster	NAICS Code	NAICS Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job % Change	17-22 Job % Change	2017 LQ	2017 Avg. Earnings
Aerospace Manufacturing	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	33,103	28,640	23,764	(13.5%)	(17.0%)	1.98	\$148,333
	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	27,156	30,299	32,523	11.6%	7.3%	2.34	\$90,647
	336414	Guided Missile and Space Vehicle Manufacturing	19,380	19,175	19,627	(1.1%)	2.4%	2.81	\$183,470
	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	2,185	1,782	1,723	(18.5%)	(3.3%)	1.52	\$140,029
	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	1,311	1,513	1,656	15.4%	9.5%	2.39	\$116,597
Air Transportation	481212	Nonscheduled Chartered Freight Air Transportation	1,102	1,277	1,535	15.9%	20.2%	1.25	\$73,189
	481219	Other Nonscheduled Air Transportation	464	514	648	10.6%	26.1%	0.74	\$240,261
	488119	Other Airport Operations	10,878	16,349	19,116	50.3%	16.9%	1.51	\$38,280
	488190	Other Support Activities for Air Transportation	8,056	10,778	12,313	33.8%	14.2%	0.81	\$69,737

<sup>15</sup> Ibid.

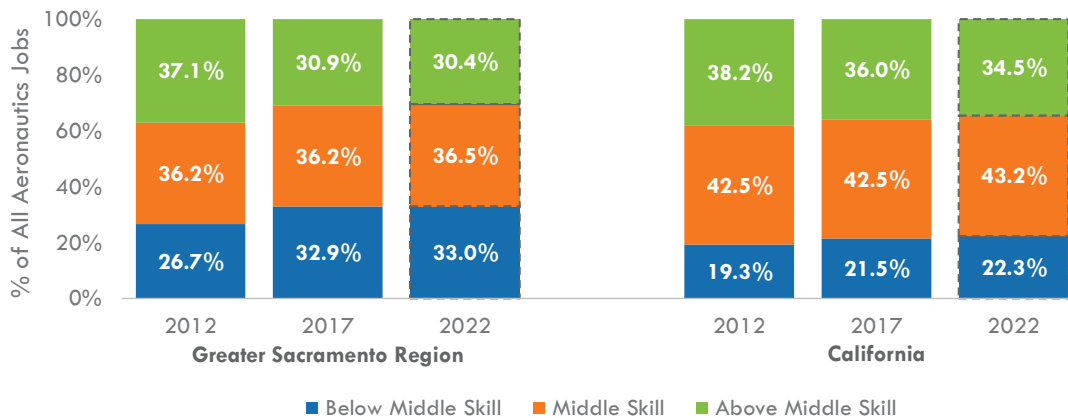


# AERONAUTICS MIDDLE-SKILL JOBS

The COE performed an occupational analysis of the two combined aeronautics subclusters—air transportation and aerospace manufacturing. A relatively skilled workforce comprises the subclusters. The current data reveals that the two subclusters have 1,000 middle-skill jobs and 1,185 above-middle-skill jobs in the region, representing 36 percent and 31 percent of all aeronautics jobs in the region.

At the state level, middle-skill and above-middle-skill jobs comprise a slightly larger share of all aeronautics jobs, accounting for 43 percent and 36 percent respectively of all aeronautics jobs in California. Over the past five years, the percentage of middle-skill jobs has not changed while the percentage of above-middle-skill jobs has declined in the region and state (Exhibit 11). Looking ahead, middle-skill aeronautics jobs are projected to grow proportionally at the regional and state levels over the next five years. The share of above-middle-skill jobs is expected to shrink regionally and statewide between now and 2022.

**Exhibit 11: Percentages of aeronautics jobs by skill category in the Sacramento region and California<sup>16</sup>**



Exhibits 12 and 13 illustrate critical middle-skill and above-middle-skill occupations in the region and the state for the two aeronautics subclusters studied. These selected occupations either occupy a high percentage of total jobs in the aeronautics cluster, or have experienced growth historically and play important roles in the high-performing industries identified in Exhibits 4 and 5.

Aircraft mechanics and service technicians is a middle-skill occupation that stands out with the most historic and projected employment growth in the region and state. Average hourly earnings are \$30 per hour.

Pilots, avionics technicians, structural workers and machinists showed small regional employment with almost no growth. All above-middle-skill jobs in the region are projected to undergo employment declines.

<sup>16</sup> EMSI; 2017Q4, Staffing Pattern Report, QCEW Employees, Non-QCEW Employees, and Self-Employed.

# AERONAUTICS MIDDLE-SKILL JOBS

Statewide, airline pilots constitute an above-middle-skill occupation that displays dramatic historical and projected growth.

**Exhibit 12: Top middle-skill and above-middle-skill aeronautics occupations in the Sacramento region<sup>17</sup>**

Skill Category	SOC Code	SOC Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	Median Hourly Earnings
Middle Skill	49-3011	Aircraft Mechanics and Service Technicians	292	340	382	48	\$30.74
	51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	64	63	68	(1)	\$35.09
	53-2012	Commercial Pilots	60	62	72	2	\$42.81
	49-2091	Avionics Technicians	47	54	60	6	\$33.94
	51-4041	Machinists	54	50	55	(4)	\$21.54
Above Middle Skill	15-1133	Software Developers, Systems Software	234	184	193	(50)	\$45.20
	13-1111	Management Analysts	89	80	84	(9)	\$33.30
	17-2011	Aerospace Engineers	83	72	75	(11)	\$61.13
	17-2141	Mechanical Engineers	67	55	62	(11)	\$45.31
	17-2112	Industrial Engineers	66	54	59	(12)	\$39.29

**Exhibit 13: Top middle-skill and above-middle-skill aeronautics occupations in California**

Skill Category	SOC Code	SOC Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	Median Hourly Earnings
Middle Skill	49-3011	Aircraft Mechanics and Service Technicians	8,655	10,197	11,353	1,542	\$30.63
	51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	2,892	3,133	3,443	242	\$22.73
	51-4041	Machinists	2,991	3,128	3,225	137	\$20.25
	51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	1,599	1,769	1,912	170	\$17.58
	53-2012	Commercial Pilots	1,470	1,630	1,893	159	\$38.58
	49-2091	Avionics Technicians	1,270	1,411	1,537	141	\$32.04
Above Middle Skill	53-2011	Airline Pilots, Copilots, and Flight Engineers	6,911	8,233	9,072	1,322	\$80.46
	15-1133	Software Developers, Systems Software	5,543	5,540	5,145	(3)	\$60.06
	17-2011	Aerospace Engineers	4,937	4,926	4,716	(11)	\$56.11
	17-2112	Industrial Engineers	3,606	3,695	3,772	89	\$48.18
	13-1199	Business Operations Specialists, All Other	2,592	2,697	2,652	106	\$36.52

<sup>17</sup> EMSI; 2017Q4, Staffing Pattern Report, QCEW Employees, Non-QCEW Employees, and Self-Employed.

# AERONAUTICS MIDDLE-SKILL JOBS

The COE used the top middle-skill and above-middle-skill occupations to analyze job postings. Exhibits 14 and 15 show top aeronautics employers and top job titles in the region and state.<sup>18</sup> Employers posting on the job boards include military and public-sector entities, manufacturers, defense contractors and technical instrument companies. Regional job postings seek mechanics, technicians, assemblers and machinists. The data partly reflects the occupational picture with mechanics having the most job growth. At the state level, manufacturing-related positions are more common, but technicians, mechanics and assemblers are also present.

## Exhibit 14: Top aeronautics employers in the Sacramento region and California

Top Employers in Sacramento Region	Top Employers in California
Textron	Lockheed Martin Corporation
US Air Force	General Atomics
Svs Group Incorporated	Northrop Grumman
Kratos Technology & Training Solutions	Arconic
Pride Industries	AECOM Technology Corporation
Transportation Security Administration	US Air Force
Progress Rail Services	Teledyne Technologies
Pittsburgh Institute of Aeronautics	General Dynamics
Ultimate	Space Exploration Technologies Corp
DynCorp International	Air Methods
L3 Technologies	National Assemblers
	Advantage Sales & Marketing

## Exhibit 15: Top aeronautics job titles in the Sacramento region and California

Top Job Titles in Sacramento Region	Top Job Titles in California
Machinist	Machinist
CNC Machinist	Electronics Technician
Mechanic	Test Technician
Aircraft Mechanic	CNC Machinist
A & P Mechanic	Mechanical Assembler
Avionics Technician	Engineering Technician
Manual Machinist	CNC Operator
Electronic Assembler	Instrumentation Technician
Mechanical Assembler	Mechanic
Assembler Proto	Electronic Assembler
	Aircraft Mechanic
	Electro-Mechanical Assembler
	Avionics Technician
	Calibration Technician
	A & P Mechanic
	CNC Lathe Machinist

<sup>18</sup> Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool," accessed April 2018. The searches are based on the Standard Occupational Classification (SOC) System codes for each of the top middle-skill and above-middle-skill occupations. The results that are not related to aeronautics industries were excluded from the top employer and job title lists.



# AERONAUTICS DEMAND & SUPPLY

This section compares the current educational supply serving the aeronautics cluster in the state to the projected demand for the top middle-skill and above-middle-skill occupations. Currently, the aeronautics programs offered by the community colleges in California focus on two areas: 1) aviation and airport management and services, and 2) aeronautical and aviation technology.

## Educational Supply

Exhibits 16 and 17 display the three-year annual average award completions for the 10 Taxonomy of Programs (TOP) codes related to aeronautics.<sup>19</sup> Across California, 22 community colleges offer aeronautics-related programs. Currently, Sacramento City College is the only postsecondary institution in the region offering aeronautics programs.

Statewide, community colleges confer, on average, 1,340 aeronautics awards annually. Of these, 985 awards are from programs related to aeronautical and aviation technology. Sacramento City College confers the most awards in aviation and airport management and services among all community colleges in the state. Sacramento City College offers programs in seven out of the 10 aeronautics TOP codes analyzed; the college does not offer programs that recorded completions in three TOP codes: 302040-Flight Attendant, 095040-Aircraft Electronics (Avionics), and 095050-Aircraft Fabrication.

Spartan College of Aeronautics & Technology, a proprietary school in Los Angeles, confers the most awards related to aeronautical and aviation technology in the state.

**Exhibit 16: Aviation and airport management and services annual average award completions in California, 2013-2016**

Educational Provider	302000 – Aviation & Airport Management & Services	302010 – Aviation & Airport Management	302020 – Piloting	302030 – Air Traffic Control	302040 – Flight Attendant
Cypress		24	30		42
Glendale		6	5		10
Mt San Antonio			41	51	
Orange Coast	10		3		10
Palomar	4		2		
Sacramento City	20	24	40	21	
San Diego Miramar		6	7		
<b>State Total</b>	<b>34</b>	<b>60</b>	<b>128</b>	<b>72</b>	<b>62</b>

<sup>19</sup> COE Supply Tables, California Community Colleges Chancellor's Office Data Mart.



# AERONAUTICS DEMAND & SUPPLY

## Exhibit 17: Aeronautical and aviation technology annual average award completions in California, 2013–2016

Educational Provider	095000 – Aeronautical & Aviation Technology	095010 – Aviation Airframe Mechanics	095020 – Aviation Powerplant Mechanics	095040 – Aircraft Electronics (Avionics)	095050 – Aircraft Fabrication
Alameda		16	10		
Antelope Valley	14	23	27		37
Aviation Institute of Maintenance	22				
Chaffey	2	26	31		
Gavilan	4	13	11		
Long Beach	14				
Mt San Antonio	5	30	29		
Orange Coast	28	9	8		
Reedley College	15	8	9		
Sacramento City	30	23	23		
San Bernardino	7	10	10		
San Diego Miramar	42	24	26		
San Francisco		25	25		
San Joaquin Valley College-Visalia	26				
Sequoias	7				
Solano	2				
Spartan College of Aeronautics & Technology	223		2		
Victor Valley	7	11	12		
West LA	4	27	28		
<b>State Total</b>	<b>451</b>	<b>244</b>	<b>252</b>	<b>0</b>	<b>37</b>

The cluster analysis also addressed manufacturing. Exhibit 18 shows program completions data for TOP codes related to manufacturing at the state level. Currently, four community colleges in the seven-county greater Sacramento region provide training related to manufacturing: American River, Cosumnes River, Sierra and Yuba. In the region, American River College confers the most awards, on average 90 per year, in manufacturing and industrial technology areas.

Welding technology (TOP code 095650) is the most popular manufacturing and industrial technology program that generates the greatest supply in the region, with 110 awards on average annually. On average, 1,570 awards are conferred annually statewide.

The greater Sacramento region does not offer any educational programs in machining and machine tools (TOP code 095630), which is a popular program in the state, or in industrial and occupational safety and health (TOP code 095670), or industrial quality control (TOP code 095680). The percentage of graduates employed in aeronautics could not be determined. Partly for this reason, no gap analysis is offered for manufacturing-related occupations.

# AERONAUTICS DEMAND & SUPPLY

**Exhibit 18: Annual average award completions for manufacturing-and-industrial-related programs in California, 2013–2016<sup>20</sup>**

Educational Provider	095600 – Manufacturing & Industrial Technology	095630 – Machining & Machine Tools	095640 – Sheet Metal & Structural Metal	095650 – Welding Technology	095670 – Industrial & Occupational Safety & Health	095680 – Industrial Quality Control
Academy of Art University	5					
Advanced Career Institute				30		
Allan Hancock		7		33		
American River			18	72		
Antelope Valley				10		
Bakersfield	2	28	2	64		
Barstow				6		
Butte				221		
Cabrillo				3		
California Career School		7				
Canyons	2			16		
Cerritos	8	16		64		
Cerro Coso				28		
CET-El Centro				66		
CET-Oxnard		37				
CET-San Bernardino		14		80		
CET-San Diego				99		
CET-Watsonville				17		
Chabot Hayward		21		2		
Chaffey						
Columbia						
Compton		5		3		
Cosumnes River				2		
Cuesta				6		
Cuyamaca					15	
De Anza	30	8				
El Camino	1	40		8		
Fab School		9		90		
Fresno City	31	7		15		
Fullerton	6	3		13		
Glendale		7		3		
Hacienda La Puente Adult Education		6		36		
Hartnell				3		
Imperial				9		
Irvine	6					

Continued

<sup>20</sup> COE Supply Tables, California Community Colleges Chancellor's Office Data Mart. Highlighted colleges are located within the seven-county greater Sacramento region.

# AERONAUTICS DEMAND & SUPPLY

**Exhibit 18: Annual average award completions for manufacturing-and-industrial-related programs in California, 2013–2016** (Continued)

Educational Provider	095600 – Manufacturing & Industrial Technology	095630 – Machining & Machine Tools	095640 – Sheet Metal & Structural Metal	095650 – Welding Technology	095670 – Industrial & Occupational Safety & Health	095680 – Industrial Quality Control
LA Pierce		4				
LA Trade		23		21		
LA Valley	6	7				
Laney		17		10		
Las Positas				7	7	
Lassen				1		
Long Beach			7	3		
Los Medanos				12		
Marin		2				
Merced				6		
Mira Costa		0				
Modesto		5	3	15		
Mt San Antonio	18			18		
Napa		8		5		
Norco College	7	4				
NTMA Training Centers of Southern California		571				
Orange Coast		62		6		
Palo Verde				16		
Palomar			14	40		
Pasadena		3		6		
Pomona Unified School District Adult and Career Education		16		3		
Porterville	9					
Redwoods	2	8		2		
Reedley College		29		8		
Rio Hondo				3		
Riverside				22		
Riverside County Office of Education				40		
Saddleback	4					
San Bernardino	2	9		4		
San Diego Adult	1		8	128		
San Diego City	8	54	13			
San Francisco				1		
San Joaquin Delta		12		4		
San Jose City		34				
San Mateo						

Continued

# AERONAUTICS DEMAND & SUPPLY

**Exhibit 18: Annual average award completions for manufacturing-and-industrial-related programs in California, 2013–2016** (Continued)

Education Provider	095600 – Manufacturing & Industrial Technology	095630 – Machining & Machine Tools	095640 – Sheet Metal & Structural Metal	095650 – Welding Technology	095670 – Industrial & Occupational Safety & Health	095680 – Industrial Quality Control
Santa Ana	4	81		15		
Santa Rosa		17		6		
Santiago Canyon						1
Sequoias				11		
Shasta				13		
Sierra	15			27		
Siskiyou				3		
Solano				5		
Southwestern					5	
Summit College				83		
Taft					12	
Ventura				14		
Victor Valley				8		
Yuba				9		
Sacramento Region Total	15	0	18	110	0	0
<b>California Total</b>	<b>168</b>	<b>1,181</b>	<b>65</b>	<b>1,574</b>	<b>39</b>	<b>1</b>

## Projected Demand for Top Middle-skill and Above-middle-skill Jobs

The following data shows projected annual openings for the top aeronautics jobs from the staffing patterns analysis. However, the projections extend beyond aeronautics. In some cases, the demand does not offer a clear direction for aeronautics education and training programs because the demand may have little to do with the industry context specific to aeronautics.

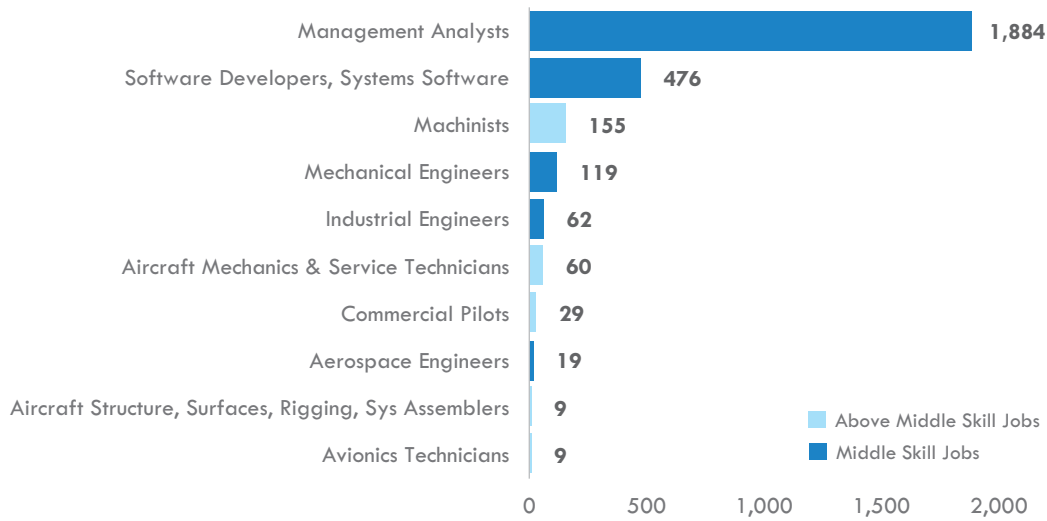
For example, at the regional and state level, the occupations with the highest demand are business operations jobs such as management analysts and business operation specialists; much of the demand is not related to aeronautics. The same is true for machinists and engineers.

The most in-demand occupation solely related to the aeronautics cluster in the region and the state is aircraft mechanics and service technicians. Exhibits 19 and 20 show top aeronautics job openings in the region and state.

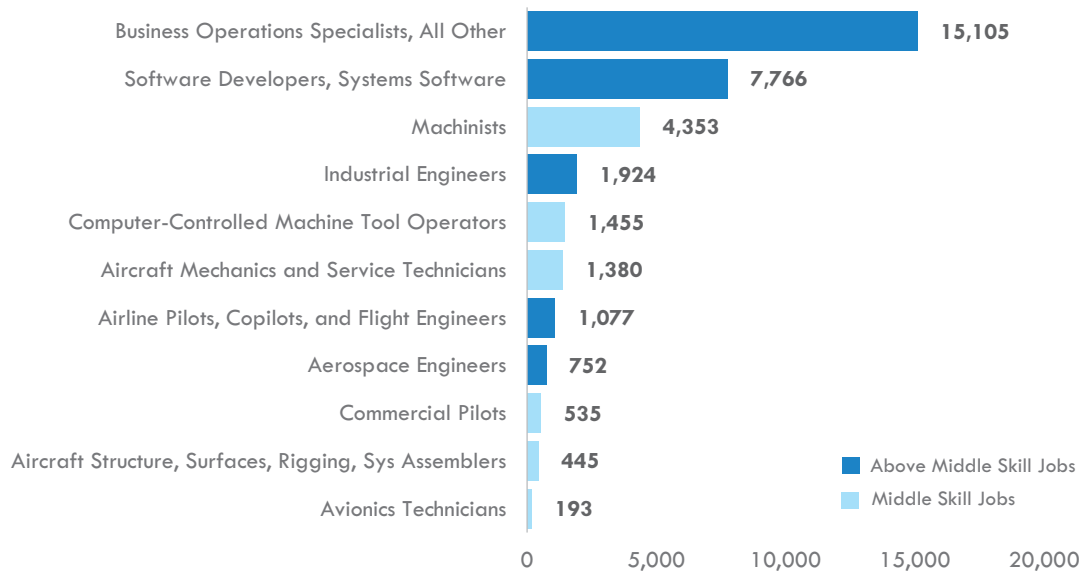
(Note: Air traffic controllers, with a regional demand of 15 annual openings, and 242 in the state, did not emerge from the staffing patterns analysis, and so did not show up in the occupational analysis.)

# AERONAUTICS DEMAND & SUPPLY

**Exhibit 19: Projected annual openings for top aeronautics occupations in the Sacramento region, 2017–2022**



**Exhibit 20: Projected annual openings for top aeronautics occupations in California, 2017–2022**







# AERONAUTICS DEMAND & SUPPLY

## Gap Discussion

The demand for business, management, engineering, software and machinist occupations in aeronautics cluster industries does not easily match program completion data, and so could not be analyzed.

The TOP code descriptions and occupational codes offer a somewhat comparable count for pilots and mechanics and other technical occupations.<sup>21</sup>

Neither comparison is adequate, and further research and employer engagement would be needed to verify the category comparisons. It is likely that private flight schools, which are offered to a national market, provide a labor market supply from outside the state.

In addition, program completers will be entering a national labor market since aeronautics jobs are centered at major transportation hubs and manufacturing regions, further complicating comparison at a regional or statewide level.

Nonetheless, it appears that the Sacramento region has a slight oversupply of pilots, with 40 average annual awards and 29 estimated annual openings.

The demand for mechanics, technicians and assemblers at the regional level is on par with program completions, roughly 80 each. The supply and demand for air traffic controllers appears on par, with about 20 annual awards conferred and 15 projected annual openings.

Comparing these same categories at the statewide level suggests that there is an undersupply of mechanics, technicians and assemblers in California. The data shows about 950 awards annually, with annual openings estimated at just over 2,000.

A similar gap is observed for pilots in California, with the available data showing just over 100 awards annually, and an estimated projected demand of about 1,600 commercial and airline pilots needed annually.

The statewide picture for air traffic controllers shows an undersupply, with about 70 annual awards and a demand of 240 annual openings in California.

<sup>21</sup> The gap discussion uses the following shorthand assumption for comparison: The TOP code for Piloting compares to the SOC codes for Commercial Pilots and Airline Pilots and Copilots. The TOP codes for Aeronautical and Aviation Technology, Aviation Airframe Mechanics, Aviation Powerplant Mechanics, and Aircraft Electronics compare to SOC Aircraft Mechanics and Service Technicians, Aircraft Structure, Surfaces, Rigging and Surfaces Assemblers, and Avionics Technicians.



## AERONAUTICS SUBCLUSTER SUMMARY

- California's aerospace industry, concentrated in the southern part of the state, has been on the decline for decades. The departure of Aerojet employment deals a blow to the Sacramento region since the company represents the major share of aerospace manufacturing in the region. News reports suggest that layoffs are occurring now, and the subcluster has registered job losses historically. Some industries in aerospace manufacturing show job gains in the last five years regionally. It is possible there are still opportunity areas in the subcluster, but the research did not reveal exactly where. Employer engagement in the subcluster should involve discussions about supplier relationships with Aerojet that may be impacted by job cuts.
- Occupational gap analysis was not possible since manufacturing programs prepare students to enter a wide range of manufacturing and other industries. However, demand for machinists, CNC operators, testing and other technicians may yield some opportunities for students in the region, and more elsewhere in the state. The jobs may have skill requirements similar to other industries.
- Connecting to statewide efforts related to aerospace manufacturing with community colleges in Southern California could yield opportunities for training programs. Still, the community colleges in the Sacramento region should engage aerospace employers and employers in manufacturing and other sectors that require skills preparation that can be applied to many industries. This report's findings discourage targeting aerospace employers for specific program development, unless those programs are part of short-term training for grants or contract education.
- Although the air transportation subcluster shows somewhat weak regional indicators (modest employment, low concentration, low earnings), students entering this field will likely be entering at least a super-regional labor market at the national level. Demand for aircraft mechanics and service technicians; aircraft structure, surfaces, rigging and systems assemblers; commercial pilots; and avionics technicians is modest, but does exist at the statewide level. Air traffic controllers did not emerge in the data as an area of high need. The most in-demand aeronautics occupation in the region and across the state is aircraft mechanics and service technicians.
- The fact that Sacramento City College offers the region's only aeronautics program may bode well for students. In addition, the program appears to be one of the strongest statewide in terms of number of program graduates and scale and scope of programs; the college shows strong numbers for management, piloting, and technician programs.
- Across the state, community colleges confer more awards related to aeronautical and aviation technology. In the region, the community colleges confer more awards related to aircraft and airport management and services, but also have robust numbers for technician programs. A basic gap analysis suggests there is an undersupply statewide, especially for pilots and technician positions. The study scope did not enable evaluating student readiness for work upon program completion. Additional employer engagement and student outcomes research may be warranted.



# SECTION III: RAIL TRANSPORTATION AND MANUFACTURING SUBCLUSTERS ANALYSIS

## RAIL OVERVIEW

This section uses cluster definitions from the U.S. Cluster Mapping Project to identify rail-related industries.<sup>22</sup> Industries were identified using the North American Industry Classification System (NAICS). Specifically, the rail cluster analyzed in this report consists of two components: 1) railroad manufacturing (NAICS Code 336510-Railroad Rolling Stock Manufacturing) and 2) rail transportation (NAICS Code 482110-Rail Transportation).



<sup>22</sup> Institute for Strategy and Competitiveness, Harvard University and U.S. Economic Development Administration, <https://www.clustermapping.us/>.

# RAIL EMPLOYMENT

In the greater Sacramento region, rail subclusters currently employ nearly 2,300 workers, comprising 3 percent of the transportation cluster.

An examination of rail subclusters reveals that rail transportation in the region had robust growth over the past five years, while railroad manufacturing declined. The region’s rail transportation sector grew by nearly 11 percent between 2012 and 2017, exceeding both the state and nation (Exhibit 21).

The railroad manufacturing employment picture, however, is somewhat unclear; the regional industry experienced growth during the recession, but declined by 13 percent over the past five years. At the state and national levels, employment increased during the same period.<sup>23</sup>

Even though it only has 650 jobs in the region, railroad manufacturing in the greater Sacramento region is nearly 3.6 times more concentrated than the nation, far higher than the state. In fact, the Sacramento region contains more than two thirds of California’s railroad manufacturing jobs. The regional advantage is likely owed to the presence of Siemens, which builds locomotives and rail cars south of Sacramento. The company announced in late 2017 that it had received a \$371 million contract for passenger rail cars.<sup>24</sup>

Rail jobs in the greater Sacramento region pay nearly \$89,000 a year on average, which is higher than the average annual rail earnings in the state and nation. In particular, rail manufacturers in the region pay more than \$110,000 annually on average, well above all other railroad manufacturing earnings at the state and national levels, a further indication that the Sacramento region possesses a special advantage. Rail transportation earnings in the region are high, well above average earnings among all regional industries.

## Exhibit 21: Rail subcluster trends in the Sacramento region, California and United States<sup>25</sup>

Geography	Industry Sector	2007 Jobs	2012 Jobs	2017 Jobs	2022 Jobs	12–17 Job % Change	17–22 Job % Change	2017 LQ	2017 Avg. Earnings
Sacramento Region	Railroad Manufacturing	435	740	644	682	(13.0%)	6.0%	3.58	\$110,033
	Rail Transportation	1,653	1,480	1,639	1,678	10.7%	2.4%	0.88	\$80,194
	Total	2,089	2,220	2,282	2,360	2.8%	3.4%	1.12	\$88,608
California	Railroad Manufacturing	436	790	960	1,180	21.5%	22.8%	0.33	\$97,790
	Rail Transportation	14,124	12,147	13,297	13,605	9.5%	2.3%	0.44	\$79,901
	Total	14,560	12,938	14,258	14,784	10.2%	3.7%	0.43	\$81,106
USA	Railroad Manufacturing	28,263	24,095	24,543	25,820	1.9%	5.2%		\$86,259
	Rail Transportation	235,670	234,279	253,797	264,389	8.3%	4.2%		\$82,316
	Total	263,933	258,374	278,340	290,209	7.7%	4.3%		\$82,664

<sup>23</sup> “Union Pacific (UNP) Aims Greater Efficiency With 750 Layoffs,” Zacks Equity Research, August 17, 2017, <https://finance.yahoo.com/news/union-pacific-unp-aims-greater-113211533.html>. The recently reported rail industry’s pursuit of cost reduction and greater productivity may have an impact on projected growth. For example, Union Pacific, the nation’s second-largest freight railroad, trimmed its workforce by 750 jobs in 2017.

<sup>24</sup> Anderson, Mark, “Siemens Picks Up \$371 Million Contract for Passenger Rail Cars,” Sacramento Business Journal, November 9, 2017, <https://www.bizjournals.com/sacramento/news/2017/11/09/siemens-picks-up-371-million-order-for-passenger.html>.

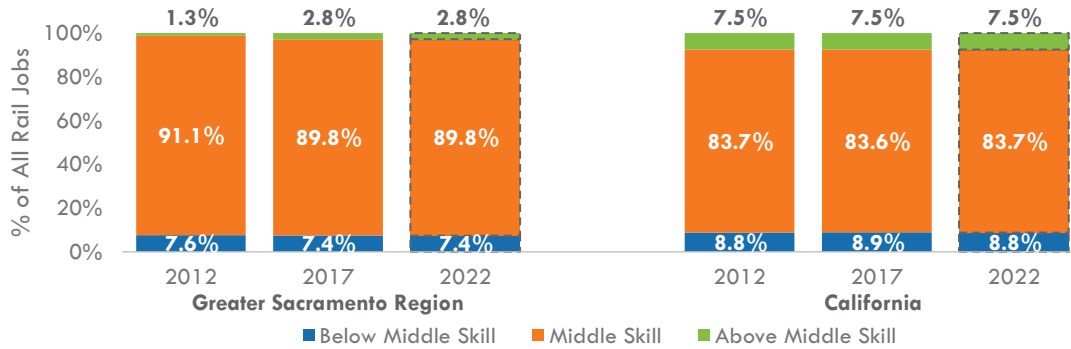
<sup>25</sup> MSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed.



# RAIL MIDDLE-SKILL JOBS

The COE performed an occupational analysis on the combined rail subclusters. The rail subclusters are unique because a majority of their occupational employment is middle skill. As Exhibit 22 illustrates, the rail cluster currently has 1,200 middle-skill jobs in the region and 10,800 middle-skill jobs across the state, accounting for 90 percent and 84 percent of all rail jobs respectively. Above-middle-skill jobs only represent a small portion of rail jobs, 3 percent, in the region. Over the past five years, the structure of rail jobs by skill category has been consistent in the region and the state, and is expected to remain the same over the next five years.

**Exhibit 22: Percentage of rail jobs by skill category in the Sacramento region, California<sup>26</sup>**



<sup>26</sup> EMSI; 2017Q4, Staffing Pattern Report, QCEW Employees, Non-QCEW Employees, and Self-Employed. Occupations with fewer than 10 jobs were excluded from the analysis.





## RAIL MIDDLE-SKILL JOBS

Exhibits 23 and 24 show critical middle-skill and above-middle-skill rail occupations in the region and state. These selected occupations have the highest percentages of total jobs in the rail cluster and have experienced strong historical growth. The greater Sacramento region and state share the same top middle-skill occupations.

All the critical above-middle-skill occupations are operational or managerial jobs that are in demand across all industries.

Middle-skill occupations include traditional railroad operations occupations—engineers, conductors, brake and switch operators, and some manufacturing-related occupations, especially welders. Other middle-skill jobs worth mentioning include machinists, and electrical and electronics installers and repairers. These occupations had slightly lower counts and did not make the summary list.

### Exhibit 23: Top middle-skill and above-middle-skill rail occupations in the Sacramento region<sup>27</sup>

Skill Category	SOC Code	SOC Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	Median Hourly Earnings
Middle Skill	53-4031	Railroad Conductors and Yardmasters	261	289	295	27	\$30.60
	53-4011	Locomotive Engineers	259	286	293	27	\$25.51
	53-4021	Railroad Brake, Signal, and Switch Operators	117	129	132	12	\$30.55
	51-4121	Welders, Cutters, Solderers, and Brazers	127	118	126	(9)	\$18.79
	49-3043	Rail Car Repairers	78	86	88	8	\$31.25
	47-4061	Rail-Track Laying and Maintenance Equipment Operators	51	57	59	6	\$30.80
Above Middle Skill	11-1021	General and Operations Managers	16	17	18	2	\$45.68
	11-9021	Construction Managers	<10	10	11		\$32.44
	11-9199	Managers, All Other	<10	10	11		\$21.84

<sup>27</sup> EMSI; 2017Q4, Staffing Pattern Report, QCEW Employees, Non-QCEW Employees, and Self-Employed.



## RAIL MIDDLE-SKILL JOBS

**Exhibit 24: Top middle-skill and above-middle-skill rail occupations in California**

Skill Category	SOC Code	SOC Description	2012 Jobs	2017 Jobs	2022 Jobs	12-17 Job Change	Median Hourly Earnings
Middle Skill	53-4031	Railroad Conductors and Yardmasters	2,153	2,349	2,398	197	\$27.26
	53-4011	Locomotive Engineers	2,133	2,332	2,385	199	\$24.29
	53-4021	Railroad Brake, Signal, and Switch Operators	963	1,052	1,074	88	\$27.98
	49-3043	Rail Car Repairers	643	701	715	58	\$28.80
	47-4061	Rail-Track Laying and Maintenance Equipment Operators	416	463	482	47	\$30.52
	51-4121	Welders, Cutters, Solderers, and Brazers	309	326	362	17	\$18.40
Above Middle Skill	11-1021	General and Operations Managers	127	139	140	11	\$51.92
	11-9021	Construction Managers	78	84	85	7	\$34.63
	11-9199	Managers, All Other	77	84	85	7	\$21.80
	15-1132	Software Developers, Applications	59	66	68	7	\$56.26
	11-3011	Administrative Services Managers	55	60	62	6	\$46.57

# RAIL MIDDLE-SKILL JOBS

An analysis of job postings from the past 12 months using the Burning Glass online database was conducted to identify top employers, job titles and education requirements in the region and state. It is noteworthy that Burning Glass does not distinguish between high school and vocational training, challenging a middle-skill analysis.

Top employers in the region include Union Pacific Railroad, California Northern Railroad and Patriot Rail (Exhibit 25).

## Exhibit 25: Top rail employers in the Sacramento region and California<sup>28</sup>

Top Employers in Sacramento Region	Top Employers in California
Union Pacific Railroad	Union Pacific Railroad
California Northern Railroad	Northrop Grumman
Patriot Rail	BNSF Railway
	California Northern Railroad

## Exhibit 26: Top rail job titles in the Sacramento region and California

Top Job Titles in Sacramento Region	Top Job Titles in California
Crew	Crew
Track Laborer	Conductor Trainee – Primary Recall
Conductor/Engineer	Railcar Repair carman
Track Laborer	Track Laborer
Nce Route & Switch	Conductor
	Test Conductor
	Passenger Conductor
	Yard Spotter
	Inspector – Track
	Test Conductor Flight Test

Additional analysis for the employer Siemens in the Sacramento region revealed 30 job postings in the last 12 months for positions requiring high school and vocational training, or an associate degree as the preferred education.

These positions included job titles such as field service technician, repair center manager, rail systems project manager, production planner, procurement specialist, materials support, heavy rail field service manager, engineering technician, designer/drafter, systems engineer.

At least eight of these postings request specific knowledge or skills applicable to the rail industry.

<sup>28</sup> Ibid. The results in Exhibits 24 and 25 are based on collective searches on the Standard Occupational Classification (SOC) System codes for the top middle-skill occupations. The searches based on above-middle-skill-jobs returned only a small number of job postings; therefore, the above-middle-skill jobs were excluded from this analysis.





## RAIL DEMAND & SUPPLY

This section compares current educational supply serving the rail cluster in the state, as well as the projected demand for the top middle-skill occupations identified in the previous section. This section provides data on manufacturing-related educational programs that could impact rail subclusters in the region and state.

### Educational Supply

Currently, community colleges in the state offer only one Taxonomy of Programs (TOP) code that directly serves the rail cluster: Railroad and Light Rail Operations-094740. Exhibit 27 displays the three-year annual average award completions for this program.<sup>29</sup> Sacramento City College and San Diego City College are the only two community colleges offering this program in California. The award counts are low, calling into question the training source for the industry. Examination of railroad operations job boards suggests a strong union presence for technician positions.

Like aeronautics, the rail subclusters include manufacturing industries. The same supply data included in the previous section applies to the rail industry. However, because the regional and statewide programs serve a wide range of manufacturing and other industries, a gap analysis could not be conducted. Please refer to Exhibit 18 in the aeronautics section for manufacturing completions data.

### Exhibit 27: Railroad and light rail operations annual average award completions, 2013–2016

Community College	094740 – Railroad and Light Rail Operations
Sacramento City College	19
San Diego City College	2
<b>California Total</b>	<b>21</b>

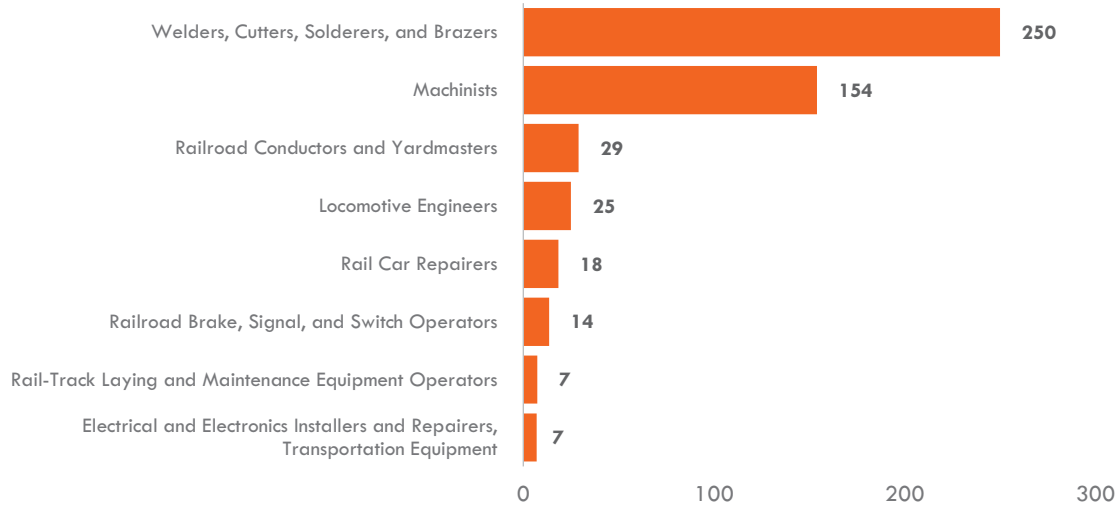
### Projected Demand for Top Middle-skill Jobs

Machinists and welders comprise the most in-demand middle-skill rail occupations in the region and state (Exhibits 28 and 29); this finding suggests these occupations serve many other industries since they comprise a smaller share of the staffing patterns. Other traditional rail occupations have a small number of annual openings, fewer than 30 each in the region. At the statewide level, projections for rail operations occupations are modest.

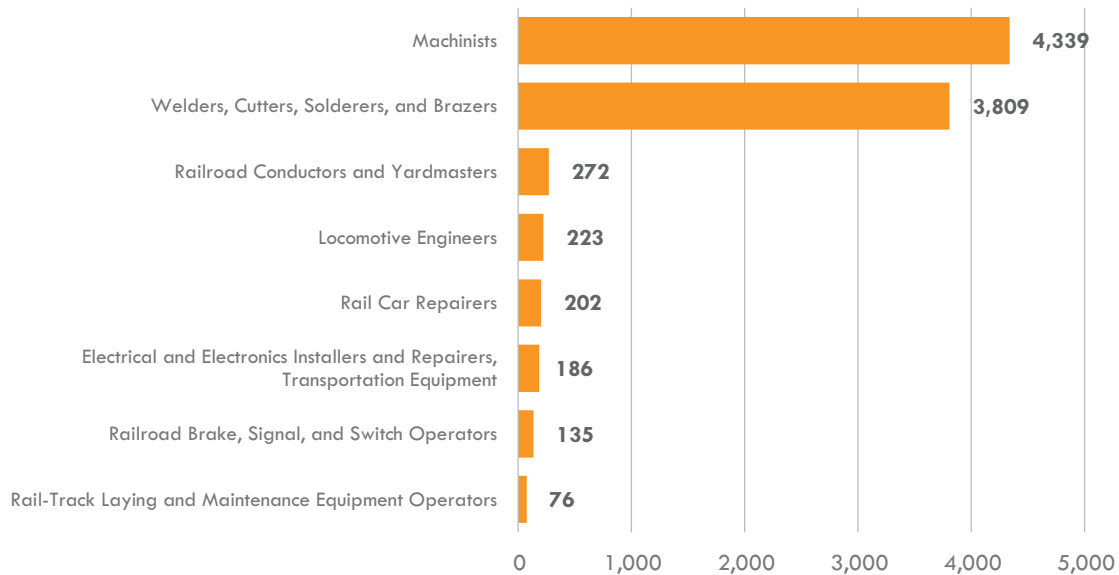
<sup>29</sup> 237310 Highway, Street and Bridge Construction, COE Supply Tables, California Community Colleges Chancellor's Office Data Mart.

# RAIL DEMAND & SUPPLY

**Exhibit 28: Projected annual openings for top rail-related middle-skill jobs in the Sacramento region, 2017–2022<sup>30</sup>**



**Exhibit 29: Projected annual openings for top rail-related middle-skill jobs in California, 2017–2022<sup>31</sup>**



<sup>30</sup> EMSI; 2017Q4, QCEW Employees, Non-QCEW Employees, and Self-Employed. Above-middle-skill occupations are not included in this analysis due to too few jobs in the rail cluster.

<sup>31</sup> Ibid.





## RAIL SUBCLUSTER SUMMARY

- The Sacramento region has a regional advantage in rail manufacturing—a high location quotient and earnings well above the state and nation. The community colleges should make a special effort to connect with Siemens and any other suppliers in the region that provide products and services to the company. The recent announcement of a major deal to construct rail cars may result in opportunities for middle-skill manufacturing technician positions that the community colleges can supply. A handful of job postings from the company in the Sacramento region indicate a variety of positions and skills needed to serve rail manufacturing activities. That said, the rail manufacturing subcluster shows only 650 jobs in the region. The colleges should consider training programs geared toward rail manufacturing job opportunities, but that also provide skills transferrable to other manufacturing industries.
- Machinists, welders, assemblers and electronics-related positions are the manufacturing-related jobs most in demand by employers. Rail manufacturing comprises only some of the annual openings, so the community colleges should consider these opportunities in conjunction with other manufacturing employers, and other industries.
- Rail transportation provides a mixed picture that warrants further investigation and employer engagement. The Sacramento region appears to be a rail hub, having a larger share of employment in the transportation cluster compared to the state or the nation. (The location quotient is higher than the state, but still below 1.0.) Still, the industry has not experienced employment growth over the last 10 years in the region, and the state has experienced some job loss.
- Occupations are high paying in rail transportation; however, annual openings are limited in the region and state. There are some job postings for traditional rail operations positions. This report's findings suggest the community colleges are not a significant supplier for the rail operations workforce. Sacramento City College and San Diego City College offer the only rail operations programs in the state. Sacramento City College confers 20 awards on average annually; San Diego City College confers two awards on average annually. A review of employer job boards suggests there is a heavy union presence for positions. This could indicate that union training facilities, or other employer-led programs, supply most of the rail operations workforce. The community colleges should further investigate student program outcomes.
- Top rail operations employers in the region with whom the community colleges could connect include Union Pacific Railroad (the nation's second largest transportation company), California Northern Railroad (a short-line railroad company owned by Genesee & Wyoming, Inc.) and Patriot Rail (a holding company for short-line railroads across the nation that is based in Florida).

# SECTION IV: ALTERNATIVE FUEL VEHICLE TECHNICIANS WORKFORCE ANALYSIS

## ALTERNATIVE FUEL OVERVIEW

This section of the report provides an overview of industry sectors that work closely with technologies related to electric vehicles (EV) and alternative fuel vehicles (AFV), and highlights the critical middle-skill automotive technician occupations that serve those sectors in the Sacramento region.

Expanding upon the previous advanced transportation studies conducted by COE, this report examines the impact that alternative fuel vehicle technologies will have on key identified occupations, as well as the training supply within the region. COE's first study was published in 2013.<sup>32</sup> A second report followed in 2014.<sup>33</sup>

This section focuses on two industry sectors that involve EV and AFV activities: 1) automotive repair shops and car dealers, and 2) fleets companies. Seven NAICS codes identified in COE's 2014 study comprise the automotive repair shops and car dealers subcluster.

The COE used 10 NAICS industries related to logistics services, car rental and leasing, and land transportation systems to estimate a portion of fleet industry and occupational activities.<sup>34</sup> Examples of fleet companies include passenger car rental companies, taxi and limousine service providers, truck and utility trailer rental companies, and bus companies. See Appendix B for a complete list of NAICS codes.

The employment analysis in this report focuses on four key middle-skill technician occupations identified in the 2014 COE advanced transportation study.<sup>35</sup> (Staffing patterns reveal these are the primary vehicle-technician occupations. See Appendix C for auto shop and dealer staffing patterns and Appendix D for fleets industry staffing patterns.) This study uses the 2014 study's survey results to estimate the number of employees who work on alternative fuel vehicles and employees who only work on traditional vehicles.<sup>36</sup> This estimate provides a general idea of the scale of EV and AFV technology jobs, rather than an exact count of those jobs.

<sup>32</sup> "Alternative and Renewable Fuels & Vehicle Technology Program: Overview of Advanced Transportation Industries and Occupations in California," Centers of Excellence, July 2013, accessed March 21, 2018, [https://www.gcccd.edu/sdic-regional-consortium/documents/consortium/ssvg/altfuel-ind\\_custom\\_ca\\_13.pdf](https://www.gcccd.edu/sdic-regional-consortium/documents/consortium/ssvg/altfuel-ind_custom_ca_13.pdf).

<sup>33</sup> "Alternative Fuels and Advanced Transportation Technologies – Automotive Workforce Needs Assessments," Centers of Excellence, July 2014.

<sup>34</sup> The two sectors are identified in the 2014 study. The transportation cluster overview research conducted in Section I contains industries encompassing automotive repair shops and car dealers, but also wider industry activity for retail, wholesale, and repair and maintenance. The selection of fleets NAICS codes is based on the description of fleet employers in the 2013 and 2014 COE studies. The COE team used the transportation cluster industries in Section I to identify industries that have fleet vehicles. The research in this section targets industries that likely employ a large number of technicians. It is worth noting that while the study does investigate transit systems, it does not investigate public sector employment, which could represent a large employment count for fleet technicians, especially in the Sacramento region.

<sup>35</sup> There are five key occupations in the COE 2014 study. Automotive service technicians and mechanics (O\*Net 49-3023.02) are combined with automotive master mechanics (O\*Net 49-3023.01) in this report because only 6-digit SOC code occupational data is available through EMSI. Staffing patterns for the industries indicate these are indeed the top technician-related occupations for the industries included in this section of the report.

<sup>36</sup> "Alternative Fuels and Advanced Transportation Technologies – Automotive Workforce Needs Assessments," Centers of Excellence, July 2014, pages 27 and 29. The method involved using incidence rates for screening questions about the presence of technician workers who worked on electric and hybrid vehicles.

# MARKET AND POLICY ANALYSIS OF AFVS AND FUELING STATIONS

This section offers a review of regional and national policy and market literature, and data from the U.S. Department of Energy (DOE) Alternative Fuels Data Center. The data provides additional context for the labor market estimates on AFV technicians. The reviewed literature and data indicate dramatic changes taking place with alternative fuel passenger vehicles. This report also provides information on heavy-duty vehicles. (Appendix E provides visual depictions of the data from the DOE.)

Overall findings include:

- Efforts from both automakers and policymakers to increase electric passenger vehicle infrastructure and market adoption appears robust. There were nearly 30 electric and plug-in hybrid car models on the market in 2016. Electric vehicle charging infrastructure is increasing at a dramatically higher rate than any other alternative fuel source (including station types for passenger and heavy-duty vehicles); electric vehicle charging stations now dwarf all other sources of alternative fuel stations.
- The Sacramento region has launched efforts to increase alternative fuel vehicles in public sector fleets. A regional group, the Sacramento Area Plug-in EV (PEV) Collaborative reported on overall efforts made in 2017 in the report, “Electric Vehicle Readiness and Infrastructure Plan.”<sup>37</sup> The city of Sacramento issued its own report around the same time and adopted its own electric vehicle strategy.<sup>38</sup> The reports cite California’s SB 1275 passenger vehicle targets for 2025, and Sacramento’s share of the statewide goals. Infrastructure at public sector facilities comprises one aspect of the effort; the Volkswagen settlement, \$44 million, includes projects to increase charging stations in the region. The reports cite other measures, such as fleet adoption and marketing campaigns.
- Despite emerging infrastructure and availability of electric vehicle car models, electric vehicles comprise only a tiny share of the Sacramento region’s vehicle ownership. Just 1 percent of Sacramento households have a Zero Emissions Vehicle (ZEV), an electric or plug-in hybrid vehicle. This translates to about 6,000 electric passenger vehicles in the six-county Sacramento region, and 3,000 in Sacramento County, as of October 2016. The city reports, however, that half of the city-owned fleet vehicles operate on alternative fuel, suggesting that adoption among fleets and public-sector entities may outpace private ownership, at the same time paving the way for private adoption by supporting infrastructure development.<sup>39</sup>
- National data on transit vehicles (buses) suggests that alternative fuels represent a soon-to-be majority of fuel sources and technology for transit vehicles. About half of all transit buses nationally are alternative fuel vehicles. The use of electric and hybrid buses has grown in recent years. Compressed natural gas and liquified natural gas is the leading source for alternative fuels in buses.

<sup>37</sup> “Electric Vehicle Readiness and Infrastructure Plan,” Sacramento Area PEV Collaborative, June 2017, accessed April 9, 2018, [http://www.cleancityofsacramento.org/uploads/2/7/8/6/27862343/sac\\_county\\_ev\\_inf\\_planfinal\\_6-20-17.pdf](http://www.cleancityofsacramento.org/uploads/2/7/8/6/27862343/sac_county_ev_inf_planfinal_6-20-17.pdf).

<sup>38</sup> “2017 Electric Vehicle Strategy,” City of Sacramento, October 2017, accessed April 9, 2018, [https://www.cityofsacramento.org/-/media/Corporate/Files/Public-Works/Electric-Vehicles/EVStrategy\\_171019\\_PUBLIC\\_DRAFT\\_CityOfSacramento.pdf?la=en](https://www.cityofsacramento.org/-/media/Corporate/Files/Public-Works/Electric-Vehicles/EVStrategy_171019_PUBLIC_DRAFT_CityOfSacramento.pdf?la=en).

<sup>39</sup> Ibid.





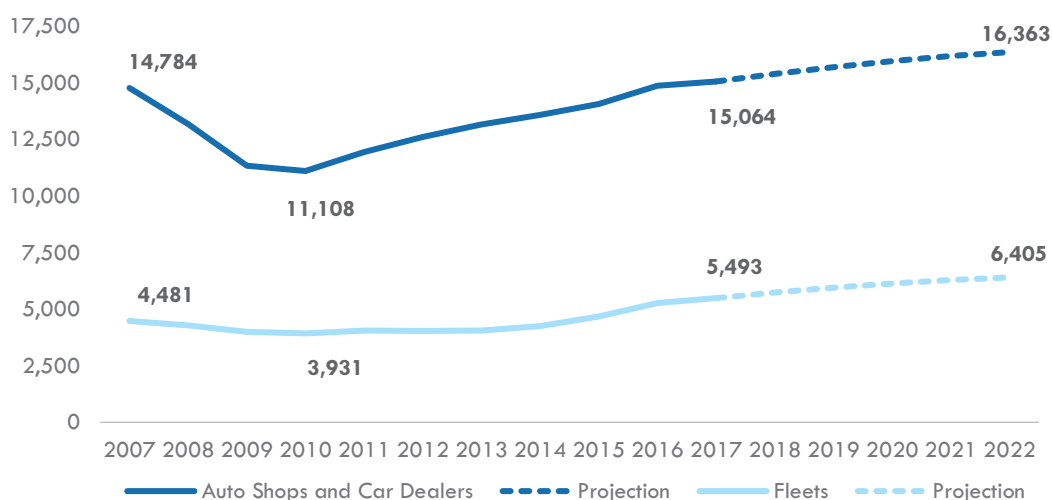
## AUTO REPAIR AND CAR DEALER EMPLOYMENT

Auto repair shops and car dealers employ 15,000 workers and fleets employ 5,500 workers in the Sacramento region.<sup>40</sup> Both sectors' employment levels are higher than 2007 pre-recession levels (Exhibit 30).

Looking ahead, both sectors are projected to add jobs in the region. Auto repair shops and dealers are projected to employ 16,360 workers by 2022; and fleets are expected to employ 6,400 workers by 2022.

Within the auto shop and car dealer sector, new car dealers employ the most workers, 8,400, in the region. The largest fleet industry in the region is ambulance services, employing 1,300 workers. See Appendix B for the industry details for both sectors.

### Exhibit 30: Employment trends for auto shops and car dealers, and fleets in the Sacramento region



<sup>40</sup> The method used to estimate fleet employment focuses on easily identified fleet industries. It does not estimate employment for general industries that may have significant fleet employment. Public sector industries are the main omission. See Appendix B for the complete list of NAICS codes.

# AUTO REPAIR AND CAR DEALER EMPLOYMENT

## EV and AFV Workforce Impacts and Trends

According to the COE's 2014 advanced transportation technology study, employers from both sectors identified four critical middle-skill technician occupations that are heavily impacted by EV and AFV technologies:

- Automotive Service Technicians and Mechanics (SOC 49-3023);
- First-Line Supervisors of Mechanics, Installers and Repairers (SOC 49-1011);
- Bus and Truck Mechanics and Diesel Engine Specialists (SOC 49-3031); and
- Transportation, Storage and Distribution Managers (SOC 11-3071).

The top occupations by employment for auto repair shops and car dealers is automotive service technicians and mechanics (Exhibit 31). Currently, more than 4,000 automotive service technicians and mechanics work for auto shops and car dealers in the region, occupying 27 percent of all jobs in this industry sector. First-line supervisors of mechanics (348 jobs) and bus and truck mechanics and diesel engine specialists (228 jobs) are smaller occupations, representing 3.8 percent of total jobs in the auto shops and car dealers sector in the region.

Within the fleet industries in the region, technician occupations play a smaller role in terms of employment size and percentage of industry employment. Currently, fleet industries in the region employ 114 bus and truck mechanics and diesel engine specialists, accounting for nearly 2 percent of all jobs in the sector. The remaining three occupations employ around 100 workers in the region, representing less than 2 percent of all fleet jobs. These key technician occupations experienced at least 15 percent growth in the two sectors during the past five years and are projected to grow by 9 percent to 20 percent over the next five years.

**Exhibit 31: Employment trends within target industry sectors in the Sacramento region<sup>41</sup>**

Industry Sector	Occupations	Employed in Industry Sector (2012)	Employed in Industry Sector (2017)	Employed in Industry Sector (2022)	% of Total Jobs in Industry Sector (2017)
Middle Skill	Automotive Service Technicians and Mechanics	3,581	4,123	4,451	27.4%
	First-Line Supervisors of Mechanics, Installers, and Repairers	301	348	388	2.3%
	Bus and Truck Mechanics and Diesel Engine Specialists	176	228	274	1.5%
Above Middle Skill	Bus and Truck Mechanics and Diesel Engine Specialists	91	114	125	1.9%
	Automotive Service Technicians and Mechanics	45	59	65	1.0%
	Transportation, Storage, and Distribution Managers	18	23	26	0.4%
	First-Line Supervisors of Mechanics, Installers, and Repairers	17	21	23	0.4%

<sup>41</sup> EMSI; 2018Q1, Staffing Pattern Reports.





# AUTO REPAIR AND CAR DEALER EMPLOYMENT

## Wage Analysis for Key Occupations

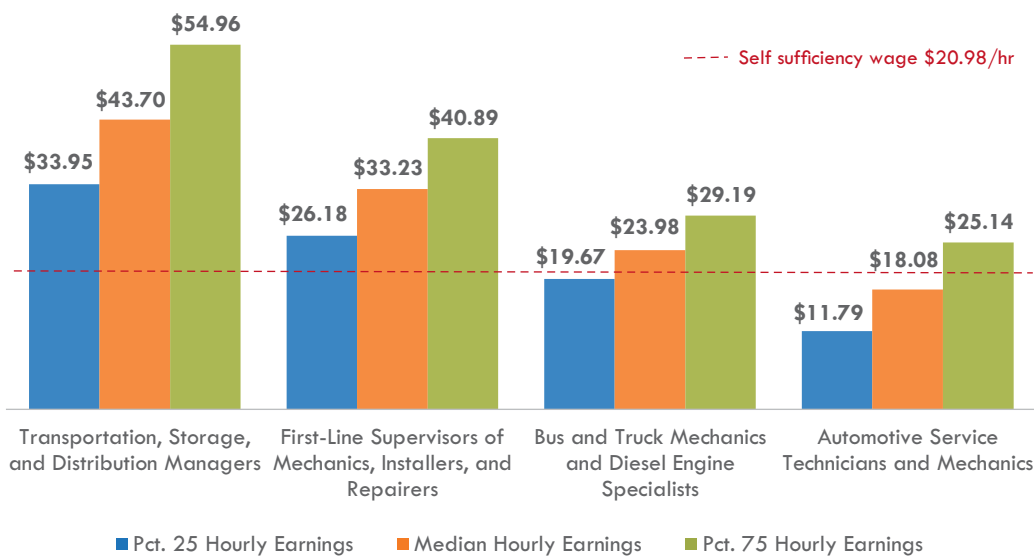
Hourly wages for managers and supervisors are higher than technician occupations (Exhibit 32). Wages for bus and truck mechanics are far higher than for automotive mechanics. Automotive mechanics wages are low, below the self-sufficiency standard for Sacramento County, \$20.98 per hour.

The wage data reveals that transportation, storage and distribution managers earn the highest pay among all four occupations in the region, with a median wage of \$43.70 per hour.<sup>42</sup> First-line supervisors of mechanics earn a median wage of \$33.23 per hour. In fact, even the entry-level jobs in these two groups offer wages that are well above the self-sufficiency wage for Sacramento County, \$20.98 per hour.<sup>43</sup>

In contrast, the other two non-managerial technician occupations pay significantly less than the two manager and supervisor technician occupations mentioned above. Bus and truck mechanics and diesel engine specialists in the region earn a median wage of \$23.98 per hour, slightly higher than the Sacramento County self-sufficiency wage.

The median wage for automotive service technicians and mechanics in the region is only \$18.08 per hour, which is below the self-sufficiency wage used for analysis.

**Exhibit 32: Hourly wages by percentile in the Sacramento region, 2017**



<sup>42</sup> EMSI; 2018Q1, QCEW Employees, Non-QCEW Employees, and Self-Employed.

<sup>43</sup> Self-Sufficiency Standard Tool for California, Living Insight Center for Community Economic Development, <https://insightccd.org/tools-metrics/self-sufficiency-standard-tool-for-california/>. The rate used is for a household of one adult and one child of preschool age.

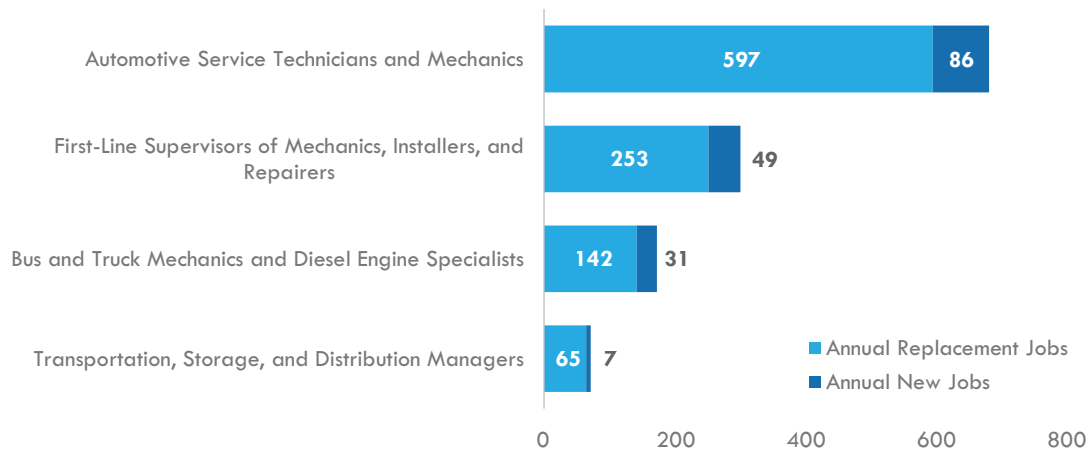


# AUTO REPAIR AND CAR DEALER EMPLOYMENT

Looking ahead, the Sacramento region is projected to have strong demand for automotive service technicians and mechanics, and first-line supervisors of mechanics, installers and repairers (Exhibit 33).

Automotive service technicians and mechanics are projected to have 680 openings annually in the region during the next five years, followed by first-line supervisors of mechanics, installers and repairers (300 annual openings), bus and truck mechanics and diesel engine specialists (173 annual openings), and transportation, storage and distribution managers (72 annual openings).

**Exhibit 33: Projected occupational demand across all industries in the Sacramento region, 2017–2022**



## AFV Workforce Impacts

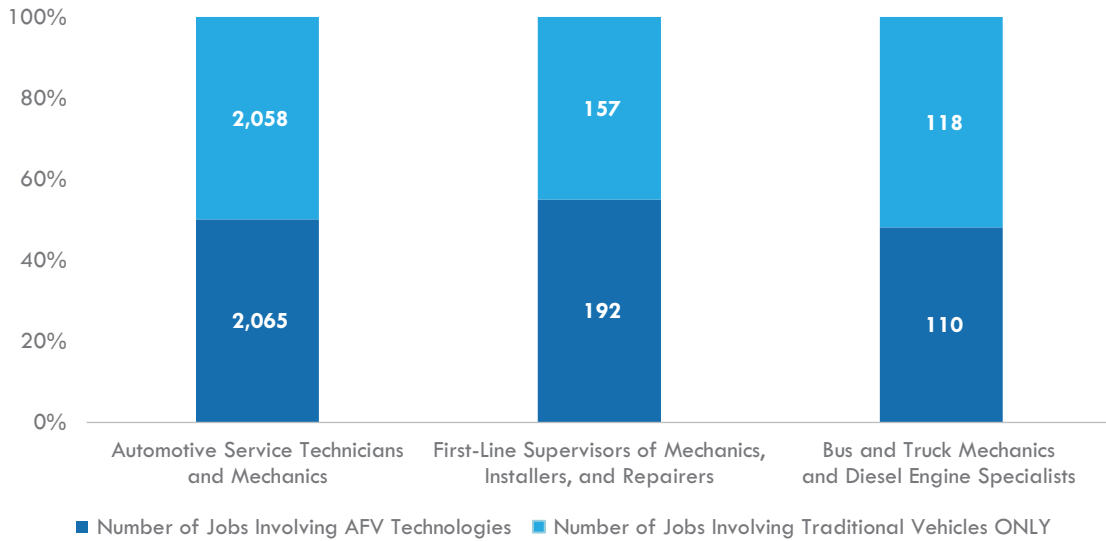
The 2014 COE study identified a ratio of occupational technician and supervisory positions that repaired electric vehicles and alternative fuel vehicles and those that only repaired traditional engines. Using COE’s findings regarding the ratio of occupational employment involving AFV technologies for these four technician occupations, Exhibits 34 and 35 show the current occupational employment estimates for alternative fuels vehicles within the auto shop and car dealer sector, and the fleet sector in the region.<sup>44</sup>

These four occupations are more impacted by AFV technologies in the fleet sector compared to the auto shops and car dealers sector. Three quarters of automotive service technicians and mechanics working for fleet companies work with AFVs, while only 50 percent of workers in this occupation deal with AFVs in auto shops and car dealers. Similar trends are observed across the other three occupations.

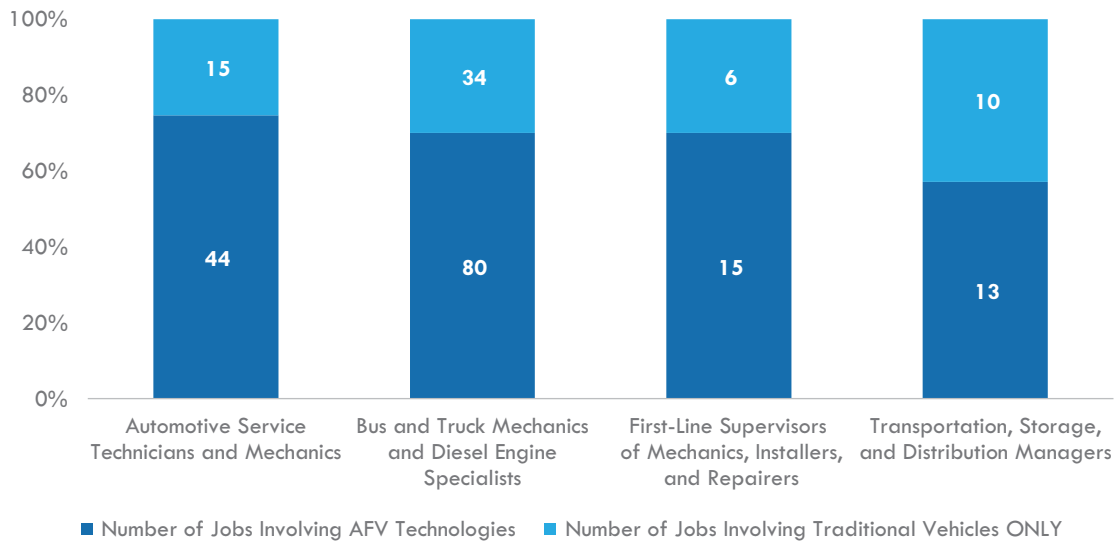
<sup>44</sup> “Alternative Fuels and Advanced Transportation Technologies – Automotive Workforce Needs Assessments,” Centers of Excellence, July 2014.

# AUTO REPAIR AND CAR DEALER EMPLOYMENT

**Exhibit 34: AFV technologies job estimates for the auto shop and car dealer sector in the Sacramento region**



**Exhibit 35: AFV technologies job estimates for the fleet sector in the Sacramento region**





## ALTERNATIVE FUEL JOB POSTINGS

Contrary to the estimates above, the Burning Glass job posting data did not reveal demand for automotive technicians specializing in alternative fuel vehicles in the region or state.

The data analysis turned up more than 230 job postings in the greater Sacramento region over the last 12 months for auto technicians. A tiny fraction of the postings (fewer than five) had any mention of keywords related to alternative fuel vehicles. Searches for the entire state with similar criteria also did not yield many results.<sup>45</sup>

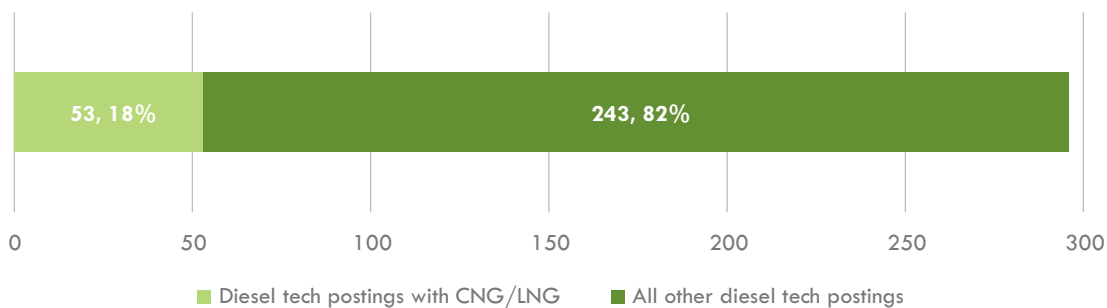
Postings for diesel technicians in the region and state similarly did not produce significant indications of demand for AFV technicians; the criteria used a variety of keywords related to alternative fuel vehicles.<sup>46</sup>

References to compressed natural gas vehicles (CNG) and liquefied natural gas (LNG) yielded postings for diesel technicians from the employer Waste Management in the region and the state.

Of the nearly 300 postings identified in the region for diesel technicians, Exhibit 36 illustrates the share of postings with references to CNG, LNG and batteries (just three of the 53 postings), compared to all diesel vehicle technician postings.

Statewide, the number of postings using the same search criteria yielded approximately 300 postings referencing CNG/LNG. Waste Management was the major employer; few other employers had job postings for AFV diesel mechanics.

### Exhibit 36: Job postings for diesel technicians with references to alternative fuel vehicles in the Sacramento region



<sup>45</sup> Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool," accessed April 2018. The data pulls included filters for job titles specifically related to automotive technicians and mechanics. Keyword filters included: "hybrid," "electric vehicle," "plug-in," "flex fuel," "ethanol," "battery" and "biodiesel."

<sup>46</sup> Ibid. The search criteria filtered by the Burning Glass occupational code for diesel technician and the specific job titles produced a representative sample of postings for vehicle diesel mechanics. Keywords included: "fuel cell," "hydrogen," "electric" (referring to AFV, not basic systems), "hybrid" and "biodiesel."





## EDUCATIONAL SUPPLY

Exhibit 37 displays the three-year annual average completions for the TOP codes related to automotive, motorcycle and diesel technologies.<sup>47</sup> Universal Technical Institute, a for-profit school in Sacramento, produces on average 762 graduates in this area, far exceeding the total number of graduates from the community colleges in these program areas.

American River College, Cosumnes River College, Yuba College and Sierra College offer programs in automotive technology (TOP code 094800). Universal Technical Institute's programs are coded under automobile/automotive mechanics (TOP code 470604).

Sacramento City College conferred one award on average in small engine repair. In total, education providers in the Sacramento region conferred on average more than 1,000 awards annually for automotive and diesel technology.

Determining the number of awards specific to electric vehicles and alternative fuel vehicles did not fall into the scope of the research.

### Exhibit 37: Annual average award completions related to automotive technicians, 2014–2017

Educational Provider	094800 – Automotive Technology	094830 – Motorcycle, Outboard and Small Engine Repair	47.0604 – Automobile/ Automotive Mechanics Technology/ Tech	094700 – Diesel – Technology	47.0605 – Diesel Mechanics Technology/ Technician	Subtotal
American River	97			49		146
Cosumnes River	109					109
Yuba	23					23
Sierra	26					26
Sacramento City		1				1
Shasta				10		10
Universal Technical Institute of Northern California Inc.			611		151	762
<b>TOTAL</b>	<b>255</b>	<b>1</b>	<b>611</b>	<b>59</b>	<b>151</b>	<b>1,067</b>

<sup>47</sup> COE Supply Tables, California Community Colleges Chancellor's Office Data Mart.



# EDUCATIONAL SUPPLY

The COE reviewed college catalogs and program websites to identify courses specifically related to electric vehicles and alternative fuel vehicles. Exhibit 38 outlines the courses by college.

American River College houses a sizeable program in clean diesel technology for light-duty and heavy-duty vehicles. It also offers courses on alternative fuel passenger car technology.

Cosumnes River College, Yuba College and Sierra College provide automotive courses on hybrid and electric vehicles.

The COE only identified one course having to do with alternative fuels at Universal Technical Institute.

## Exhibit 38: Alternative fuel courses by education and training institution

Educational Provider	Program Name	Alternative Fuels Courses
American River College	Automotive Technology	AT 307 Biodiesel Technology
		AT 309 Introduction to Hybrid and Electric Vehicle Technology
		AT 316 Alternative Fuels and Advanced Technology Vehicles
		AT 156 Light Duty Diesel/Green Diesel Technology
		AT 157 Advanced Light Duty Diesel/Green Diesel Technology
	Clean Diesel/Hybrid/Management Technology Certificates	DCDT 102 Biodiesel Fuel and Fuel Systems
		DCDT 103 Clean Diesel Systems
		DCDT 104 Clean Diesel Rebuild, Retrofit, Repower, Retire
		DCDT 112 Clean Diesel Retrofit
		DCDT 109 Hybrid Diesel Component Application
		DCDT 113 Diesel Hybrid Motor Generators
		DCDT 107 Hybrid Diesel Power Trains
		DCDT 108 Hybrid Diesel High Voltage Systems
DCDT 162 Clean Diesel Software Support		
Cosumnes River	Automotive Mechanics Technology	AMT 305: Survey of Alternative Fueled & Hybrid Vehicles
		AMT 321: Advanced Automotive Electrical & Hybrid Vehicle Systems
		AMT 323: Alternative Fueled-Hybrid Vehicle Safety-Service
Yuba	Automotive Technology	AUTO 80: Fundamental of Hybrid/Alternative Fuel Vehicles
		AUTO 81: Hybrid/Alternative Fuels Vehicles for Service Technicians
Sierra	Automotive Technology	AUTO 0058: Introduction to Hybrid and Electric Vehicle Technology
Universal Technical Institute of Northern California Inc.	Automotive/Diesel Technology II	AT 12-204: Advanced Technology/Hybrid & Service Advising

# ALTERNATIVE FUEL SUBCLUSTER SUMMARY

## General Findings for the Vehicle Technician Workforce:

- In the Sacramento region, there are 4,700 workers in the three occupations that comprise the technician workforce in the auto repair shop and dealer sector. Industries employing auto technicians employed 15,000 workers in 2017 in the Sacramento region. Auto technician employment in these industries is projected to grow by 1,000 jobs over the next five years. The industry data presented in the cluster findings and this section of the report demonstrates that automotive technology is a key area of the transportation sector.
- The total size of fleet technician employment is not clear. Employment analysis of four target occupations in the fleet sector revealed that 217 workers are employed in the region. The numbers are likely much higher given the dominance of public sector industries in the region, which have fleet vehicles and service centers. (Note: The research did not include public sector fleet technicians.)
- Major occupational demand will be for automotive service technicians, the occupation comprising most of the vehicle technician workforce. Projected annual openings total nearly 700 for the Sacramento region. On the supply side, private providers and community colleges confer 870 awards annually for auto technicians.
- There are fewer than 200 projected openings for bus and truck mechanics and diesel engine specialists. American River College and Universal Technical Institute supply the diesel technicians in the region according to the available data—about 200 annual awards on average. A review of curriculum found that American River College is the major player in the region for alternative fuel diesel vehicles. The college offers coursework in hybrid, biodiesel and clean diesel.
- Hourly wages for managers and supervisors are higher than technician occupations. Wages for bus and truck mechanics is far higher than for automotive mechanics. The technician manager jobs pay wages between \$20 per hour and \$40 per hour. Automotive mechanics wages are low, below the self-sufficiency wage for Sacramento County, posing a concern for the hundreds of students exiting these programs.

## General Findings for the AFV Workforce:

- Data for the current AFV stations in California indicates that electric charging stations make up a huge majority of AFV stations (nearly 5,000). The next most common is compressed natural gas (330), and propane (300). CNG and LNG stations mostly serve heavy duty vehicles, which echoes the job posting data for diesel technicians. National data suggests electric vehicle charging stations have increased dramatically in the last five years. The number of electric and other AFV passenger vehicles has also risen remarkably. The number of transit buses nationally using AFV has reached a majority share.
- California has a disproportionately large share of AFV stations—70 percent of hydrogen, 25 percent of electric and LNG, and 20 percent of CNG. California also represents a large share of several national vendors' electric vehicle charging stations—ChargePoint, Tesla and Blink Network.
- Estimates using COE survey data suggest that three quarters of fleet vehicle technicians repair alternative fuel vehicles, while half of the technicians in auto shops and dealerships do so. The four occupations studied are more impacted by AFV technologies in the fleet sector compared to those occupations employed by auto shops and car dealers. The estimation method suggests that approximately 2,500 jobs are impacted by AFV technologies within those four occupations in the region.
- Analysis of technicians in the four occupations across all industries, not just the industries studied, reveals a projected annual demand of more than 1,200 workers in the Sacramento region. If increased market penetration, especially from electric vehicles, requires substantial skill development, the demand projections suggest there could be a significant increased demand for skills training to repair and maintain passenger, heavy-duty and fleet vehicles.

# ALTERNATIVE FUEL SUBCLUSTER SUMMARY

## Findings for the Automotive AFV Technician Workforce:

- Given the small size of the passenger (light duty) electric vehicle market, the likelihood is that more auto technicians are impacted by hybrid vehicles than electric vehicles. Despite the growth of charging stations and available models, the current market share for electric and plug-in hybrid vehicles is tiny. Electric vehicles represent a fraction of the market, though national data suggests the number of stations are growing quickly as are the number of car models. There are roughly 3,000 electric vehicles on the road in Sacramento County, representing about 1 percent of households in the city of Sacramento.
- The data suggests the electric vehicle marketplace has potential to grow, and the community colleges should stay abreast of these trends given the scale of policy and marketplace efforts to increase charging infrastructure; indeed, the vehicle technology appears to be widely available. The number of electric passenger vehicle models on the market has grown from one to nearly 30 in the last 10 years.
- Nationally, the number of electric vehicle charging stations (plugs) has grown exponentially from 3,000 stations (plugs) in 2011 to 42,000 in 2016. E85 (ethanol flex-fuel) accounts for a much smaller share of growth of alternative fuel stations nationally.
- The job posting data confounds the assumptions regarding demand for automotive service technicians using the impact estimates. There were few references to alternative fuel vehicles in job postings for auto technicians and mechanics in the Sacramento region and across the state. The variability in job postings, estimates and market data indicates continued engagement with employer partners is needed to determine needed skills now and in the coming years.

## Findings for the Fleet and Heavy-Duty AFV Technician Workforce:

- The impact of alternative fuel vehicles may be higher for fleet technicians for both automotive vehicles and medium and heavy-duty vehicles. The city of Sacramento reports that half of its fleet vehicles are alternative fuel vehicles. Nationally, about half of transit buses run on alternative fuels.
- Job posting data partly challenges the AFV occupational impact estimates using the COE's 2014 study, which provides a high estimate. Waste Management job postings for diesel technicians mention compressed and liquefied natural gas as a small part of overall knowledge and skill requirements. These postings represent fewer than 20 percent of the postings for diesel technicians in the last 12 months.
- Statewide there is a more diverse pool of employers seeking technicians with skills related to CNG and LNG, but the number of postings is small, just over 300 in the last 12 months. Other technology keyword searches did not produce results. The number of other AFV fuel stations (hydrogen, CNG/LNG, propane) has not grown substantially at the national level. The data on transit buses suggests that about half of buses use alternative fuels.
- Overall, more engagement with students exiting programs, especially American River College's clean diesel program, and employer engagement is needed to determine specific skill needs for alternative fuel medium-duty and heavy-duty vehicles.



## ALTERNATIVE FUEL SUBCLUSTER SUMMARY

### Findings on Educational Supply for Vehicle Technicians and AFV Technicians:

- It is not unusual for a gap analysis to show oversupply across California for automotive service technicians. Community college programs typically have strong employer relationships and experienced, dedicated faculty. American River College, Cosumnes River College, Yuba College and Sierra College offer programs. These programs are long standing and have robust completion data. It appears that the colleges have a more robust AFV curriculum than Universal Technical Institute. American River College offers the most courses of any regional college.
- Universal Technical Institute, a private provider, shows the most awards, more than 600 annually in the Sacramento region. Anecdotally, some of the completions registered are for students whose permanent residence is outside the Sacramento study region.

### Additional Notes on Other Positions Related to EV Charging Infrastructure:

The Los Rios Community College District's CTE leadership team additionally requested labor market information on positions related to electric vehicle charging stations.

The research determined that installation, maintenance and repair is performed by journey-level and licensed electricians. Review of job postings and report literature did not indicate a significant, specific demand for positions related to electric vehicle charging infrastructure beyond the electrician workforce. Given the workforce shortage in the construction industry, it would not be surprising to find that companies installing and maintaining charging stations have a hard time finding electricians. Nonetheless, the research did not identify any special need for a new skill set, or a specialized workforce.

- Tesla job postings from across California suggest that licensed electricians comprise the electric vehicle charging station technician labor market. According to the postings, electrician duties include many other tasks besides electric vehicle charging stations. Report data supports the finding that electricians are the primary workers who install and maintain charging stations.
- Anecdotally, ChargePoint is exploring training and hiring junior electrical technicians to service charging stations given the shortage of journey-level electricians.



# SECTION V: EMERGING TECHNOLOGY & SPECIAL TOPICS

The Los Rios Community College District CTE leadership team requested analysis of several emerging areas and special topics, including autonomous vehicles, drones and nondestructive testing.

## AUTONOMOUS VEHICLES & ADVANCED DRIVER ASSISTANCE SYSTEMS

Generally, autonomous vehicle technology fits into two categories:

1. Current features for luxury cars (parking assistance, collision avoidance) and automated features in heavy-duty trucking; and
2. Future developments for fully-automated, driverless and self-driving cars and trucks for which research and development is currently underway.

The first category may have immediate and lasting impacts on vehicle technician workforce training for skills development; current technicians and industry observers know what skills and knowledge is needed now since the technology is widely available.

The second category has an unclear technician workforce impact; the timeline for large-scale commercialization and adoption of fully autonomous driverless vehicles is not clear. Research and reporting exists in the realm of market and policy timeline estimates. Most reporting and news summaries focus on potential workforce impacts in terms of displacement of vehicle operators.

The COE did not identify literature on the implications of autonomous driver technology for the vehicle technician workforce. Instead, the key findings below summarize analysis of job postings and a literature review:

- A 2017 Department of Commerce report suggests fully autonomous vehicles could be widespread within five to 10 years. (The report focuses on potential future workforce impacts related to displacement.) The report predicts that workers whose primary task is routinized vehicle operation will be most impacted, and that these workers tend to be older and lower skilled than workers whose secondary duties involve driving. The report notes the workforce impact could be massive, including job creation in some cases. The report discusses potential scenarios wherein drivers pick up vehicles at transfer hubs when complex operation in urban areas would be needed off major highways.<sup>48</sup>
- The job posting data offered scant evidence that advanced driver assistance systems (ADAS) impact vehicle technicians. Numerous keyword searches yielded little evidence that there is current demand for skills related to autonomous vehicles or advanced driver assistance systems (ADAS) in passenger or heavy-duty vehicles. There is evidence from the overall literature and review of job postings that truck drivers commonly use these systems—collision avoidance, automatic braking systems, etc. Most postings for related keywords call for software programmers and engineers for product and research development.<sup>49</sup>

<sup>48</sup> Beede, David, Regina Powers and Cassandra Ingram, "The Employment Impact of Autonomous Vehicles," U.S. Department of Commerce Economics and Statistics Administration Office of the Chief Economist, August 11, 2017, accessed April 9, 2017, [http://www.esa.doc.gov/sites/default/files/Employment%20Impact%20Autonomous%20Vehicles\\_0.pdf](http://www.esa.doc.gov/sites/default/files/Employment%20Impact%20Autonomous%20Vehicles_0.pdf).

<sup>49</sup> Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool," accessed April 2018.

# AUTONOMOUS VEHICLES & ADVANCED DRIVER ASSISTANCE SYSTEMS

- Anecdotally, the cameras and sensors in luxury cars and highway trucks that offer lane and collision avoidance and other automated features may require some additional skills training for programming computerized systems and high voltage safety. Since the technology is currently in use and widespread, industry partners will know what the current needs are for skill requirements and enhancements.
- News reports and various agencies have written extensively about the implications of the arrival of fully autonomous vehicles. The timeline to widespread adoption has been moved up compared to several years ago, when industry representatives and policymakers predicted widespread adoption would be decades away. Several companies are engaged in autonomous vehicle testing in California; news reports and the Department of Motor Vehicles (DMV) website suggest driverless testing permits will begin in April 2018.<sup>50</sup>
- The National Science Foundation awarded Dayton Community College in Ohio an instructor training grant for autonomous vehicle technology in 2017; the award will sunset in early 2020. It is unclear if community colleges in California have adopted related curriculum in vehicle technician programs, or if there are efforts underway to develop curriculum needed for electrical safety, programming or other skills these systems may require.<sup>51</sup>

Overall, the research did not reveal any specific, immediate workforce development investment priorities or skills training needs deriving from new technology. The community colleges should engage employers to identify needs arising from technological features on heavy-duty vehicles and luxury cars.

## DRONES & UNMANNED AIRCRAFT SYSTEMS

The community colleges appear poised to expand recent investments into training and education programs for drone technology. A variety of terms for drones is employed in the literature and reports, including variations on the term “unmanned aircraft systems” (UAS). Through their own press releases and related media coverage, the community colleges have generally positioned investments into two categories: 1) piloting programs aligned with Federal Aviation Administration (FAA) requirements, targeting an area of perceived workforce need, such as photography or logistics; 2) a knowledge and skill development opportunity akin to robotics or maker spaces. The second opportunity appears to be in developing programming, electronics and other skills that align with STEM fields.

A literature review and analysis of job postings revealed the following key findings:

- Burning Glass analysis indicates that engineering and software positions for research and product development mainly comprise employment related to drones. However, there are a host of other positions related to drones, such as media production, piloting, sales, project management and manufacturing. No position category emerged from the job posting analysis, challenging assumptions about skill needs or specific workforce demand. In short, there is no clear demand for a position that would be called, “drone pilot,” “drone technician,” or the like.<sup>52</sup>
- Statewide searches in Burning Glass yielded job postings from aerospace manufacturing defense contractors such as Northrup Grumman and General Atomics for engineering, piloting and technician positions related to drones. The scale of requirements suggests these are drones for military and industrial use, not small devices referred to as small unmanned aircraft systems (sUAS). Requirements appear extensive, far beyond what a program of two years or less would provide.<sup>53</sup>

<sup>50</sup> “Driverless Testing of Autonomous Vehicles,” California Department of Motor Vehicles, 2018, accessed March 20, 2018, <https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto>.

<sup>51</sup> Ibid.

<sup>52</sup> Burning Glass Technologies, “Labor Insight Real-Time Labor Market Information Tool,” accessed April 2018.

<sup>53</sup> Ibid.

# DRONES & UNMANNED AIRCRAFT SYSTEMS

- A report from PwC predicts drone use and investment across a multitude of industries including infrastructure (roads and railways), agriculture, transportation, security, media and entertainment, insurance, telecommunications and mining. The PwC report focuses on investment monitoring, asset inventory and maintenance and notes that drones can quickly and accurately perform site surveys, testing of roads and bridges, and that cameras integrate with 3D modeling software like BIM. Drones can quickly perform inventories of railyards and shipping ports by scanning barcodes and radio frequency tags. The report does not offer evidence of a widespread, present workforce need that would warrant workforce training programs in the short term.<sup>54</sup>
- There is no shortage of press releases from community colleges, CSUs and UCs announcing drone programs and partnerships.<sup>55</sup> In 2016 Grossmont College announced a drone technology program.<sup>56</sup> San Bernardino Community College District has expressed interest in partnering with the planned “National Commercial Drone Research Center” at the San Bernardino International Airport.<sup>57</sup> And Miramar College plans to offer new courses on drone operations courses as early as fall 2018.<sup>58</sup> Many, but not all, of the colleges and universities developing or offering programs are in Southern California, where the aerospace industry has a strong presence.
- The Federal Aviation Association (FAA) credentialing requirements and other regulations are the basis of some piloting training programs. Another apparent angle for program development places drones alongside robotics and other advanced manufacturing programs. Again, the labor market outlook based on these regulations is unclear.<sup>59</sup>
- The Advanced Transportation Sector Navigator and the Deputy Sector Navigators are actively engaged in supporting drone equipment purchases, setting up faculty and student demonstrations and holding faculty trainings as part of the Clean Energy and Transportation Initiative (CETI) which they sponsor.<sup>60</sup>

The community college drone programs are not uncommon. Press releases and news reports indicate that the community colleges have invested in drone programs for two reasons: potential piloting or operator jobs that may exist in the future; and the technology’s connection to STEM education, similar to robotics or maker spaces, for example.

Still, as an emerging technology whose use is not yet widespread, normalized or standardized, the implications for workforce and CTE program development are not clear from the point of view of specific labor market needs that employers would be able to articulate. The positions needed and skills required for these positions remains unclear. While there will likely be future workforce impacts, identifying and quantifying current demand is not possible.<sup>61</sup>

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<sup>54</sup> “Clarity from above: Transport Infrastructure,” PwC, January 2017, accessed April 10, 2018, <https://www.pwc.pl/pl/pdf/clarity-from-above-transport-infrastructure-pwc-report.pdf>.

<sup>55</sup> Coghlan, Ed, “California colleges adapt to training workforce for autonomous, flying future,” CA FWD, May 30, 2017, <http://cafwd.org/reporting/entry/california-colleges-adapt-to-training-workforce-for-autonomous-flying-futur>.

<sup>56</sup> “Grossmont moving ahead with drone technology program,” Grossmont-Cuyamaca Community College District, December 5, 2016, accessed April 10, 2018, <https://www.gcccd.edu/news/2016/12/05-drone-technology-workshop.html>.

<sup>57</sup> Decillis, M. Daniel, “California maneuvers to stay on the cutting edge of drone research,” California Council on Science and Technology, July 21, 2016, accessed April 10, 2017, <http://ccst.us/news/2016/0708drones.php>.

<sup>58</sup> “Drone program headed for takeoff,” San Diego Community College District, May 23, 2017, accessed April 10, 2017, <https://www.sdccd.edu/about/departments-and-offices/communications-and-public-relations/newscenter/articles/miramar-aviation-operations-drone-2017.asp>.

<sup>59</sup> “Unmanned Aircraft Systems (UAS) Frequently Asked Questions,” Federal Aviation Administration, February 1, 2018, accessed April 10, 2018, <https://www.faa.gov/uas/faqs/>.

<sup>60</sup> “Drone Partners,” The Clean Energy and Transportation Initiative, 2018, accessed April 10, 2018, <http://www.atreeducation.org/drone-partners/>.

<sup>61</sup> Woyke, Elizabeth, “Colleges are marketing drone pilot courses, but the opportunities are murky,” MIT Technology Review, October 4, 2017, <https://www.technologyreview.com/s/608968/colleges-are-marketing-drone-pilot-courses-but-the-career-opportunities-are-murky/>.

# NONDESTRUCTIVE TESTING OVERVIEW

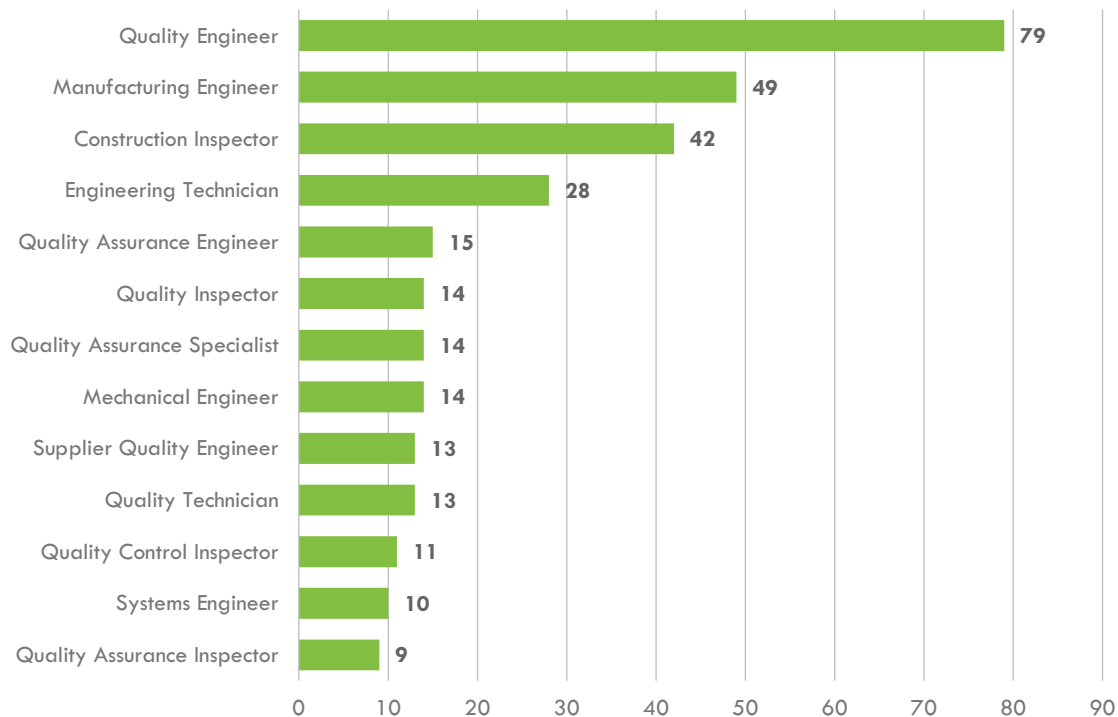
Nondestructive testing (NDT) is the term given to an array of methods and technology that enable safety and quality testing for a variety of industries including architecture and engineering, manufacturing involving steel, fossil fuel production, warehousing and distribution, industrial repair and maintenance, and aerospace manufacturing.

Testing and inspection use a variety of equipment—such as X-rays, fiber optics, ultrasound and magnetic particle testing—to conduct quality control and inspections. The COE conducted research for this study to assess the demand for nondestructive testing in job posting data across the state of California.<sup>62</sup>

## NONDESTRUCTIVE TESTING JOB POSTINGS

Job postings from the last 12 months related to nondestructive testing in California were analyzed. Job titles in postings requesting nondestructive testing as a skill mostly include positions that involve quality control and assurance, and inspection. Top job titles were quality engineer, manufacturing engineer and construction inspector (Exhibit 39).

**Exhibit 39: Top job titles requesting nondestructive testing as a skill**



<sup>62</sup> Burning Glass Technologies, "Labor Insight Real-Time Labor Market Information Tool," accessed April 2018. Criteria included nondestructive testing (NDT) as a skill. The criteria excluded the occupation Radiology Technician and the following industries: Insurance Carriers, Medical and General Hospitals, Employment Services, and Medical and Diagnostic Laboratories. Though Nondestructive Testing has an application in healthcare, the research questions relate to manufacturing and engineering; medical and health-related searches did not yield job postings for positions whose role was focused on materials testing, engineering, or manufacturing.



# NONDESTRUCTIVE TESTING JOB POSTINGS

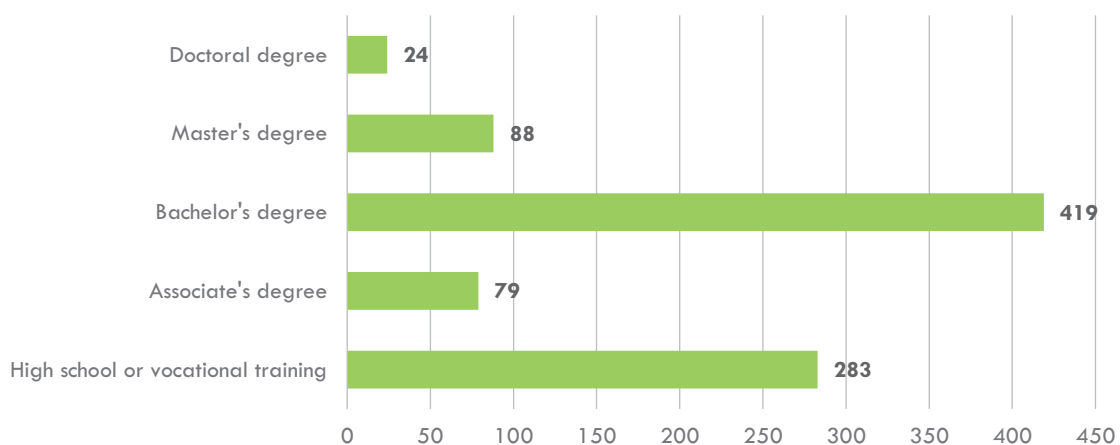
Security clearance was the top certification in job postings requesting nondestructive testing as a skill (Exhibit 40). Another top certification is AWS certified welding inspector, which likely refers to certification through the American Welding Society. ACI field testing technician may refer to the American Concrete Institute's concrete field testing certification. The certified ambulatory perianesthesia nurse certification shown in the chart should be disregarded because it is likely the result of a problem with the search criteria and algorithm.<sup>63</sup>

**Exhibit 40: Top certifications in job postings requesting nondestructive testing as a skill**



The largest share of job postings requesting nondestructive testing as a skill prefer or require a bachelor's degree, followed by high school or vocational training (Exhibit 41).

**Exhibit 41: Education levels in job postings requesting nondestructive testing as a skill**

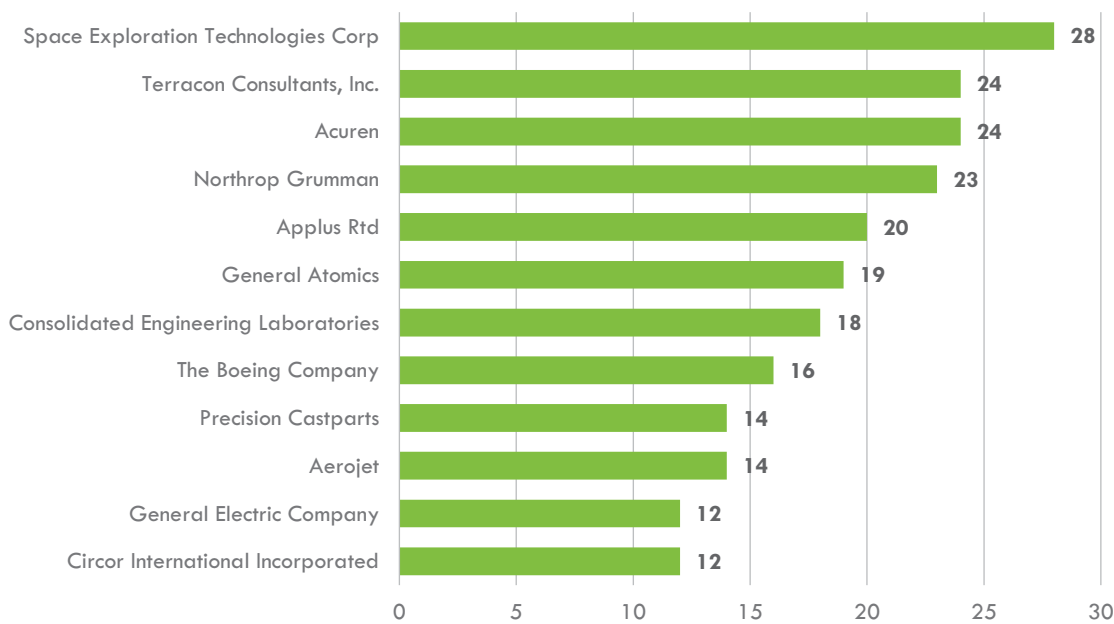


<sup>63</sup> Again, multiple search criteria sought to filter out health-related occupations for NDT, due to the number of unrelated results.

# NONDESTRUCTIVE TESTING JOB POSTINGS

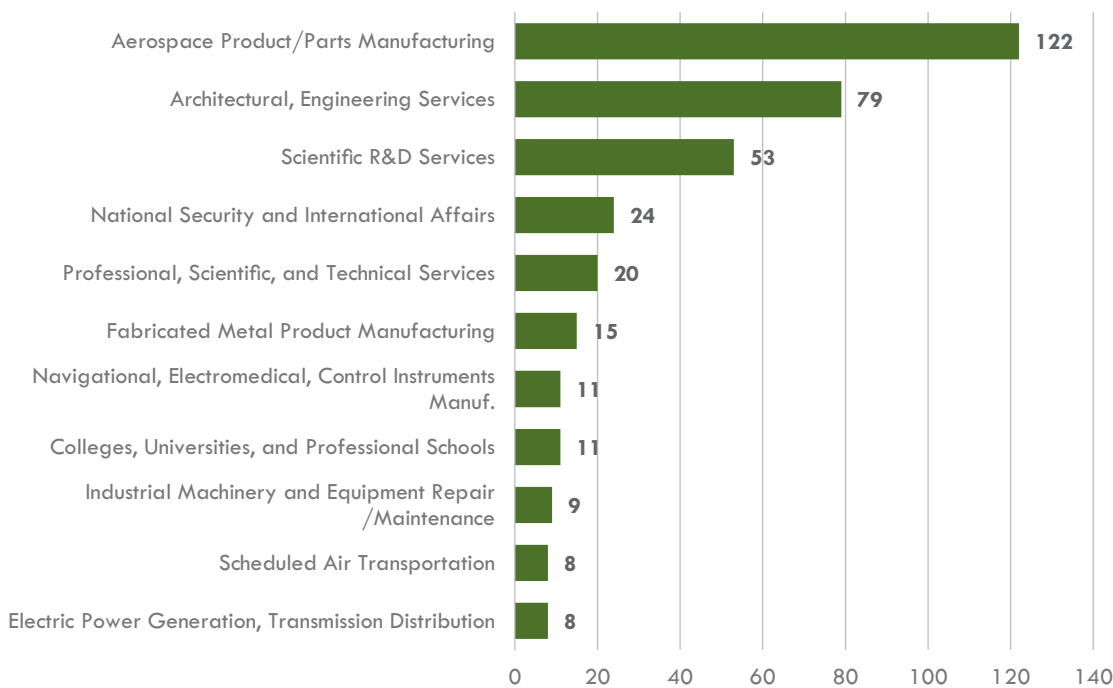
The top three employers requesting nondestructive testing skills are Space Exploration Technologies Corp. (SpaceX), Terracon Consultants Inc. and Acuren (Exhibit 42). While some of these firms are aerospace companies, others specialize in other areas, such as Terracon, which provides environmental, facilities, geotechnical and materials consulting and engineering services. Acuren provides NDT testing, inspection, engineering and rope access-enabled industrial services.

**Exhibit 42: Top employers in job postings requesting nondestructive testing**



Top industries requesting nondestructive testing skills include aerospace product/parts manufacturing, architectural/engineering services and scientific R&D services (Exhibit 43).

**Exhibit 43: Top industries in job postings requesting nondestructive testing as a skill**

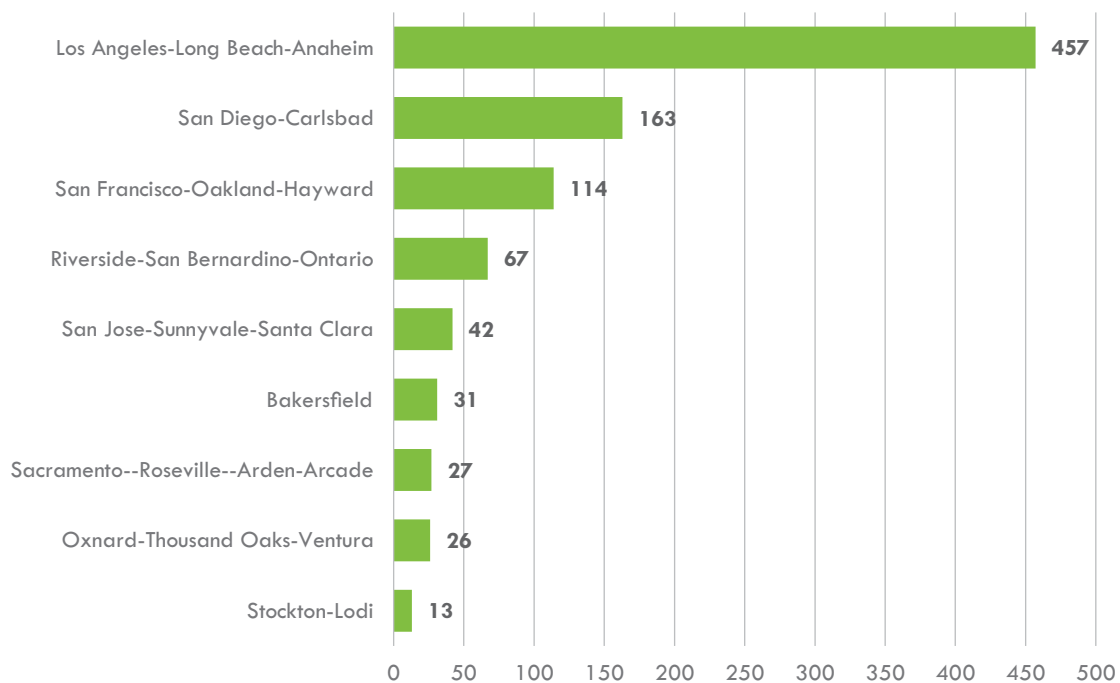




## NONDESTRUCTIVE TESTING JOB POSTINGS

The job posting analysis also focused on the metropolitan statistical areas (MSAs) with the greatest concentration of job postings requesting nondestructive testing as a skill (Exhibit 44). Many of the locations are in Southern California, where aerospace firms have a strong presence. The top two MSAs are Los Angeles-Long Beach-Anaheim and San Diego-Carlsbad. The third top location in the state is San Francisco-Oakland-Hayward.

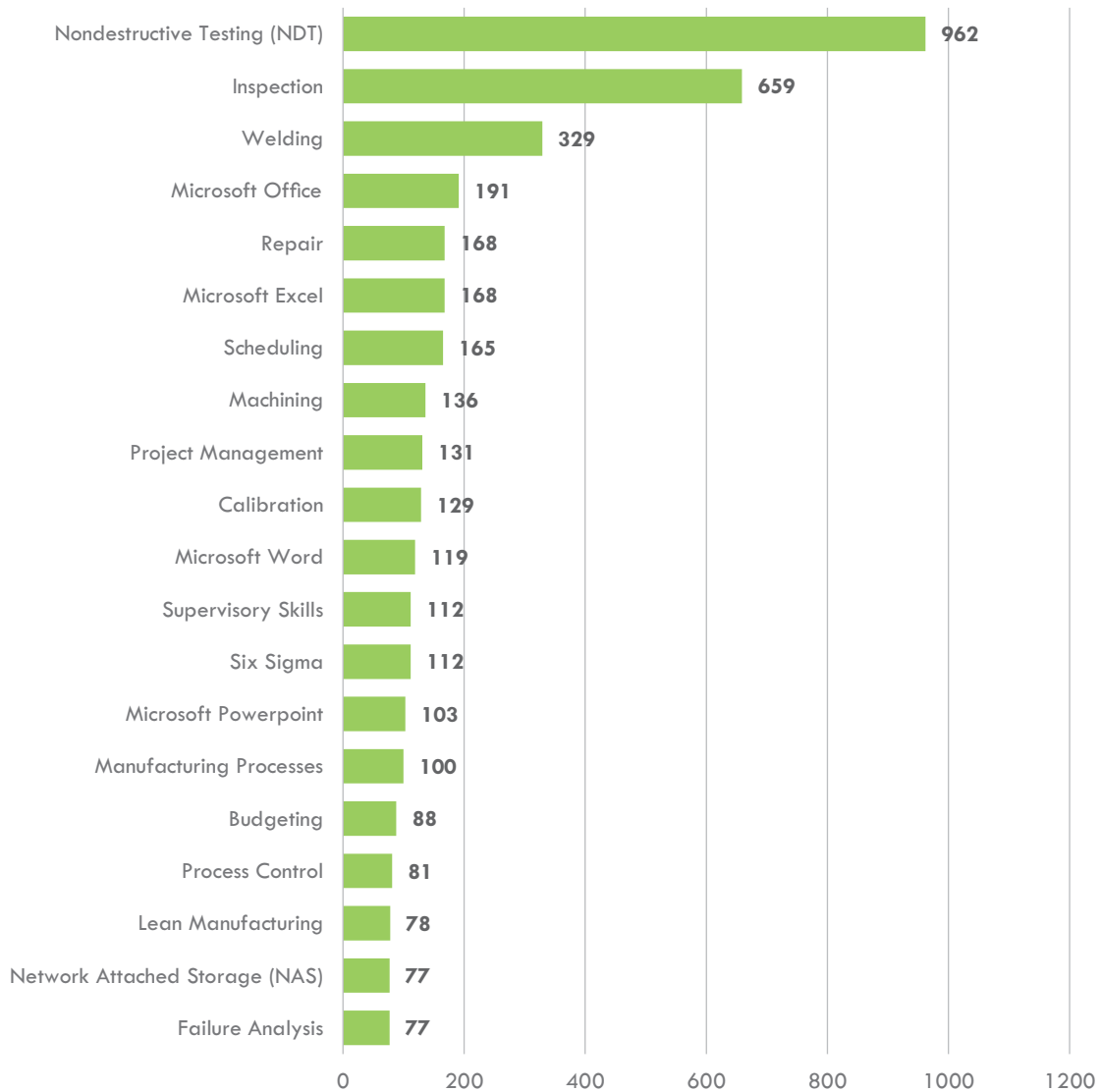
**Exhibit 44: Top California MSAs in job postings requesting nondestructive testing as a skill**



# NONDESTRUCTIVE TESTING JOB POSTINGS

Aside from nondestructive testing, the top skills that appeared in related job postings were inspection, welding and Microsoft Office (Exhibit 45). Some of the skills shown in the chart below are related to manufacturing, such as welding, machining and repair (calibration). Other skills are related to process management, such as Six Sigma.

**Exhibit 45: Top skills in job postings requesting nondestructive testing as a skill**







## NONDESTRUCTIVE TESTING SUMMARY

Key findings include:

- A variety of industries show concentrations of job postings for positions requiring nondestructive testing skills, including architecture, engineering, repair and maintenance, manufacturing, research and development, and scientific and technical services.
- Most of job postings that cite NDT are in aerospace and aeronautics-related industries. These industries, and consequently the location concentration of the postings, strongly favor Southern California. Considering both the concentration of aerospace manufacturing in Southern California, and the decline of aerospace in the Sacramento region, the community colleges should consider the extent of the need for NDT skills in other industries listed in the job postings findings.
- The skills and job titles from the postings suggest NDT is not a job by itself, but a skill among many required for quality control and inspection positions. The most common job titles for positions requesting NDT skills include quality and assurance, engineer and inspector. Alongside NDT skills, manufacturing-related skills were commonly cited, including welding, inspection, project management and operations processes (Six Sigma).
- Preferred or required education levels most commonly cited are bachelor's degrees and high school or vocational training, suggesting a wide variety of skill levels and education levels that utilize NDT skills. Professional credentials are common requirements for these positions, including NDT-specific credentials. The community colleges should explore NDT-related credentials that are commonly asked for from employer partners and that transfer between companies and industries.
- The job posting analysis did not find conclusive evidence that NDT is an in-demand skill. Occupational demand analysis was challenging for these reasons: The SOC system has an emerging category for NDT specialists, but the category is not counted in occupational surveys per se; and the quality control and assurance, and inspection titles in the job postings indicate that NDT-related activity is counted across numerous SOC codes, including several emerging and "other" categories.
- The community colleges should continue engaging partners across a variety of industries to determine requirements for credentialing and skill development.

# APPENDIX A: METHODOLOGY

A cluster is a group of industries that share suppliers, workforce resources and other assets. Economists have analyzed clusters to compare regions, showing what specializations give a competitive edge, and generate wealth in specific geographies. From a workforce development standpoint, clusters represent targets for analysis and partnership since the industries likely share similar types of workers (knowledge, skills and abilities). Here, the term “subcluster” is a subunit of analysis that represents similar features to the cluster (industry relationships and other assets), but at a more specific level.

Within each cluster, the report refers to “traded” and “local” subclusters. Traded subclusters or industries refer to industries that sell products and services outside the region, generally having high rates of productivity and output, which translates into higher earnings. Local clusters primarily serve the region and tend to have lower productivity, output and earnings.

The transportation cluster section incorporates research methods using labor market data from the Bureau of Labor Statistics (BLS) and U.S. Census Bureau data from EMSI to evaluate historical and projected trends for transportation employment. The study used cluster definitions from the U.S. Cluster Mapping Project to identify additional transportation-related industries including automotive manufacturing, automotive wholesale/retail, auto repair and maintenance, air transportation, water transportation, logistics and services, transit systems and transportation systems.

The transportation cluster section identifies additional industries under NAICS 48-49 that are related to this study. These industries include rail transportation, water transportation, transportation systems, and logistics and services.

The Aeronautics and Railroad Operations programs at Sacramento City College form the primary backdrop for the reporting within the aeronautics and rail sections. No other community colleges in the Los Rios Community College District have programs for aeronautics and railroad operations.

In addition, the COE team used cluster research methods for the analysis of aeronautics and railroad-related industry and occupational activity. As in the transportation cluster section, the aeronautics and rail subcluster analyses also use cluster definitions from the U.S. Cluster Mapping Project to identify related industries.

The industrial analysis for the aeronautics and rail subclusters uses the same industry NAICS codes from the transportation cluster analysis: air transportation, aerospace manufacturing, rail transportation and rail manufacturing.

The aeronautics and rail sections identify key middle-skill and above-middle-skill occupations and include a basic supply-and-demand gap analysis of occupations in the region and state. The analysis uses statewide and national study regions since employment, especially in the operations categories, commonly involves relocation to national and international transportation hubs.

In the alternative fuel section, research methods included COE’s survey and interview results from a 2014 study on the alternative fuel vehicle workforce for alternative fuel vehicle (AFV) labor market estimates. The section also uses policy and labor market data and literature to add context to other findings. Job posting data from Burning Glass provided additional data on the AFV technician labor market. This section also has a brief section on labor market implications for the installation and maintenance workforce for electric vehicle charging stations.

The fifth section of the report concerns emerging technology and special topics and derives its source material from the job posting data and literature review.

Community college educational supply data was sourced from the California Community Colleges Chancellor’s Office Data Mart and the National Center for Education Statistics (IPEDS).

# APPENDIX B: TRANSPORTATION CLUSTER NAICS CODES BY SUBCLUSTER DEFINITION

**Exhibit B1: Subclusters with NAICS codes and industry descriptions**

Subcluster	NAICS	Description
Aerospace Manufacturing	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
	336411	Aircraft Manufacturing
	336412	Aircraft Engine and Engine Parts Manufacturing
	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
	336414	Guided Missile and Space Vehicle Manufacturing
	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
Air Transportation	481111	Scheduled Passenger Air Transportation
	481112	Scheduled Freight Air Transportation
	481211	Nonscheduled Chartered Passenger Air Transportation
	481212	Nonscheduled Chartered Freight Air Transportation
	481219	Other Nonscheduled Air Transportation
	488111	Air Traffic Control
	488119	Other Airport Operations
	488190	Other Support Activities for Air Transportation
Auto Repair and Maintenance	811111	General Automotive Repair
	811112	Automotive Exhaust System Repair
	811113	Automotive Transmission Repair
	811118	Other Automotive Mechanical and Electrical Repair and Maintenance
	811121	Automotive Body, Paint, and Interior Repair and Maintenance
	811122	Automotive Glass Replacement Shops
	811191	Automotive Oil Change and Lubrication Shops
	811192	Car Washes
Automotive Manufacturing	811198	All Other Automotive Repair and Maintenance
	331511	Iron Foundries
	331512	Steel Investment Foundries
	331513	Steel Foundries (except Investment)
	331523	Nonferrous Metal Die-Casting Foundries
	331524	Aluminum Foundries (except Die-Casting)
	331529	Other Nonferrous Metal Foundries (except Die-Casting)
	332114	Custom Roll Forming
	336111	Automobile Manufacturing
	336112	Light Truck and Utility Vehicle Manufacturing
	336120	Heavy Duty Truck Manufacturing
	336211	Motor Vehicle Body Manufacturing
	336212	Truck Trailer Manufacturing
	336213	Motor Home Manufacturing
336214	Travel Trailer and Camper Manufacturing	

Continued

# APPENDIX B: TRANSPORTATION CLUSTER NAICS CODES BY SUBCLUSTER DEFINITION

**Exhibit B1: Subclusters with NAICS codes and industry descriptions** (Continued)

Subcluster	NAICS	Description
Automotive Manufacturing	336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing
	336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing
	336340	Motor Vehicle Brake System Manufacturing
	336350	Motor Vehicle Transmission and Power Train Parts Manufacturing
	336360	Motor Vehicle Seating and Interior Trim Manufacturing
	336370	Motor Vehicle Metal Stamping
	336390	Other Motor Vehicle Parts Manufacturing
	336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing
336999	All Other Transportation Equipment Manufacturing	
Automotive Retail	441310	Automotive Parts and Accessories Stores
	441320	Tire Dealers
	447110	Gasoline Stations with Convenience Stores
	447190	Other Gasoline Stations
	453930	Manufactured (Mobile) Home Dealers
Automotive Wholesale	423110	Automobile and Other Motor Vehicle Merchant Wholesalers
	423120	Motor Vehicle Supplies and New Parts Merchant Wholesalers
	423130	Tire and Tube Merchant Wholesalers
	423140	Motor Vehicle Parts (Used) Merchant Wholesalers
	423860	Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers
	441110	New Car Dealers
	441120	Used Car Dealers
	441210	Recreational Vehicle Dealers
441228	Motorcycle, ATV, and All Other Motor Vehicle Dealers	
Logistics Services	331511	Iron Foundries
	331512	Steel Investment Foundries
	331513	Steel Foundries (except Investment)
	331523	Nonferrous Metal Die-Casting Foundries
	488510	Freight Transportation Arrangement
	488991	Packing and Crating
	488999	All Other Support Activities for Transportation
	491110	Postal Service
	492110	Couriers and Express Delivery Services
	493110	General Warehousing and Storage
	493120	Refrigerated Warehousing and Storage
	493130	Farm Product Warehousing and Storage
	493190	Other Warehousing and Storage
541614	Process, Physical Distribution, and Logistics Consulting Services	
Logistics Services (Local)	492210	Local Messengers and Local Delivery
	531130	Lessors of Miniwarehouses and Self-Storage Units
	621910	Ambulance Services
Marine Manufacturing	336611	Ship Building and Repairing
	336612	Boat Building

Continued

# APPENDIX B: TRANSPORTATION CLUSTER NAICS CODES BY SUBCLUSTER DEFINITION

**Exhibit B1: Subclusters with NAICS codes and industry descriptions** (Continued)

Subcluster	NAICS	Description
Marine Wholesale	441222	Boat Dealers
Misc Manufacturing	335312	Motor and Generator Manufacturing
	335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing
	336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing
Rail Transportation	482110	Rail transportation
Railroad Manufacturing	336510	Railroad Rolling Stock Manufacturing
Rental and Leasing	532111	Passenger Car Rental
	532112	Passenger Car Leasing
	532120	Truck, Utility Trailer, and RV (Recreational Vehicle) Rental and Leasing
	532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing
Transit Systems (Rail)	485112	Commuter Rail Systems
	485119	Other Urban Transit Systems
Transportation Systems (Land)	485111	Mixed Mode Transit Systems
	485113	Bus and Other Motor Vehicle Transit Systems
	485210	Interurban and Rural Bus Transportation
	485310	Taxi Service
	485320	Limousine Service
	485410	School and Employee Bus Transportation
	485510	Charter Bus Industry
	485991	Special Needs Transportation
	485999	All Other Transit and Ground Passenger Transportation
	487110	Scenic and Sightseeing Transportation, Land
	488410	Motor Vehicle Towing
	488490	Other Support Activities for Road Transportation
812930	Parking Lots and Garages	
Transportation Systems (Rail)	488210	Support Activities for Rail Transportation
Transportation Systems (Water)	487210	Scenic and Sightseeing Transportation, Water
	488330	Navigational Services to Shipping
	488390	Other Support Activities for Water Transportation
Trucking Logistics (Local)	484110	General Freight Trucking, Local
	484122	General Freight Trucking, Long-Distance, Less Than Truckload
	484210	Used Household and Office Goods Moving
	484220	Specialized Freight (except Used Goods) Trucking, Local
Trucking Logistics (Traded)	484121	General Freight Trucking, Long-Distance, Truckload
	484230	Specialized Freight (except Used Goods) Trucking, Long-Distance
Water Transportation (Passenger & Logistics)	483111	Deep Sea Freight Transportation
	483112	Deep Sea Passenger Transportation
	483113	Coastal and Great Lakes Freight Transportation
	483114	Coastal and Great Lakes Passenger Transportation
	483211	Inland Water Freight Transportation
	483212	Inland Water Passenger Transportation
	488310	Port and Harbor Operations
	488320	Marine Cargo Handling
713930	Marinas	



# APPENDIX C: NAICS CODES FOR AUTO SHOPS AND CAR DEALERS, AND FLEETS

**Exhibit C1: NAICS codes for auto shops and car dealers, and fleets**

Industry Sector	NAICS Code	NAICS Description	2007 Jobs	2012 Jobs	2017 Jobs	2022 Jobs
Auto Shops and Car Dealers	441110	New Car Dealers	9,360	7,096	8,399	8,813
	811111	General Automotive Repair	3,524	3,482	4,114	4,581
	441120	Used Car Dealers	713	991	1,615	2,112
	811198	All Other Automotive Repair and Maintenance	441	470	455	459
	811118	Other Automotive Mechanical and Electrical Repair and Maintenance	383	291	205	134
	811113	Automotive Transmission Repair	258	195	200	190
	811112	Automotive Exhaust System Repair	105	84	76	73
Fleets	621910	Ambulance Services	948	1,038	1,318	1,663
	532111	Passenger Car Rental	901	959	1,159	1,258
	485320	Limousine Service	288	416	888	1,100
	485991	Special Needs Transportation	737	788	738	874
	532120	Truck, Utility Trailer, and RV (Recreational Vehicle) Rental and Leasing	1,018	401	522	516
	485310	Taxi Service	107	98	302	386
	485210	Interurban and Rural Bus Transportation	120	36	155	191
	485113	Bus and Other Motor Vehicle Transit Systems	57	63	145	162
	485410	School and Employee Bus Transportation	154	122	141	141
	485510	Charter Bus Industry	150	124	124	114

# APPENDIX D: AUTOSHOPS AND CAR DEALERS INDUSTRY SECTOR STAFFING PATTERNS (TOP 35 OCC.)

**Exhibit D1: Staffing patterns for the autoshops and car dealers industry sector**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2017)	Employed in Industry Group (2022)	% of Total Jobs in Industry Group (2017)	Median Hourly Earnings	Skill Category
49-3023	Automotive Service Technicians and Mechanics	3,581	4,123	4,451	27.4%	\$18.08	Middle-skill
41-2031	Retail Salespersons	1,578	1,909	2,108	12.7%	\$11.90	Below Middle-skill
53-7061	Cleaners of Vehicles and Equipment	777	938	1,011	6.2%	\$11.79	Below Middle-skill
41-2021	Counter and Rental Clerks	536	679	733	4.5%	\$13.76	Below Middle-skill
41-2022	Parts Salespersons	451	572	628	3.8%	\$14.54	Below Middle-skill
43-9061	Office Clerks, General	393	459	494	3.0%	\$17.27	Below Middle-skill
41-1011	First-Line Supervisors of Retail Sales Workers	357	414	438	2.7%	\$16.67	Middle-skill
49-3021	Automotive Body and Related Repairers	354	412	449	2.7%	\$18.51	Middle-skill
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	301	348	388	2.3%	\$33.23	Middle-skill
11-2022	Sales Managers	249	328	356	2.2%	\$43.07	Above Middle-skill
11-1021	General and Operations Managers	267	326	358	2.2%	\$45.68	Above Middle-skill
53-6031	Automotive and Watercraft Service Attendants	252	296	313	2.0%	\$12.21	Below Middle-skill
43-3031	Bookkeeping, Accounting, and Auditing Clerks	266	293	300	1.9%	\$19.87	Middle-skill
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	176	228	274	1.5%	\$23.98	Middle-skill
13-2072	Loan Officers	170	228	245	1.5%	\$34.65	Above Middle-skill
41-1012	First-Line Supervisors of Non-Retail Sales Workers	167	194	210	1.3%	\$22.08	Middle-skill
53-3033	Light Truck or Delivery Services Drivers	157	192	212	1.3%	\$15.97	Below Middle-skill
43-4051	Customer Service Representatives	156	189	211	1.3%	\$17.43	Below Middle-skill
41-2011	Cashiers	147	182	195	1.2%	\$10.81	Below Middle-skill
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	153	173	189	1.2%	\$17.40	Below Middle-skill

# APPENDIX D: AUTOSHOPS AND CAR DEALERS INDUSTRY SECTOR STAFFING PATTERNS (TOP 35 OCC.)

**Exhibit D1: Staffing patterns for the autoshops and car dealers industry sector**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2017)	Employed in Industry Group (2022)	% of Total Jobs in Industry Group (2017)	Median Hourly Earnings	Skill Category
53-3041	Taxi Drivers and Chauffeurs	593	1,107	1,389	18.5%	\$10.51	Below Middle-skill
29-2041	Emergency Medical Technicians and Paramedics	606	823	1,076	13.8%	\$20.64	Middle-skill
41-2021	Counter and Rental Clerks	574	740	774	12.4%	\$13.76	Below Middle-skill
53-3021	Bus Drivers, Transit and Intercity	208	338	385	5.6%	\$25.21	Middle-skill
53-3022	Bus Drivers, School or Special Client	275	268	313	4.5%	\$17.11	Below Middle-skill
43-5032	Dispatchers, Except Police, Fire, and Ambulance	130	189	218	3.2%	\$18.41	Middle-skill
53-7061	Cleaners of Vehicles and Equipment	142	184	197	3.1%	\$11.79	Below Middle-skill
39-2021	Nonfarm Animal Caretakers	128	149	152	2.5%	\$12.02	Below Middle-skill
53-6021	Parking Lot Attendants	110	116	111	1.9%	\$11.30	Below Middle-skill
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	91	114	125	1.9%	\$23.98	Middle-skill
43-9061	Office Clerks, General	86	109	118	1.8%	\$17.27	Below Middle-skill
11-1021	General and Operations Managers	84	108	122	1.8%	\$45.68	Above Middle-skill
43-4051	Customer Service Representatives	88	107	119	1.8%	\$17.43	Below Middle-skill
43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	40	74	85	1.2%	\$14.42	Below Middle-skill
41-1011	First-Line Supervisors of Retail Sales Workers	52	63	67	1.1%	\$16.67	Middle-skill
53-1031	First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	48	60	68	1.0%	\$28.70	Middle-skill
49-3023	Automotive Service Technicians and Mechanics	45	59	65	1.0%	\$18.08	Middle-skill
43-1011	First-Line Supervisors of Office and Administrative Support Workers	43	58	66	1.0%	\$27.02	Middle-skill
33-9099	Protective Service Workers, All Other	49	55	57	0.9%	\$12.12	Below Middle-skill
43-3021	Billing and Posting Clerks	39	53	62	0.9%	\$19.27	Middle-skill
41-3099	Sales Representatives, Services, All Other	41	52	56	0.9%	\$24.19	Middle-skill
29-1141	Registered Nurses	35	51	62	0.9%	\$55.95	Above Middle-skill

# APPENDIX D: AUTOSHOPS AND CAR DEALERS INDUSTRY SECTOR STAFFING PATTERNS (TOP 35 OCC.)

**Exhibit D1: Staffing patterns for the autoshops and car dealers industry sector**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2017)	Employed in Industry Group (2022)	% of Total Jobs in Industry Group (2017)	Median Hourly Earnings	Skill Category
43-3031	Bookkeeping, Accounting, and Auditing Clerks	39	46	48	0.8%	\$19.87	Middle-skill
53-6061	Transportation Attendants, Except Flight Attendants	31	43	45	0.7%	\$16.72	Below Middle-skill
43-5031	Police, Fire, and Ambulance Dispatchers	33	42	52	0.7%	\$28.35	Middle-skill
53-3033	Light Truck or Delivery Services Drivers	27	37	41	0.6%	\$15.97	Below Middle-skill
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	30	36	41	0.6%	\$17.40	Below Middle-skill
53-2012	Commercial Pilots	24	33	42	0.5%	\$42.81	Middle-skill
53-3032	Heavy and Tractor-Trailer Truck Drivers	27	31	33	0.5%	\$18.83	Middle-skill
53-7199	Material Moving Workers, All Other	20	28	31	0.5%	\$10.96	Below Middle-skill
13-2011	Accountants and Auditors	19	26	28	0.4%	\$31.47	Above Middle-skill
13-1111	Management Analysts	19	25	25	0.4%	\$33.30	Above Middle-skill
428005	Transportation, Storage, and Distribution Managers	18	23	26	0.4%	\$43.70	Middle-skill
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	17	21	23	0.4%	\$33.23	Middle-skill
53-6031	Automotive and Watercraft Service Attendants	15	21	22	0.3%	\$12.21	Below Middle-skill

# APPENDIX E: FLEETS INDUSTRY SECTOR STAFFING PATTERNS (TOP 35 OCC.)

**Exhibit E1: Staffing patterns for the fleets industry sector**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2017)	Employed in Industry Group (2022)	% of Total Jobs in Industry Group (2017)	Median Hourly Earnings	Skill Category
53-3041	Taxi Drivers and Chauffeurs	593	1,107	1,389	18.5%	\$10.51	Below Middle-skill
29-2041	Emergency Medical Technicians and Paramedics	606	823	1,076	13.8%	\$20.64	Middle-skill
41-2021	Counter and Rental Clerks	574	740	774	12.4%	\$13.76	Below Middle-skill
53-3021	Bus Drivers, Transit and Intercity	208	338	385	5.6%	\$25.21	Middle-skill
53-3022	Bus Drivers, School or Special Client	275	268	313	4.5%	\$17.11	Below Middle-skill
43-5032	Dispatchers, Except Police, Fire, and Ambulance	130	189	218	3.2%	\$18.41	Middle-skill
53-7061	Cleaners of Vehicles and Equipment	142	184	197	3.1%	\$11.79	Below Middle-skill
39-2021	Nonfarm Animal Caretakers	128	149	152	2.5%	\$12.02	Below Middle-skill
53-6021	Parking Lot Attendants	110	116	111	1.9%	\$11.30	Below Middle-skill
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	91	114	125	1.9%	\$23.98	Middle-skill
43-9061	Office Clerks, General	86	109	118	1.8%	\$17.27	Below Middle-skill
11-1021	General and Operations Managers	84	108	122	1.8%	\$45.68	Above Middle-skill
43-4051	Customer Service Representatives	88	107	119	1.8%	\$17.43	Below Middle-skill
43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	40	74	85	1.2%	\$14.42	Below Middle-skill
41-1011	First-Line Supervisors of Retail Sales Workers	52	63	67	1.1%	\$16.67	Middle-skill
53-1031	First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	48	60	68	1.0%	\$28.70	Middle-skill
49-3023	Automotive Service Technicians and Mechanics	45	59	65	1.0%	\$18.08	Middle-skill
43-1011	First-Line Supervisors of Office and Administrative Support Workers	43	58	66	1.0%	\$27.02	Middle-skill
33-9099	Protective Service Workers, All Other	49	55	57	0.9%	\$12.12	Below Middle-skill
43-3021	Billing and Posting Clerks	39	53	62	0.9%	\$19.27	Middle-skill
41-3099	Sales Representatives, Services, All Other	41	52	56	0.9%	\$24.19	Middle-skill
29-1141	Registered Nurses	35	51	62	0.9%	\$55.95	Above Middle-skill

Continued



# APPENDIX E: FLEETS INDUSTRY SECTOR STAFFING PATTERNS (TOP 35 OCC.)

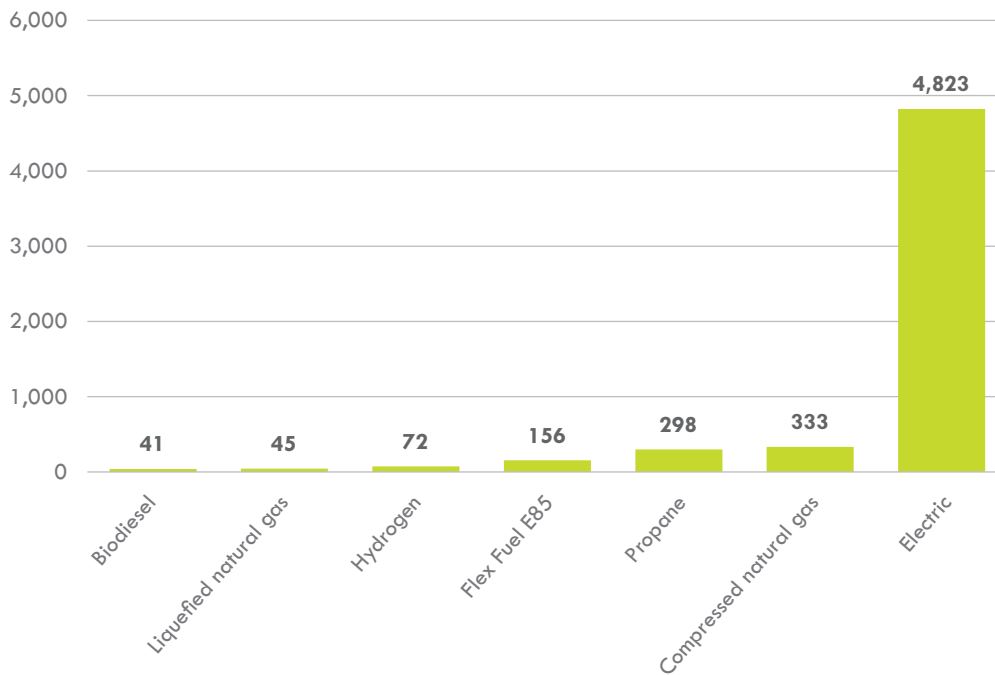
**Exhibit E1: Staffing patterns for the fleets industry sector** (Continued)

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2017)	Employed in Industry Group (2022)	% of Total Jobs in Industry Group (2017)	Median Hourly Earnings	Skill Category
43-3031	Bookkeeping, Accounting, and Auditing Clerks	39	46	48	0.8%	\$19.87	Middle-skill
53-6061	Transportation Attendants, Except Flight Attendants	31	43	45	0.7%	\$16.72	Below Middle-skill
43-5031	Police, Fire, and Ambulance Dispatchers	33	42	52	0.7%	\$28.35	Middle-skill
53-3033	Light Truck or Delivery Services Drivers	27	37	41	0.6%	\$15.97	Below Middle-skill
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	30	36	41	0.6%	\$17.40	Below Middle-skill
53-2012	Commercial Pilots	24	33	42	0.5%	\$42.81	Middle-skill
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53-7199	Material Moving Workers, All Other	20	28	31	0.5%	\$10.96	Below Middle-skill
13-2011	Accountants and Auditors	19	26	28	0.4%	\$31.47	Above Middle-skill
13-1111	Management Analysts	19	25	25	0.4%	\$33.30	Above Middle-skill
428005	Transportation, Storage, and Distribution Managers	18	23	26	0.4%	\$43.70	Middle-skill
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	17	21	23	0.4%	\$33.23	Middle-skill
53-6031	Automotive and Watercraft Service Attendants	15	21	22	0.3%	\$12.21	Below Middle-skill

# APPENDIX F: FINDINGS FROM THE ALTERNATIVE FUELS DATA CENTER, U.S. DEPARTMENT OF ENERGY

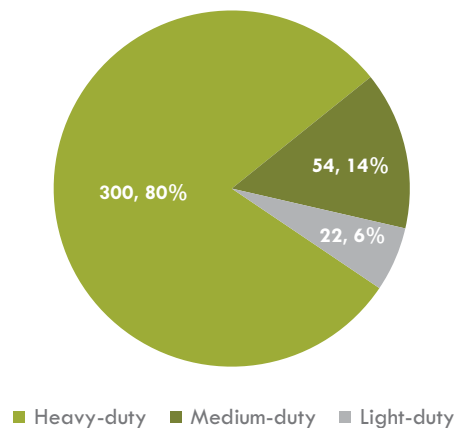
Electric vehicle charging stations comprise an overwhelming majority of alternative fuel stations in California. Compressed natural gas and propane each have around 300 stations in the state (Exhibit F1).

**Exhibit F1: California alternative fuel station counts by fuel type, March 2018**<sup>64</sup>



Compressed natural gas and liquefied natural gas stations in California primarily serve heavy-duty vehicles. Of the 375 stations in California, 300 stations are for heavy-duty vehicles.

**Exhibit F2: Compressed natural gas and liquefied natural gas stations in California by type of vehicle serviced**<sup>65</sup>



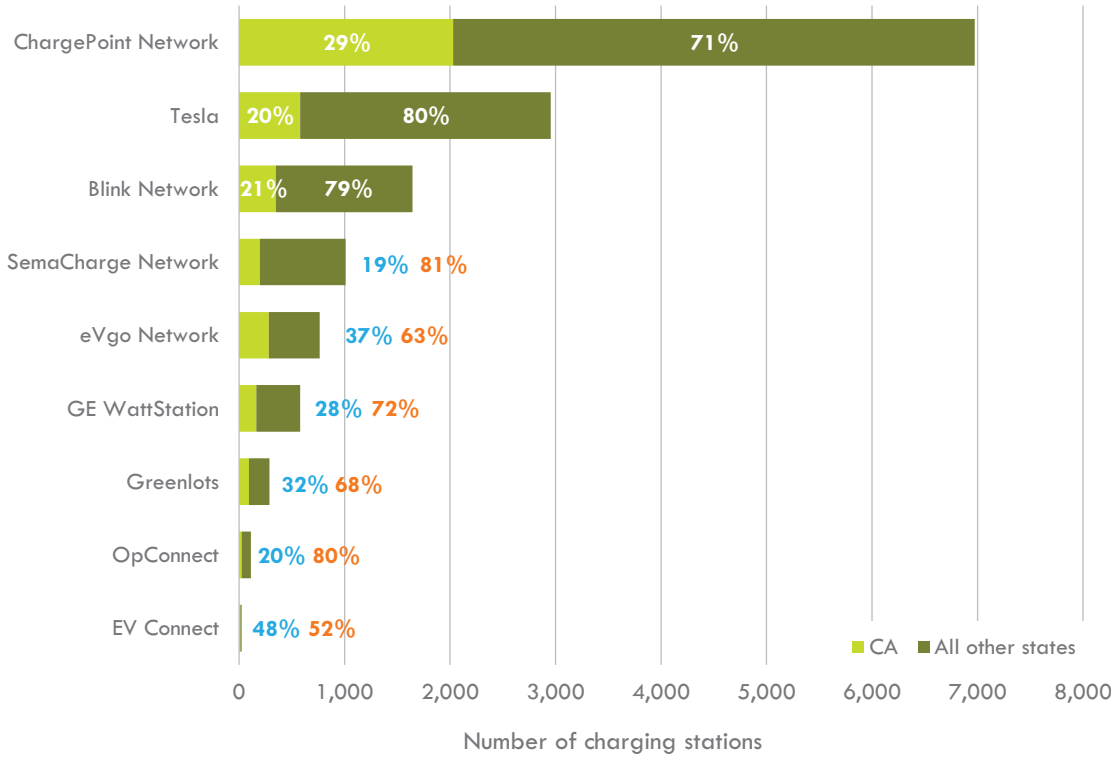
<sup>64</sup> "Maps and Data," Alternative Fuels Data Center, U.S. Department of Energy, accessed April 9, 2018, <http://www.afdc.energy.gov/afdc/data/>.

<sup>65</sup> Ibid.

# APPENDIX F: FINDINGS FROM THE ALTERNATIVE FUELS DATA CENTER, U.S. DEPARTMENT OF ENERGY

The private sector has invested in the installation and maintenance of electric vehicle charging stations. ChargePoint, Tesla and Blink Network are among the vendors who operate and maintain the most charging stations. Exhibit F3 shows the ranking of the vendors based on DOE data. California occupies a major segment of these vendors’ market share—30 percent for ChargePoint, and 20 percent for Tesla.

**Exhibit F3: Number of electric charging stations by vendor and California’s market share<sup>66</sup>**

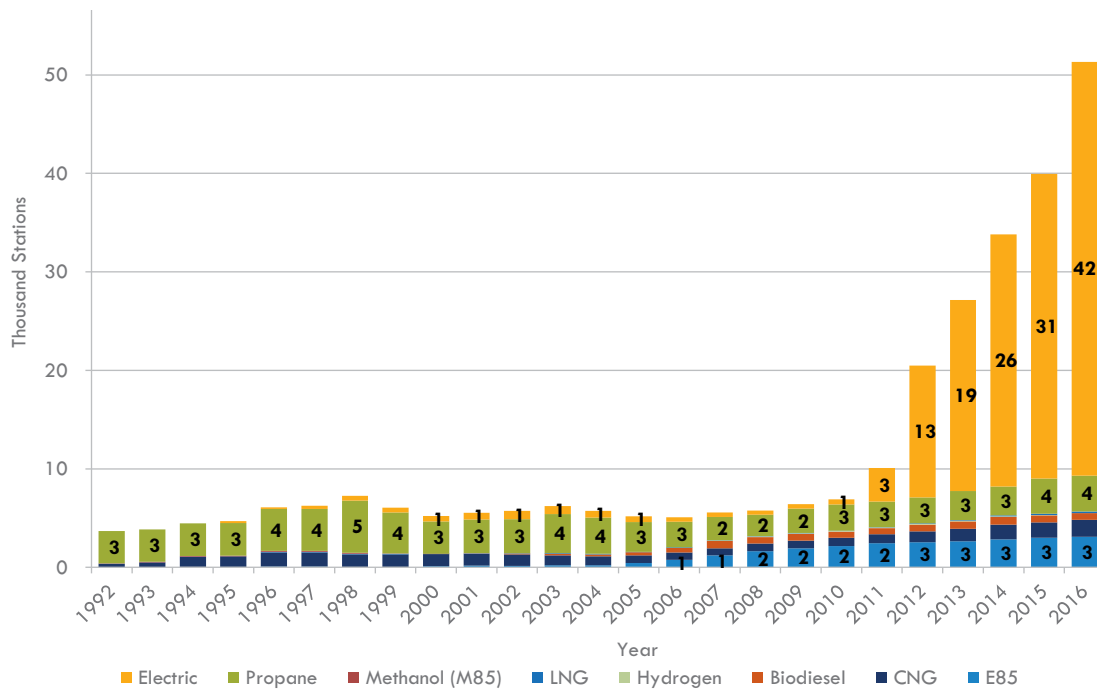


<sup>66</sup> Ibid. Calculations by the COE.

# APPENDIX F: FINDINGS FROM THE ALTERNATIVE FUELS DATA CENTER, U.S. DEPARTMENT OF ENERGY

Electric vehicle charging plugs have undergone dramatic growth since 2011 (Exhibit F4). The chart below is slightly skewed because the data counts the electric charging station plugs, whereas other types of alternative fuels are counted by station. Nonetheless, the chart illustrates a rapid increase in the number of vehicle plugs nationally. Propane, compressed natural gas (CNG) and ethanol are the other dominant station types. The growth of stations with these other fuel types has been slower.

**Exhibit F4: Alternative fueling station count, United States (in thousands)**<sup>67</sup>

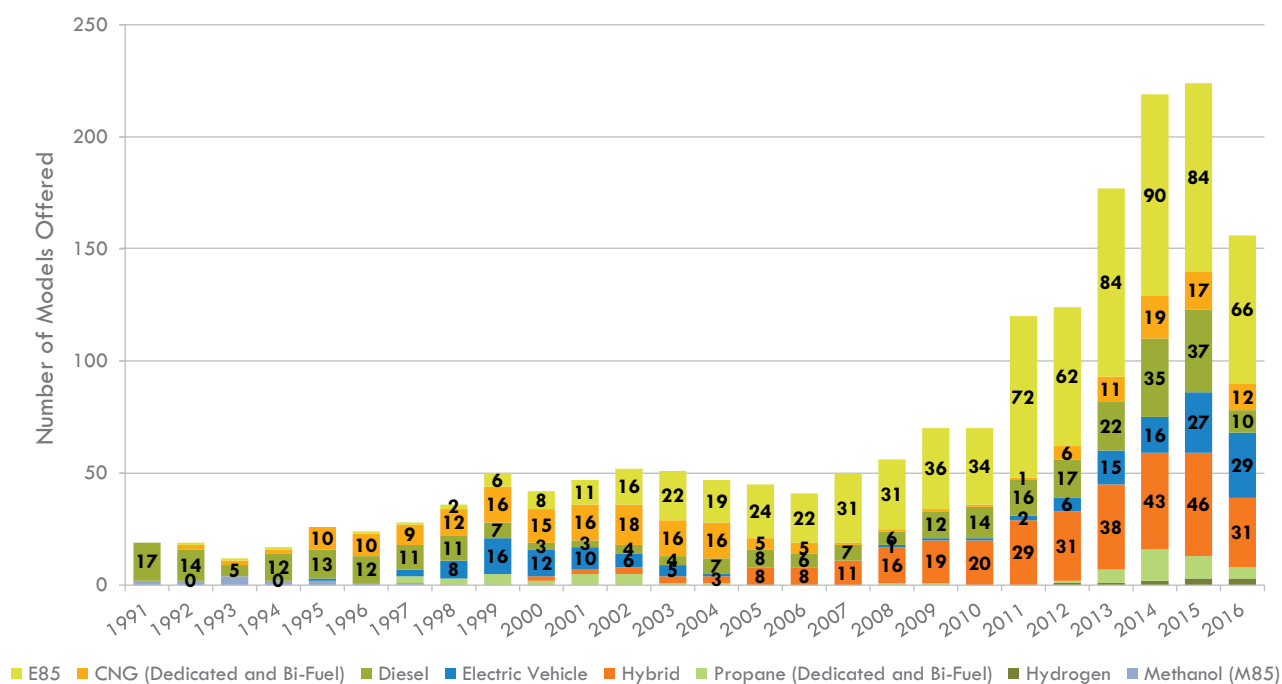


<sup>67</sup> Ibid. Note: The Alternative Fuels Data Center notes, "Starting in 2011, electric charge equipment was counted by the plug rather than by the geographical location. This is different than other fuels, which only count the geographical location regardless of how many dispensers or nozzles are on site. Stations selling low-level biodiesel blends (less than B20) are included in the station listing only for the years 2005-2007. Total is the total number of fuel types sold at stations. Stations are counted once for each type of fuel sold."

# APPENDIX F: FINDINGS FROM THE ALTERNATIVE FUELS DATA CENTER, U.S. DEPARTMENT OF ENERGY

Of all alternative fuel vehicles, ethanol flex-fuel vehicle models have grown the most over the last 15 years, increasing from about 20 in 2003 to dozens in recent years (Exhibit F5). The growth of electric vehicles between 2012 and 2016 is remarkable. In 2012 there were six models of electric vehicles. In 2016 there were nearly 30. The growth of hybrid vehicles has been similarly impressive. In 2006, there were eight hybrid models. In 2016, the data shows hybrid models had increased to more than 30. Compressed natural gas and propane models are also notable trending vehicles in recent years.

**Exhibit F5: Number of alternative fuel, hybrid-electric and diesel light-duty vehicle models by fuel type, 1991–2016**<sup>68</sup>



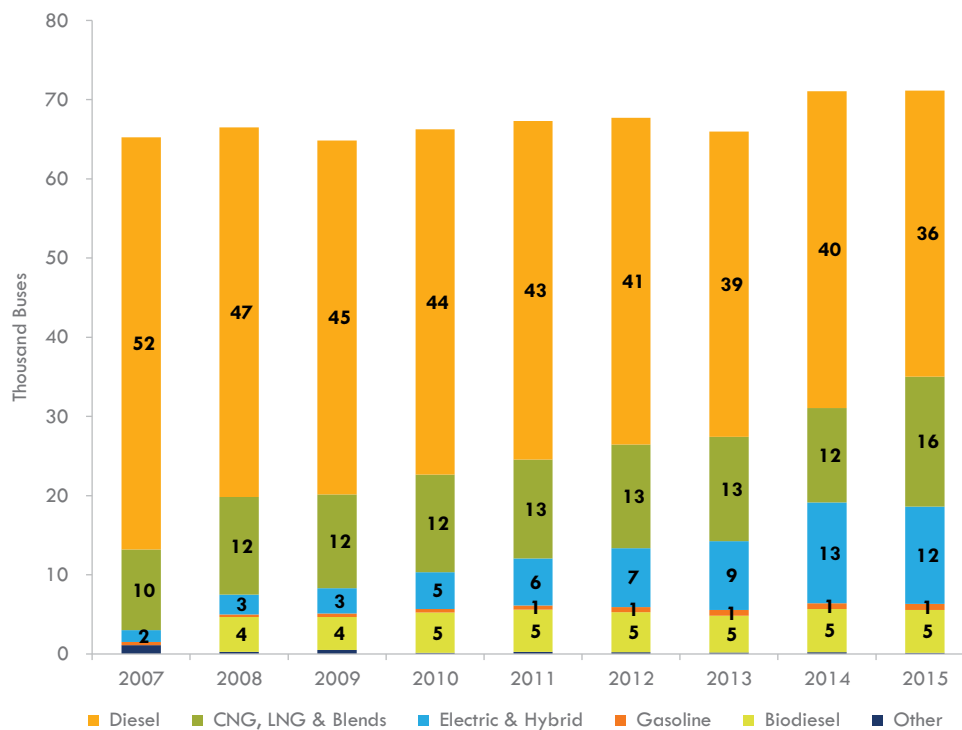
<sup>68</sup> Ibid. Note: The Alternative Fuels Data Center notes, "EVs include plug-in HEVs, but do not include Neighborhood Electric Vehicles, Low Speed Electric Vehicles, or two-wheeled electric vehicles. Only full-sized vehicles sold in the U.S. and capable of 60 mph are listed."



# APPENDIX F: FINDINGS FROM THE ALTERNATIVE FUELS DATA CENTER, U.S. DEPARTMENT OF ENERGY

The number of alternative fuel transit buses has increased steadily in the last 10 years in the United States (Exhibit F6). The most growth has occurred with electric and hybrid buses; electric and hybrid technology ranks as the second most common alternative fuel type in transit buses. Compressed natural gas and liquefied natural gas rank first. Biodiesel is the third most common.

**Exhibit F6: United States transit bus fleet by fuel type, 2007-2015<sup>69</sup>**



## APPENDIX G: DATA SOURCES

Data sources used in this report's analysis include:

- U.S. Department of Labor/Employment and Training Administration (DOLETA) O\*NET OnLine
- Burning Glass, Labor Insight/Jobs
- Economic Modeling Specialists, International (EMSI)
- Employment Development Department, Labor Market Information Division (EDD, LMID)
- Living Insight Center for Community Economic Development, Self-Sufficiency Standard Tool for California
- California Community Colleges Chancellor's Office Management Information Systems (MIS Data Mart)

<sup>69</sup> Ibid. Note: The Alternative Fuels Data Center notes, "Biodiesel was counted in the 'other' category until 2008. Current numbers do not indicate methodology for defining what blend qualifies a bus as biodiesel and discretion is advised in the use of these numbers beyond basic trend analyses. 2012 vehicle power source percentages were not available from the Public Transportation Fact Book, so an average of 2011 and 2013 power source percentages in combination with the number of transit buses in 2012 is used in place of the missing values."

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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 information has proven valuable to colleges in beginning, revising, or updating economic development and Career Education (CE) programs, strengthening grant applications, assisting in the accreditation process, and in 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](http://www.coecc.net).

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