

SECTOR STRATEGY

ZERO-EMISSION VEHICLES

MEDIUM-AND HEAVY-DUTY

SAN DIEGO-IMPERIAL COUNTIES REGION



DATE CREATED
10.31.2022

VERSION
05 (PRINT)

REPORT BY
Rocket 1 Group & Workforce Training Associates



Report Prepared for the
San Diego and Imperial Counties
Community Colleges Regional Consortium

Report By
Rocket 1 Group
www.rocketonegroup.com

Jonathan Kropp
Writer & Designer

Workforce Training Associates
www.wrforce.org

Jannet Malig
Contributor

Additional Contributors:
Centers of Excellence
Tina Ngo Bartel
John Edwards
Labor Market Information

SECTOR STRATEGY

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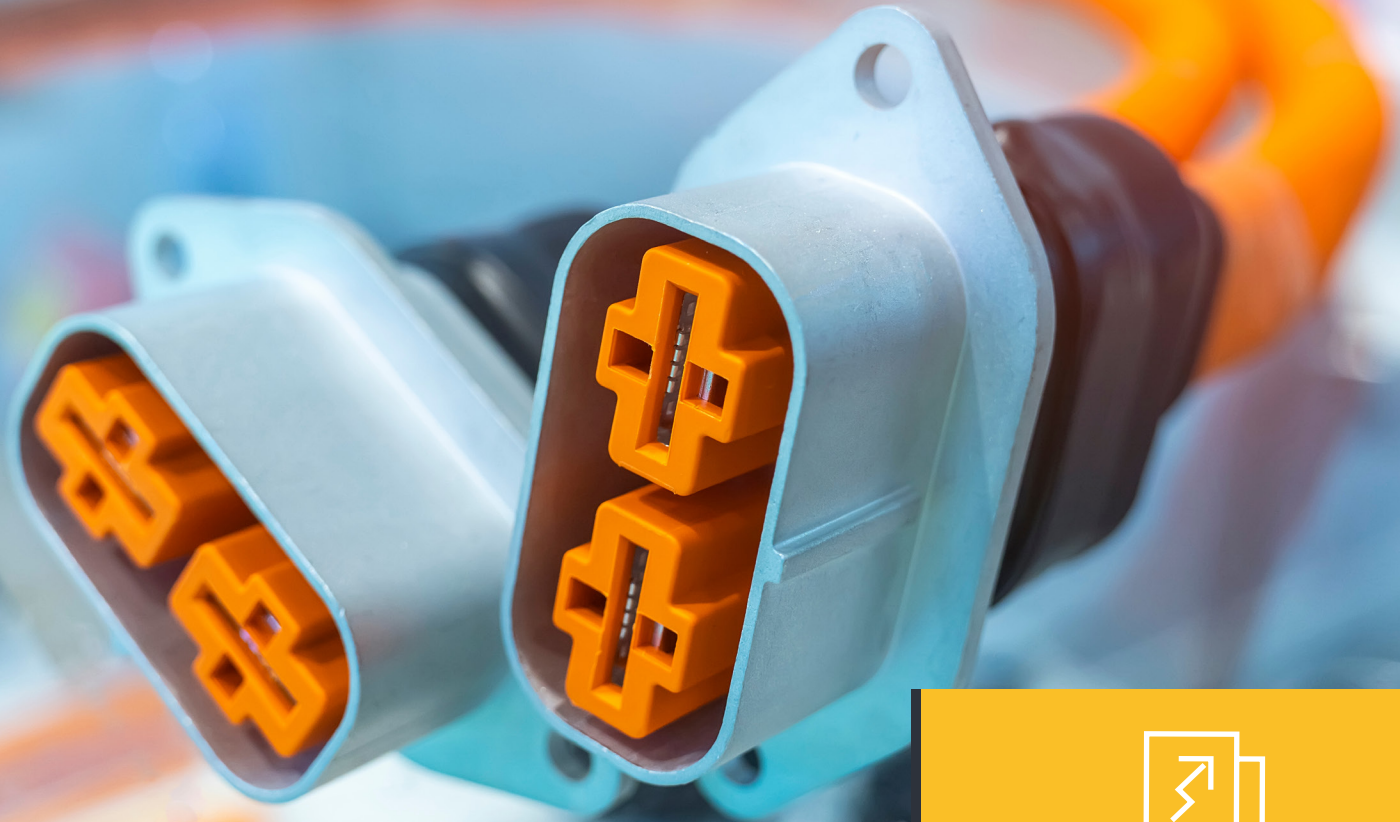
SAN DIEGO-IMPERIAL COUNTIES REGION

COMMUNITY COLLEGES
SAN DIEGO & IMPERIAL COUNTIES
CAREER EDUCATION



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Report Objectives

This strategy report is intended to be a resource for Medium-and Heavy-Duty Zero Emission Vehicle training program planning.

The report objectives include:

- A** To provide information and background on the coming market transition to zero-emission vehicles as well as current labor market information
- B** To provide early recommendations for planning to help inform partnership development, program planning, and advisory committee questions
- C** To provide a resource document to assist with grant and resource development



CLICK HERE

To view the light-duty ZEV sector strategy report

SUMMARY

Zero-emission trucks (ZETs) are relatively new to the medium-and heavy-duty (MHD) market segment. However, a growing number of manufacturers, purchase commitments, increasing regulatory policy, and incentive reinforcements are priming ZETs for increased deployment over the coming years.

In an effort to decarbonize and move to healthier air quality standards, California is advancing the transition to zero-emission trucks and buses operated within the state. The goal set by the Governor is 100 percent zero-emission transportation by 2045 (Executive Order N-79-20). To help accelerate this adoption, California has implemented the Advanced Clean Trucks (ACT) regulation, Innovative Clean Transit (ICT) regulation, and the Advanced Clean Fleets (ACF) regulation. Each regulation includes target adoption or sales requirements to transition various medium- and heavy-duty vehicle platforms to zero-emission.

Why do we need zero-emission technology in the transportation sector? California faces challenging mandates to reduce air pollutants in order to protect public health and meet state climate targets. In California, the transportation sector is responsible for approximately 80% of smog-forming nitrogen oxide (NOx) emissions. The sector also represents around 50% of greenhouse gas emissions and more than 95% of toxic diesel particulate matter emissions. Zero-emission vehicles, on the other hand, have zero emissions and when compared to diesel vehicles, they are up to five times more energy efficient, and reduce GHG emissions substantially (1).

AVERAGE ANNUAL VEHICLE MILES TRAVELED

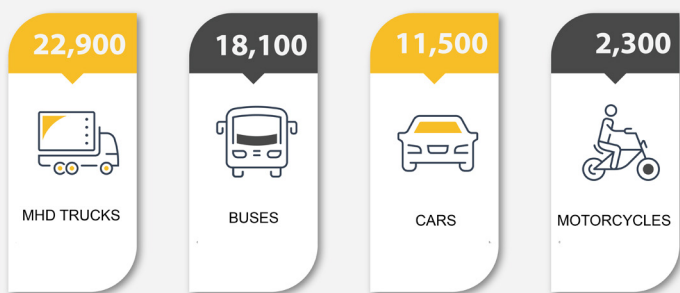


Exhibit 1: U.S. Federal Highway Administration, Annual Vehicle Distance Travelled in Miles Data - 2019 (2) by Highway Category and Vehicle Type (revised Oct. 2021), <https://www.fhwa.dot.gov/policyinformation/statistics/2019/pdf/vm1.pdf>

To keep pace with this sector transition to zero-emission platforms, investments need to be made to develop capacity at the community colleges. Various strategy reports call upon the colleges to assist with the ZEV transition in the following ways:

- Build pre-apprenticeship and apprenticeship programs
- Build robust training programs that connect to both current and future workforce needs
- Create and maintain close connections with industry
- Pilot programs such as ZEV car-sharing, micro-mobility (e-bikes), and EV charging

MHD BACKGROUND INFO

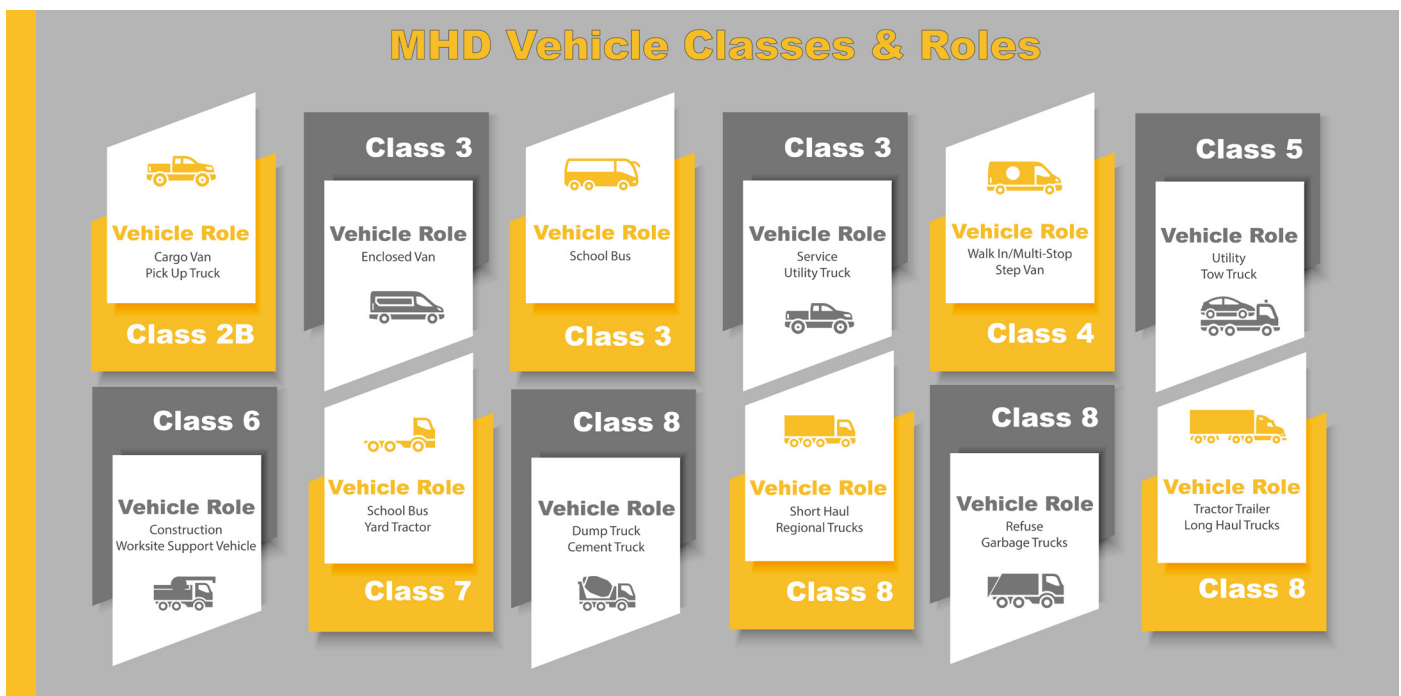
COMMON ACRONYMS

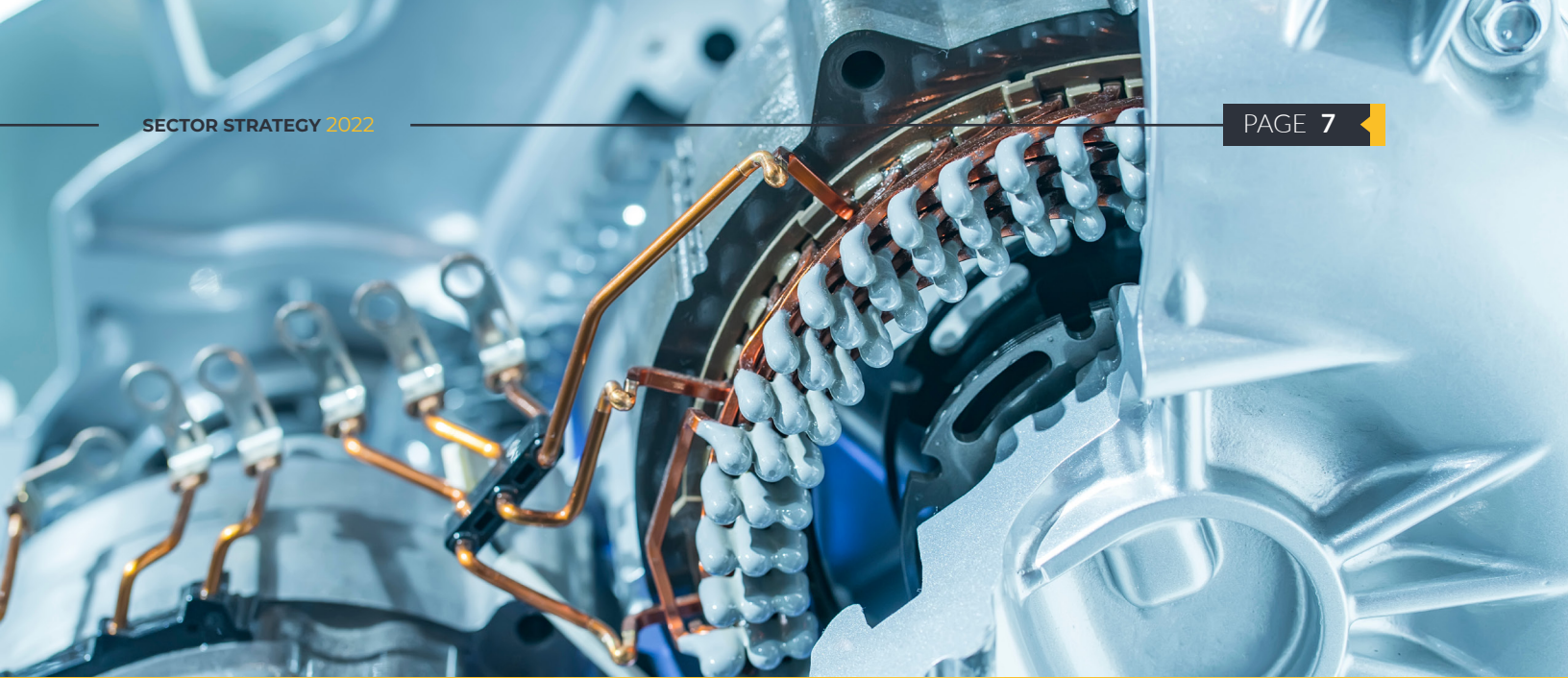
	Acronym		Acronym
Zero-Emission Truck	ZET	Medium- and Heavy-Duty	MHD
Zero-Emission Vehicle	ZEV	Battery Electric Vehicle	BEV
Zero-Emission Bus	ZEB	Fuel-Cell Electric Truck	FCET
Medium-Duty	MD	Electric Vehicle	EV
Heavy-Duty	HD	Gross Vehicle Weight Rating	GVWR

DEFINITIONS

- **Weight Class:** The Federal Highway Administration classifies vehicles by their gross vehicle weight rating (GVWR). GVWR is the vehicle manufacturer's specification of the vehicle's loaded weight. Vehicle weight class ranges from 1 through 8. See exhibit 2 below for more information
- **GVWR:** Gross vehicle weight rating – the maximum operating weight of the vehicle set by the manufacturer. This includes the empty vehicle weight, fuel, passengers, and cargo combined
- **Light-Duty:** Vehicles with a GVWR under 10,000 pounds. Includes weight classes 1 and 2
- **Medium-Duty:** Vehicles with a GVWR between 10,001 – 26,000 pounds. Includes weight classes 3, 4, 5, & 6
- **Heavy-Duty:** Vehicles with a GVWR greater than 26,000 pounds. Includes weight classes 7 & 8

Exhibit 2: MHD vehicle Classes & Roles





THE MARKET

The Zero-Emission MHD market is primed for rapid growth in California as a result of technology innovation support, declining costs, favorable regulations, and incentives.

California's Air Quality and Climate Targets

California faces challenging mandates to reduce air pollutants and to meet state climate change goals including (3)

- Federal health-based ambient air quality standards (key dates in 2023 and 2031)
- 40% reduction in greenhouse gasses (GHG) by 2030;
- 80% reduction in GHGs by 2050; and
- 50% reduction in petroleum use by 2030

REGULATIONS

California Advanced Clean Trucks (ACT) Requirements:

The Advanced Clean Trucks regulation is intended to accelerate a large-scale transition of zero-emission medium- and heavy-duty vehicles. The regulation is comprised of two components which include a manufacturer sales requirement and a reporting requirement (4):

- Manufacturers who certify Class 2b-8 chassis or complete ICE vehicles will be required to sell an increasing number of zero-emission trucks annually in California from 2024-2045, as shown below in exhibit 3.
- Company Fleet Reporting: Large employers and fleet owners will be required to report on fleet operations to help identify future strategies and deployments.

Exhibit 3: California Advanced Clean Trucks ACT 2035 Requirements.

California Advanced Clean Trucks (ACT) 2035 Requirements



California Clean Transit Requirements:

California's Innovative Clean Transit (ICT) regulation requires all transit agencies to purchase only zero-emission buses (ZEBs) starting in 2029. This regulation will result in a state-wide zero-emission transit fleet by 2040 as aging conventionally-fueled buses are replaced or repowered by ZEBs (5).

California Fleet Purchase Requirements:

To complement the ACT regulation, California is also developing the Advanced Clean Fleets (ACF) regulation. This regulation will require fleets that are well-suited for electrification (i.e., drayage, public fleets, federal fleets, and other high-priority fleets) to transition to MHD ZEVs. These fleet purchase requirements will further accelerate the utilization of MHD ZEVs and reduce harmful truck emissions in highly impacted communities.

OTHER

Declining Battery Costs:

Battery costs are the greatest influence on electric vehicle purchase prices, but through rapid innovation in battery technology and design, these costs have sharply declined. During the last ten years, battery prices declined roughly 90 percent, from more than \$1,100 per kilowatt hour (kWh) (6) to an average of \$137 per kWh. These cost reductions and improvements in battery technology (like range) have helped enhance the business case for electrification in the MHD space. Such advances are also helping to foster favorable economics for electric MHD vehicles over their internal combustion counterparts due in part to lower fuel, powertrain, and maintenance costs. Market analysts are projecting a favorable total cost of ownership (TCO) without government subsidies for MHD ZEVs in many weight classes by 2025, and all weight classes by 2030 (7).

Incentives

There are a significant number of incentive programs for MHD ZEVs both in California and at the federal level which include CARB, CalStar, CDE, and CEC in California. See: <https://lao.ca.gov/Publications/Report/4561>.

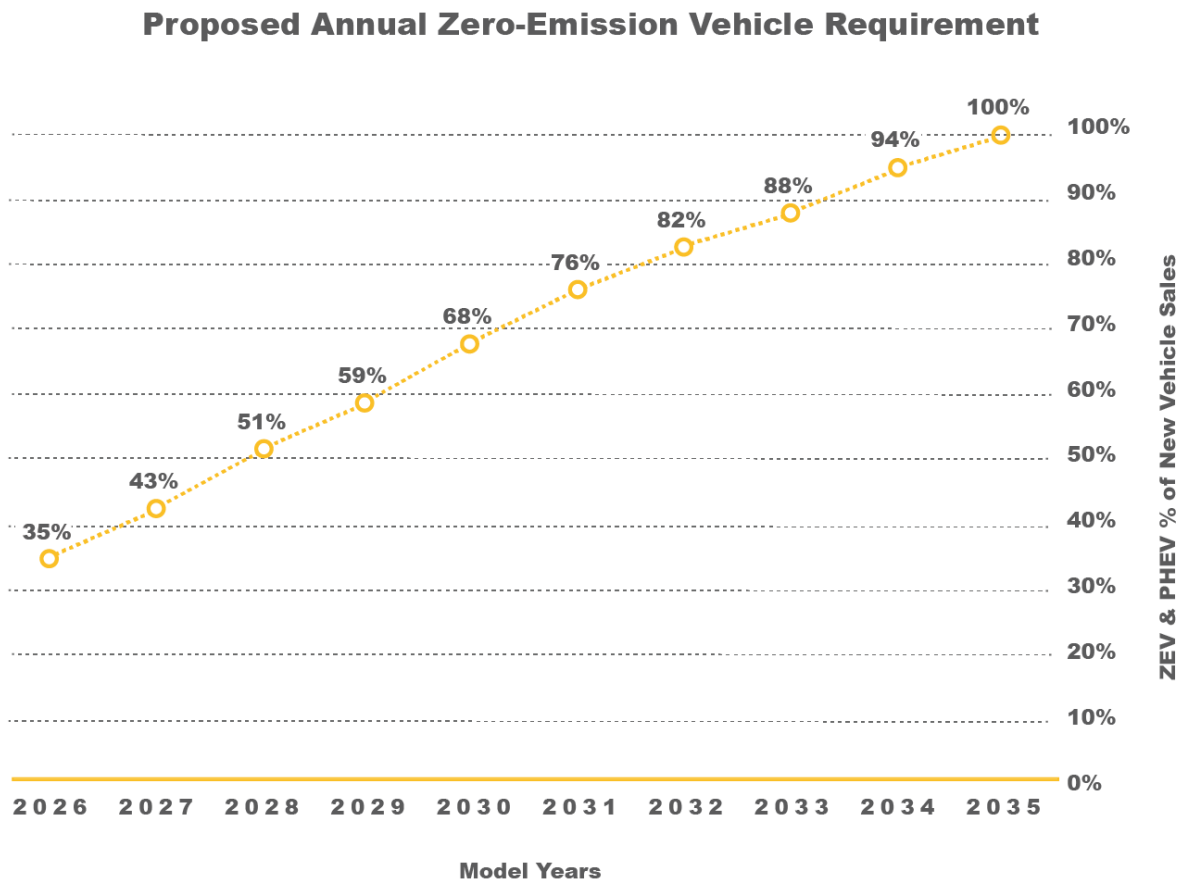
Most recently, on a federal level, The Inflation Reduction Act includes incentives for both consumers and Manufacturers. Some key allocations related to MHD include (8):

- \$3 billion to electrify the USPS Fleet & Infrastructure
- \$1 billion to states, municipalities, Indian Tribes, or non-profit school transportation associates to replace class 6 and 7 heavy-duty vehicles with ZEVs.
- Up to 30% tax credit for commercial EV purchases
- \$3 billion for the Advanced Technology Vehicle Manufacturing program
- \$2.25 billion deployed to ports for ZEV technology

GOALS & TARGETS

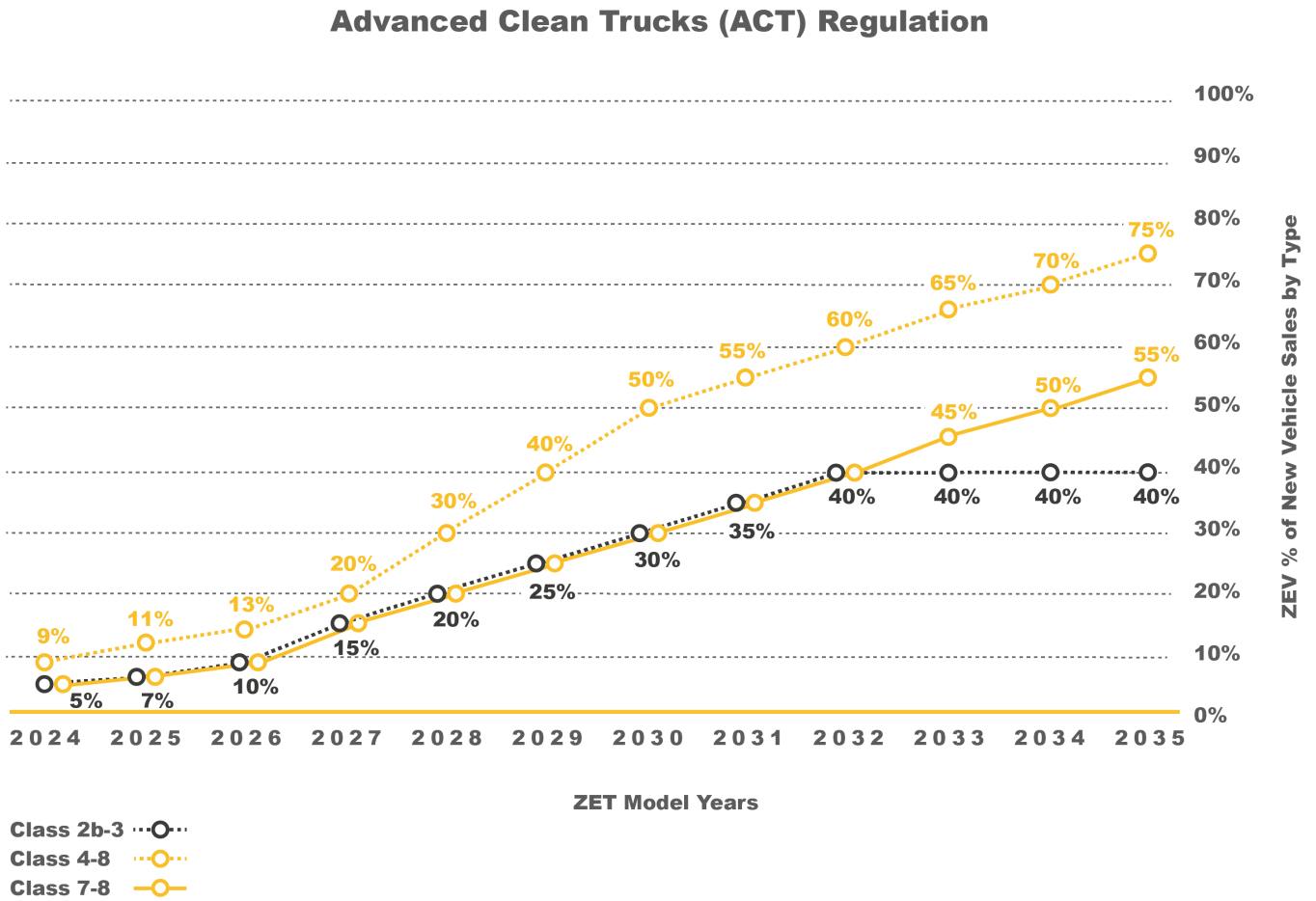
California has the largest zero-emission vehicle market in the nation with more than 16% of new vehicles sold being zero-emission or plug-in hybrids. Exhibit 4 below represents California’s light-duty vehicle sales goals by percentage starting in 2026 with 35% of all new cars sold being electric in 2026 and 100% by 2035 (9).

Exhibit 4: Proposed Annual Zero-Emission Vehicle Requirement



The medium- and heavy-duty vehicle requirement of the ACT Regulation is less aggressive than light-duty electric and has different requirement targets based on classification. By 2035, MHD sales requirements range from 40% to 75%. California still has an overall target of 100% by 2045 through Executive Order (N-79-20). Exhibit 5 below represents the ACT MHD ZEV sales percentage requirement by year.

Exhibit 5: Advanced Clean Trucks (ACT) Regulation by Model Year and Classification.



VOLVO LIGHTS PROJECT

The Volvo Group North America a project in partnership with 14 diverse partners, which included fleets, government, ports, community colleges, equipment supplies, and utilities worked together to develop a test model for the successful deployment of Class 8 battery-electric trucks. The \$90 million project was funded by California Climate Investments to help reduce GHG emissions, strengthen the economy, and improve public health. The project deployed 25 Volvo VNR electric trucks, 25 freight vehicles, a solar site, and over 50 EV chargers. The three-year collaboration demonstrated that heavy-duty BEVs and equipment can be successfully integrated into commercial fleets transporting freight with less noise pollution and zero-tailpipe emissions.

www.lightsproject.com

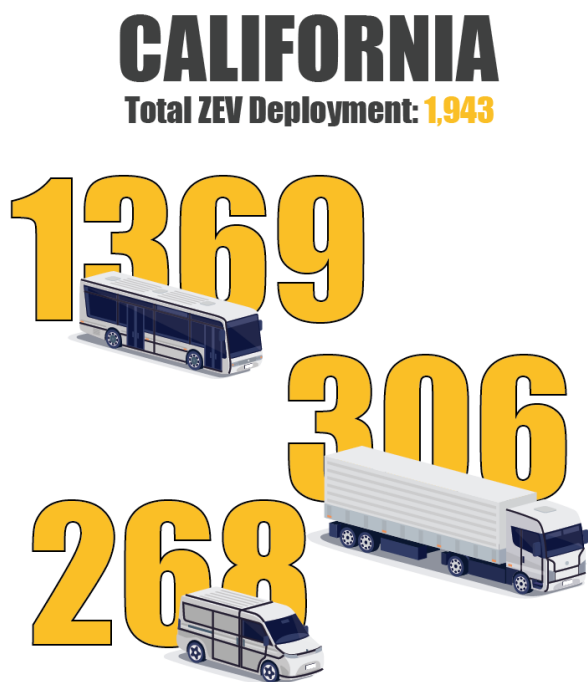
CURRENT DEPLOYMENTS

The below deployment figures and datasets are updated annually in April and reflect the number of DMV-registered vehicles (on-road) during the previous calendar year. The numbers below were sourced during Q2 2022 (10) and as such represent deployments at the end of 2021. These numbers will likely be much higher in 2022 based on conversations with industry both in the state and here locally in San Diego.

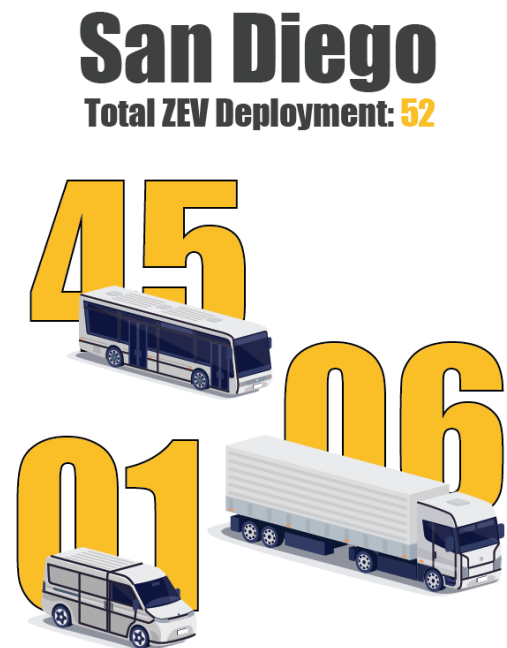
Note: The dataset contains DMV-registered medium- and heavy-duty vehicles licensed for operation on California roads.

However, it does not necessarily include vehicles that operate off of California roads. For example, some medium- and heavy-duty ZEVs may operate only within a port facility and not be registered

Exhibit 6: Zero-Emission Vehicle Deployments in San Diego and California as a Whole



In California these deployments include 446 school buses, 841 transit buses, 172 straight trucks, 87 on-road drayage tractors, 212 panel vans, 68 coach buses, 56 step-vans, 46 terminal tractors, 14 incomplete chassis, and 1 fire truck.



In San Diego, these deployments include 32 school buses, 13 transit buses, 4 straight trucks, 2 on-road drayage tractors, and a one-panel van.

San Diego's ZEV brand deployments include Blue Bird, Lion Electric, IC Bus, New Flyer, Smith Electric, Proterra, Greenpower Motors, BYD Coach & Bus, and Navistar.



LOCAL DEPLOYMENT PLANNING

LOCAL DEPLOYMENT STRATEGIES

Port of San Diego Maritime Clean Air Strategy (MCAS)

In 2021, the Port of San Diego Board approved a policy document to help identify future projects and initiatives to improve air quality while supporting efficient and modern maritime operations. “The Maritime Clean Air Strategy (MCAS) and its vision, ‘Health Equity for All,’ represent the Port’s commitment to environmental justice and is more ambitious than any other clean air policy document of its kind in the state. In fact, nearly all the MCAS goals and/or objectives go beyond what is currently required by the State of California”(11).

As an update to the Port’s 2007 Clean Air Program, the MCAS identifies a vision centered on health equity, with ambitious 2030 goals. Highlights of the MCAS goals and/or objectives that go beyond State requirements include:

- A goal of **100 percent** of cargo trucks calling on the Port of San Diego cargo maritime terminals being zero-emission vehicles by 2030
 - *An interim goal of **40 percent** of the Port’s annual cargo truck trips being performed by ZE trucks by June 30, 2026
- A goal of **100 percent** of cargo handling equipment being ZE by 2030
- Facilitate implementation of the first all-electric tugboat in the United States by June 30, 2026

The port also is deploying the first all-electric mobile harbor cranes in North America and authorized the acquisition of 16 electric vehicles to replace their gas/diesel fleet.

San Diego Metropolitan Transit System (MTS) Zero-Emissions Bus Fleet Transition:

In 2020, the MTS Board approved the agency’s Zero-Emission Bus (ZEB) transition plan to facilitate the transition of the bus fleet to all zero-emission vehicles. This plan helped fast-track the acquisitions of zero-emission vehicles including the purchase of the agency’s first 60-ft articulated electric buses. Beginning in 2029, **100%** of new bus purchases will be ZEBs, with the goal for full fleet transition by 2040 (12).

MTS currently has thirteen **(13)** electric buses in service in San Diego.



VIDEO

MTS: Electric Bus Pilot Program
(<https://youtu.be/sapwLBjXXFo>)



VIDEO

MTS: New Electric Bus Chargers
(<https://youtu.be/m1JqOXf45n4>)



LABOR MARKET INFO

WORKFORCE

The ZEV workforce will see job growth from the manufacturing of ZE vehicles, batteries, infrastructure (such as charging), and components. Job opportunities will also be created through commissioning, installation, and maintenance of charging infrastructure; technical assistance to fleets; vehicle maintenance and repair; and battery recycling and disposal. Most of the new, higher-quality careers will require mechanical and electrical skills.

LABOR MARKET DEMAND

Diesel Mechanic Occupations

Labor Market Analysis: San Diego County

Introduction

This following provides labor market information in San Diego County for the following occupational codes in the Standard Occupational Classification (SOC) (13) system:

- Bus and Truck Mechanics and Diesel Engine Specialists (**SOC 49-3031**): Diagnose, adjust, repair, or overhaul buses and trucks, or maintain and repair any type of diesel engines. Includes mechanics working primarily with automobile or marine diesel engines.
- Mobile Heavy Equipment Mechanics, Except Engines (**SOC 49-3042**): Diagnose, adjust, repair, or overhaul mobile mechanical, hydraulic, and pneumatic equipment, such as cranes, bulldozers, graders, and conveyors, used in construction, logging, and mining.

For the purpose of this report, these occupations are referred to as Diesel Mechanic Occupations.

Projected Occupational Demand

Between 2021 and 2026, Diesel Mechanic Occupations are projected to increase by nine net jobs or zero percent. Employers in San Diego County will need to hire 341 workers annually to fill new jobs and back-fill jobs due to attrition caused by turnover and retirement, for example.

Exhibit 7 disaggregates the projected number of jobs change by occupation. “Bus and Truck Mechanics and Diesel Engine Specialists” are projected to have the most labor market demand between 2021 and 2026, with 227 annual job openings

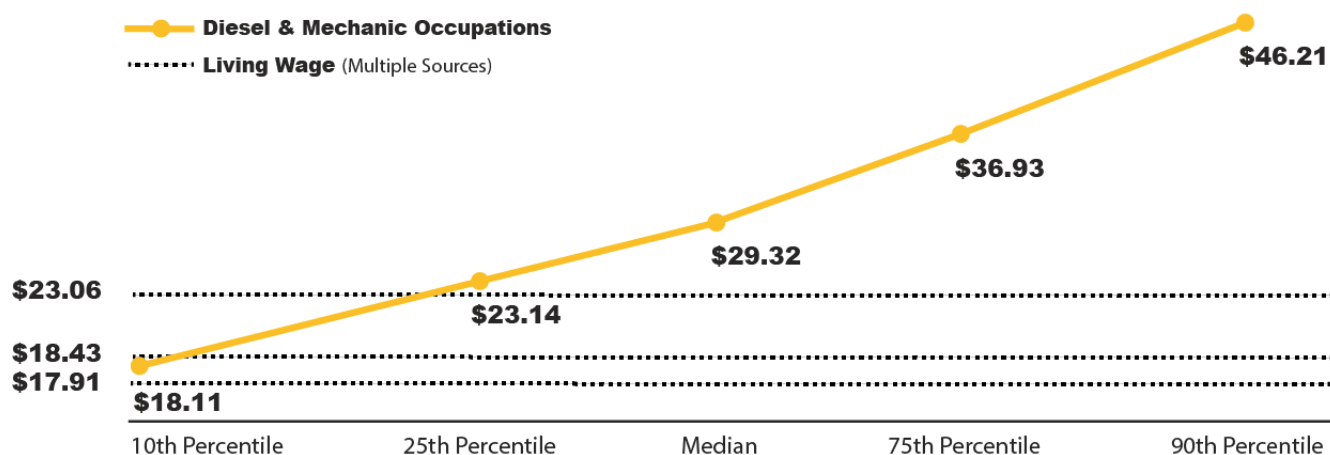
Exhibit 7: Number of Jobs for Diesel Mechanic Occupations in San Diego County (2021-2026) (14)

OCCUPATIONAL TITLE	2021 JOBS	2026 JOBS	2021-2026 NET JOBS CHANGE	2021-2026 % NET JOBS CHANGE	ANNUAL JOB OPENING DEMAND
BUS AND TRUCK MECHANICS AND DIESEL ENGINE SPECIALISTS	2,354	2,370	16	1%	227
MOBILE HEAVY EQUIPMENT MECHANICS, EXCEPT ENGINES	1,150	1,143	-7	-1%	114
TOTAL	3,504	3,513	9	0%	341

Earnings

Exhibit 8a disaggregates hourly earnings by occupation. The entry-level hourly earnings for Diesel Mechanic Occupations range from \$23.13 to \$23.15.

Exhibit 8a Average Hourly Earnings for Diesel Mechanic Occupations in San Diego (15).



Living Wages

- MIT Living Wage Calculator, Calculation for San Diego County **\$23.06** (16)
- City of San Diego, Compliance Department, Office of Labor Standards Enforcement **\$17.91** (17)
- Insight Center, Family Needs Calculator for San Diego **\$18.43** (18)

Exhibit 8b: Hourly Earnings for Diesel Mechanic Occupations in San Diego County (19)

OCCUPATIONAL TITLE	ENTRY-LEVEL HOURLY EARNINGS (25TH PERCENTILE)	MEDIAN HOURLY EARNINGS	EXPERIENCED HOURLY EARNINGS (75TH PERCENTILE)
BUS & TRUCK MECHANICS & DIESEL ENGINE SPECIALISTS	\$23.13	\$29.16	\$37.37
MOBILE HEAVY EQUIPMENT MECHANICS, EXCEPT ENGINES	\$23.15	\$29.48	\$36.48

On average, the entry-level hourly earnings for Diesel Mechanic Occupations are \$23.14; this is more than the living wage for a single adult in San Diego County, which is \$18.43 per hour (Exhibit 8b) (20).

Educational Supply

Educational supply for an occupation can be estimated by analyzing the number of awards in related Taxonomy of Programs (TOP) or Classification of Instructional Programs (CIP) codes (21). There are four TOP codes and six CIP codes related to Diesel Mechanic Occupations (Exhibit 9).

Exhibit 9: Related TOP and CIP Codes for Diesel Mechanic Occupations (22)

TOP OR CIP CODE	TOP OR CIP PROGRAM TITLE
TOP 0116.00	AGRICULTURAL POWER EQUIPMENT TECHNOLOGY
TOP 0947.00	DIESEL TECHNOLOGY
TOP 0947.20	HEAVY EQUIPMENT MAINTENANCE
TOP 0947.30	HEAVY EQUIPMENT OPERATION
CIP 01.0201	AGRICULTURAL MECHANIZATION, GENERAL
CIP 01.0204	AGRICULTURAL POWER MACHINERY OPERATION
CIP 01.0205	AGRICULTURAL MECHANICS AND EQUIPMENT/MACHINE TECHNOLOGY
CIP 47.0302	HEAVY EQUIPMENT MAINTENANCE TECHNOLOGY/TECHNICIAN
CIP 47.0605	DIESEL MECHANICS TECHNOLOGY/TECHNICIAN
CIP 49.0202	CONSTRUCTION/HEAVY EQUIPMENT/EARTHMOVING EQUIPMENT OPERATION

According to TOP data, two community colleges supply the region with awards for these occupations: Palomar College and San Diego Miramar College. According to CIP data, no non-community-college institutions supply the region with awards (Exhibit 10a).



Exhibit 10b: Number of Awards (Certificates and Degrees) Conferred by Postsecondary Institutions (Program Year 2017-18 through Program Year 2020-21 Average)

TOP6 OR CIP CODE	TOP OR CIP PROGRAM TITLE	3-YR ANNUAL AVERAGE CC AWARDS (PY18-19 TO PY20-21)	OTHER EDUCATIONAL INSTITUTIONS 3-YR ANNUAL AVERAGE AWARDS (PY17-18 TO PY19-20)	3-YR TOTAL AVERAGE SUPPLY (PY17-18 TO PY20-21)
0947.00	DIESEL TECHNOLOGY	37	0	37
	PALOMAR	9	0	
	SAN DIEGO MIRAMAR	28	0	

TOP6 OR CIP CODE	TOP OR CIP PROGRAM TITLE	3-YR ANNUAL AVERAGE CC AWARDS (PY18-19 TO PY20-21)	OTHER EDUCATIONAL INSTITUTIONS 3-YR ANNUAL AVERAGE AWARDS (PY17-18 TO PY19-20)	3-YR TOTAL AVERAGE SUPPLY (PY17-18 TO PY20-21)
0947.20	HEAVY EQUIPMENT MAINTENANCE	9	0	9
	SAN DIEGO MIRAMAR	9	0	
			TOTAL	46

Comparing labor demand (annual openings) with labor supply (23) suggests that there is a supply gap for these occupations in San Diego County, with 341 annual openings and 46 awards. Comparatively, there are 4,121 annual openings in California and 1,094 awards, suggesting that there is also a supply gap across the state (24) (Exhibit 11).

Exhibit 11: Labor Demand (Annual Openings) Compared with Labor Supply (Average Annual Awards)

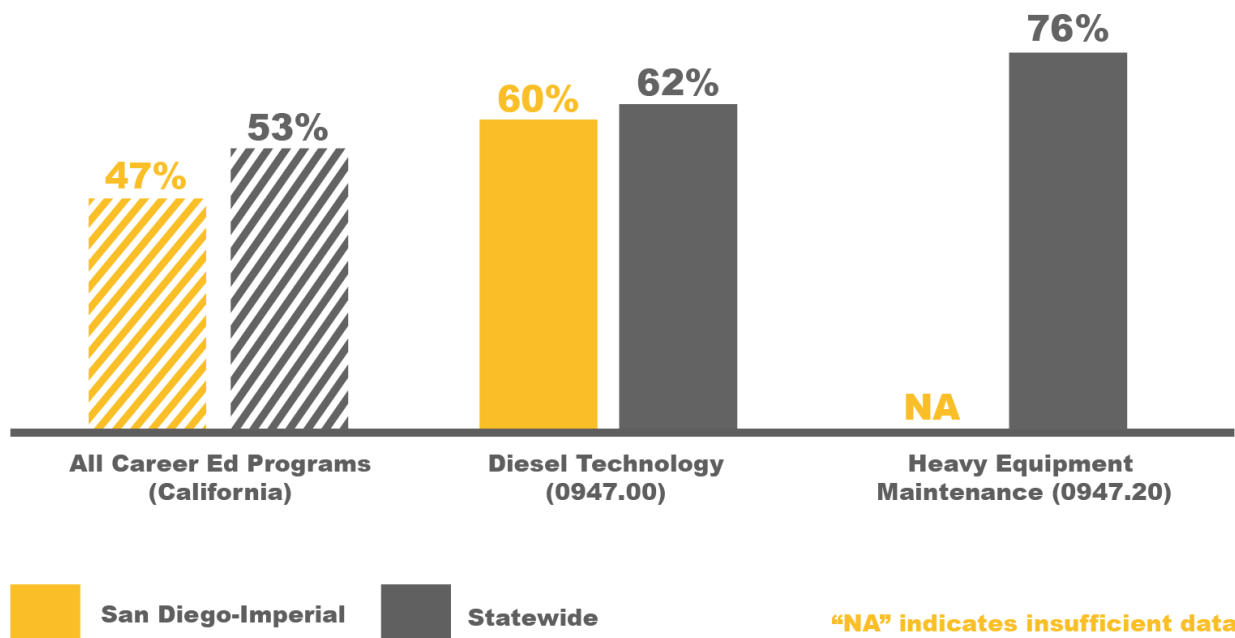
	DEMAND (ANNUAL OPENINGS)	SUPPLY (TOTAL ANNUAL AVERAGE SUPPLY)	SUPPLY GAP OR OVERSUPPLY
SAN DIEGO	341	46	295
CALIFORNIA	4,131	1,094	3,027

Please note: This is a basic analysis of supply and demand of labor. The data does not include workers currently in the labor force who could fill these positions or workers who are not captured by publicly available data. This data should be used to discuss the potential gaps or oversupply of workers; however, it should not be the only basis for determining whether or not a program should be developed.

Student Outcomes and Regional Comparisons

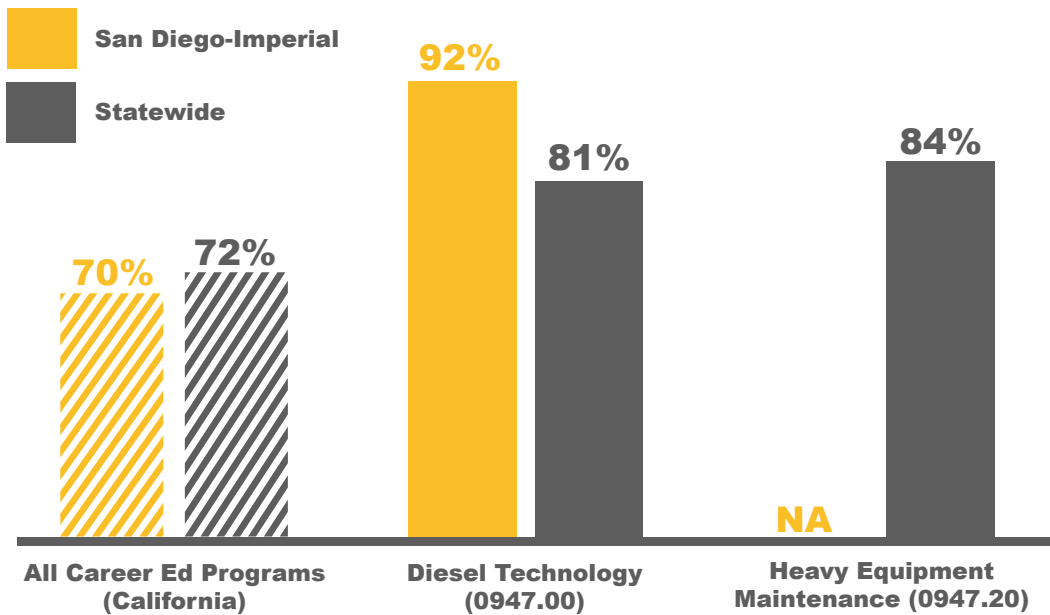
According to the California Community Colleges LaunchBoard, 60 percent of students in the San Diego-Imperial region earned a living wage after completing a program related to Diesel Mechanic Occupations, compared to 62 to 78 percent statewide and 53 percent of students in Career Education programs in general across the state (Exhibit 12a) (25).

Exhibit 12a: Percentage of Students Who Earned a Living Wage by Program, PY2018-19 (26)



According to the California Community Colleges LaunchBoard, 92 percent of students in the San Diego-Imperial region obtained a job closely related to their field of study after completing a program related to Diesel Mechanic Occupations, compared to 74 to 88 percent statewide and 72 percent of students in Career Education programs in general across the state (Exhibit 12b) (27).

Exhibit 12b: Percentage of Students in a Job Closely Related to Field of Study by Program, PY2017-18

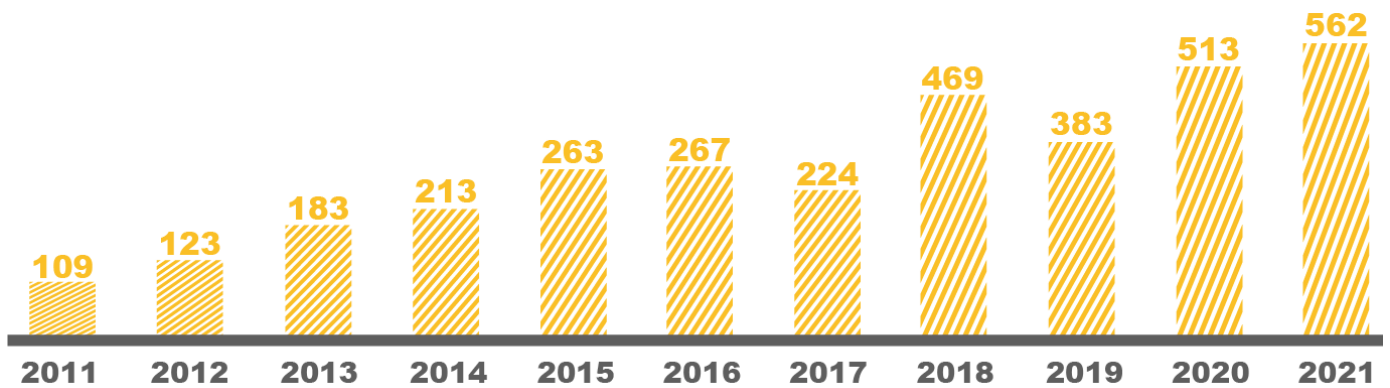


NA indicates insufficient data

Online Job Postings

This report analyzes not only historical and projected (traditional LMI) data, but also recent data from online job postings (real-time LMI). Online job postings may provide additional insight about recent changes in the labor market that are not captured by historical data. Between 2011 and 2021, there was an average of 301 online job postings per year for Diesel Mechanic Occupations in San Diego County (Exhibit 13). Please note that online job postings do not equal labor market demand; demand is represented by annual job openings (see Exhibit 7). Employers may post a position multiple times for various reasons, such as increasing the pool of applicants, for example.

Exhibit 13: Number of Online Job Postings for Diesel Mechanic Occupations in San Diego County (2011-2021) (28)



Top Employers

Between January 1, 2019 and December 31, 2021, the top five employers in San Diego County for Diesel Mechanic Occupations were Penske, Rush Truck Centers, Amerit Fleet Solutions, United Rentals, and Waste Management based on online job postings (Exhibit 14).

Southern California employers specific to zero-emission vehicles in the MHD space include Rivian (Irvine), TransPower/Meritor (San Diego), Canoo (Torrance), Battle Motors (LA), and BYD (LA).

Exhibit 14: Top Employers for Diesel Mechanic Occupations in San Diego County (29)

TOP EMPLOYERS	
<ul style="list-style-type: none"> • PENSKE • RUSH TRUCK CENTERS • AMERIT FLEET SOLUTIONS • UNITED RENTALS • WASTE MANAGEMENT 	<ul style="list-style-type: none"> • SYSCO CORPORATION • RYDER SYSTEM INCORPORATED • MECHANICS HUB • NAVAL FACILITIES ENGINEERING COMMAND • CROWN EQUIPMENT CORPORATION

Education, Skills, and Certifications

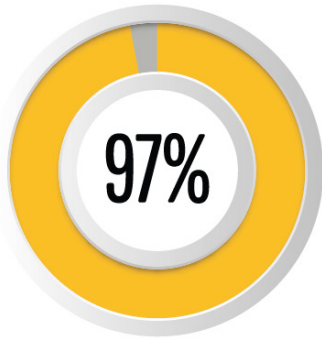
Diesel Mechanic Occupations have a national educational attainment of a high school diploma or equivalent (Exhibit 15a).

Exhibit 15a: National Educational Attainment for Diesel Mechanic Occupations (30)

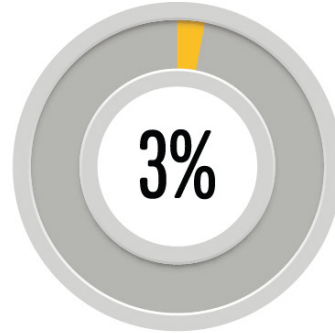
OCCUPATIONAL TITLE	TYPICAL ENTRY-LEVEL EDUCATION
BUS AND TRUCK MECHANICS AND DIESEL ENGINE SPECIALISTS	HIGH SCHOOL DIPLOMA OR EQUIVALENT
MOBILE HEAVY EQUIPMENT MECHANICS, EXCEPT ENGINES	HIGH SCHOOL DIPLOMA OR EQUIVALENT

Based on online job postings between January 1, 2019 and December 31, 2021 in San Diego County, employers posted a high school diploma or equivalent as the educational requirement for Diesel Mechanic Occupations (Exhibit 15b) (31).

Exhibit 15b: Educational Requirements for Diesel Mechanic Occupations in San Diego County (32)



HS Diploma or Equivalent



Associates Degree

Exhibit 16 lists the top specialized, soft, and software skills that appeared in online job postings between January 1, 2019 and December 31, 2021.

Exhibit 16: Top Skills for Diesel Mechanic Occupations in San Diego County (33)

SPECIALIZED SKILLS	SOFT SKILLS	SOFTWARE SKILLS
<ul style="list-style-type: none"> • REPAIR • PREDICTIVE / PREVENTATIVE MAINTENANCE • ELECTRICAL SYSTEMS • WELDING • HAND TOOLS • FORKLIFT OPERATION • VEHICLE MAINTENANCE • HYDRAULICS • CUSTOMER SERVICE • AUTO REPAIR • HEAVY EQUIPMENT • OCCUPATIONAL HEALTH & SAFETY • FLEET PREVENTIVE MAINTENANCE • POWER TOOLS • MACHINERY 	<ul style="list-style-type: none"> • PREVENTIVE MAINTENANCE • TROUBLESHOOTING • PHYSICAL ABILITIES • COMMUNICATION SKILLS • COMPUTER LITERACY • PROBLEM SOLVING • WORK AREA MAINTENANCE • VERBAL / ORAL COMMUNICATION • BUILDING EFFECTIVE RELATIONSHIPS • RESEARCH • ORGANIZATIONAL SKILLS • TEAMWORK / COLLABORATION • WRITING • ENGLISH • WRITTEN COMMUNICATION 	<ul style="list-style-type: none"> • MICROSOFT EXCEL • ORACLE • MICROSOFT POWERPOINT • MICROSOFT WORD • SAP • MICROSOFT WINDOWS • MICROSOFT OUTLOOK • WORD PROCESSING • MICROSOFT ACCESS • PAINT SHOP PRO • ACTIVE SERVER PAGES

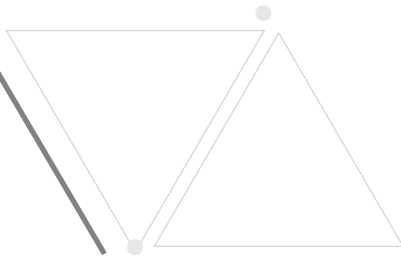


Exhibit 17: Skills Identified Through Employers Surveys and Interviews

SPECIALIZED SKILLS	OTHER SKILLS
<ul style="list-style-type: none"> • HYBRID • HVAC • ELECTRIC MOTORS, WIRING, MODULES • HIGH-VOLTAGE BATTERIES • HIGH-VOLTAGE SAFETY • SOFTWARE DIAGNOSIS & UPLOADING • ADAS • CNG • AIR BRAKES • TECHNICAL DOCUMENTATION • THERMAL MANAGEMENT & COOLING SYSTEMS • PNEUMATICS • BATTERY MANAGEMENT SYSTEMS 	<ul style="list-style-type: none"> • QUALITY ASSURANCE • TROUBLE SHOOTING

Exhibit 18 lists the top certification that appeared in online job postings between January 1, 2019 and December 31, 2021.

Exhibit 18: Top Certification for Diesel Mechanic Occupations in San Diego County (34)

TOP CERTIFICATION IN ONLINE JOB POSTINGS
<ul style="list-style-type: none"> • 1. AUTOMOTIVE SERVICE EXCELLENCE (ASE) CERTIFICATION • 2. AIR BRAKE CERTIFIED • 3. CDL CLASS A • 4. SECURITY CLEARANCE • 5. DIESEL MECHANIC CERTIFICATION • 6. CDL CLASS B • 7. BRAKE INSPECTOR CERTIFICATION • 8. CDL CLASS C • 9. CDL CLASS D • 10. OSHA FORKLIFT CERTIFICATION • 11. PROJECT MANAGEMENT CERTIFICATION • 12. ADJUSTER LICENSE • 13. AIR CONDITIONING (AC) CERTIFICATION • 14. EPA 609 • 15. HAZARDOUS MATERIALS CERTIFICATION



“

The wide-scale electrification of the transportation system will require a highly skilled and specialized workforce to support, maintain, and repair advanced electric drivetrains and their increasingly sophisticated technology.
www.lightsproject.com

VOLVO LIGHTS PROJECT INSIGHTS

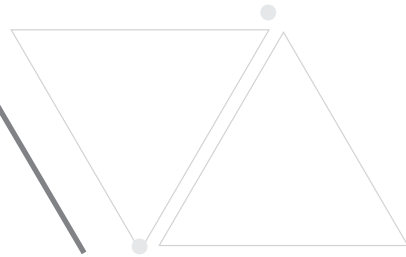
TRUCK TECHNICIANS

“Trained technicians are critical for boosting the uptime of electric trucks. Electric powertrains are vastly different than diesel trucks in terms of their parts. A common perception is that electric trucks will have fewer moving parts and are therefore less technically complex than diesel- and gasoline-powered trucks. Although true on one level, electric trucks also have highly specialized components, such as battery systems, advanced power management software and computing systems, regenerative braking systems, and high-voltage electrical systems, requiring the development and implementation of appropriate training modules for the safety of service technicians.”

STRATEGY

ZEV TASKFORCE: MULTI-STATE MEDIUM- AND HEAVY-DUTY ZERO-EMISSION VEHICLE ACTION PLAN

To achieve a timely transition and help ensure continued progress towards reduced emissions, 19 states (or jurisdictions) made a goal to require at least 30% of new MHD vehicle sales to be ZEV by 2030 and 100% by no later than 2050 (35).



Community Colleges

The high-level objectives for Community Colleges include:

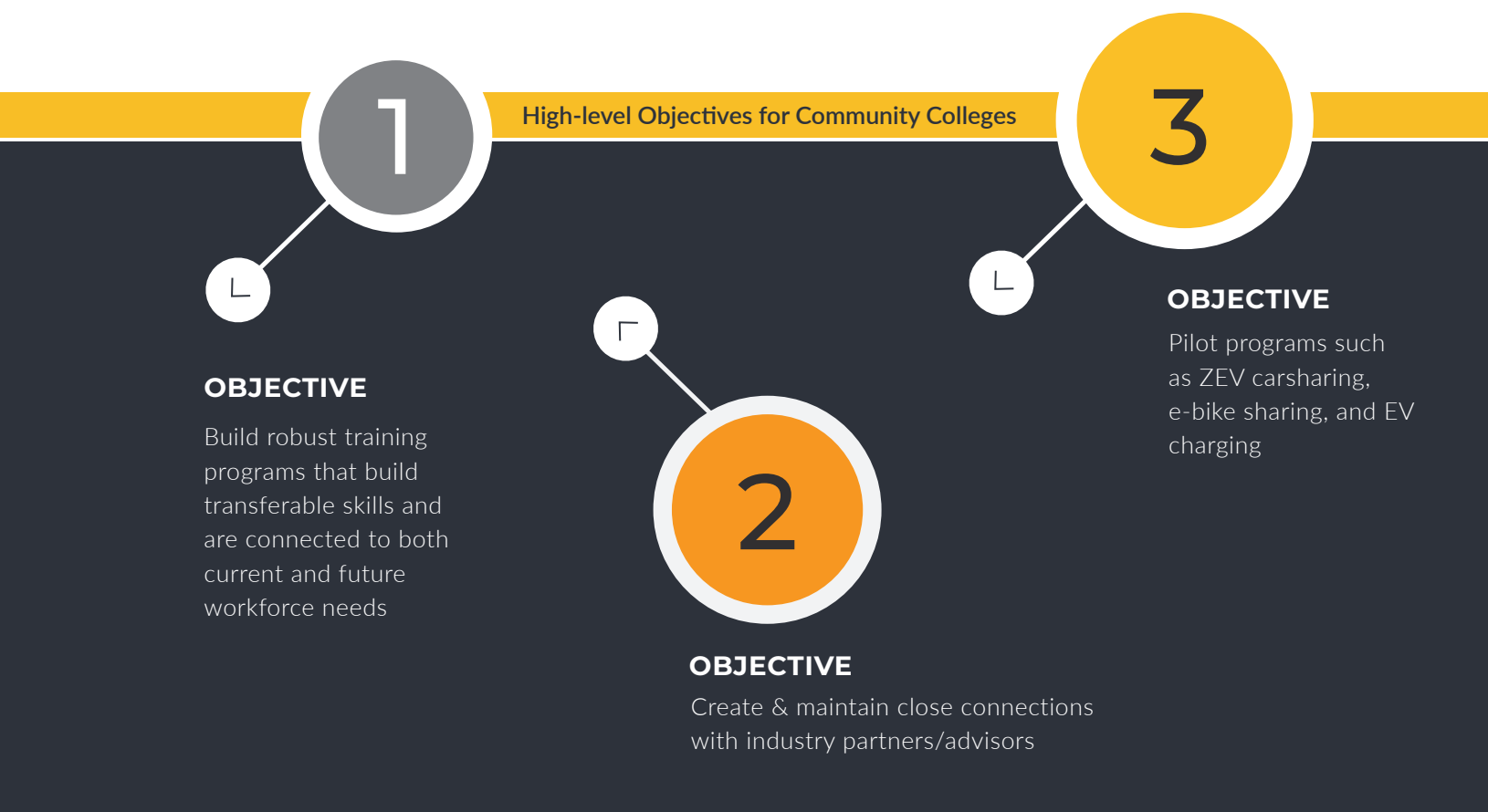


The ZEV Taskforce is comprised of the following states or jurisdictions:

California, Colorado, Connecticut, Hawaii, Maine, Maryland, Massachusetts, Nevada, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, District of Columbia, and Quebec.

The Taskforce's action plan was intended to facilitate rapid transition and acceleration. The graphic below illustrates some of the strategies related to education and community colleges.

States are encouraged to provide funding to develop or update pre-apprenticeship and apprenticeship programs and partnerships at high schools, community colleges, vocational and technical schools, training organizations, and government agencies. These programs should equip workers with the necessary skills for high-quality jobs and careers, and entrepreneurship in the clean transportation sector. Existing workers in the automotive sector at risk of job loss should be targeted for training to assist with upskilling.



Training and apprenticeship programs should be developed with input and support from relevant industries. States should enlist employers to sponsor, participate in, and fund apprenticeship and training programs for jobs in vehicle manufacturing and assembly, fueling infrastructure deployment, the battery supply chain, and repair and maintenance of vehicle mechanical and electrical systems. Sponsoring employers should compensate trainees for their time and commit to offer jobs to a percentage of top graduates.

States should work together to advocate for significant increases in U.S. federal funding for workforce training and apprenticeship programs.

CALIFORNIA STRATEGY

California Zero-Emission Vehicle Market Development Strategy Market Development Strategy

In September 2020, Governor Newsom signed Executive Order N-79-20 which set some ambitious zero-emission vehicle targets for California.

To assist in meeting these targets, the Governor tasked the Governor's Office of Business and Economic Development (GO-Biz) to collaborate with multiple agencies and partners to lead the administration's ZEV Market Development Strategy. This strategy document is the first part of the ongoing and evolving effort to make California's 100 percent ZEV vision a reality. The ZEV Strategy includes some high-level approaches involving community colleges.

Community colleges play a key role in California's Zero-Emission Vehicle Market Development Strategy. This includes training California's workforce, exposing students to ZEV technology, and establishing partnerships with ZEV companies (35). The high-level objectives for Community Colleges include:

- Establish robust training programs that build transferable skills and are connected to both current and future workforce needs
- Create & maintain close connections with industry partners/advisors
- Pilot programs such as ZEV carsharing, e-bike sharing, and EV charging (exposure)

California's Equity-Focused Workforce Development Efforts

Through California state law (AB398) and funding (High Roads initiative grants), the state calls for various workforce interventions to ensure that the state's transition to a carbon-neutral economy creates high-quality jobs; broadens career opportunities for disadvantaged communities; supports at-risk workers; and prepares workers to adapt and master new technologies related to low- and zero-emissions (36). This equity focus is a common theme in federal grants as well.



Equity Planning

Plan Programs
& Interventions
Around Equity

Equity is and will continue to be a major deliverable for state and federal funds related to the ZEV sector. Creating equitable access to future ZEV careers will be a priority and require the development of workforce training and upskilling programs for workers that serve underserved and disadvantaged communities.



A photograph of two men in a workshop setting. The man on the left is wearing safety glasses and a blue jacket, looking intently at a mechanical component. The man on the right is wearing a suit and glasses, holding a tablet and pointing at the component. The background is a blurred industrial environment.

**COMMUNITY COLLEGE
STRATEGY
RECOMMENDATIONS**

COMMUNITY COLLEGE STRATEGY RECOMMENDATIONS

MHD ZEV technology is very new and deployments are low but will continue to grow through the aforementioned state regulations and incentives. Major maintenance is not projected to be an issue for some time. Currently, manufacturers deploy technicians to the field to troubleshoot issues or have the customer send parts back for repair. However, manufacturers and employers agree that colleges should implement system introduction courses as well as high-voltage safety courses to start preparing for the industry transition of both on-road and off-road vehicles and equipment. Community Colleges have been identified as playing a key role in training and education in this sector and are ultimately tied to the success of adoption and scalability.

Advisory Committees

Programs should consider adding new members to their advisory committees that include expanded pathways (like local EV manufacturing), zero-emission platforms, ZEV fleet managers, Ports, or plug-in hybrid advisors to help with the proposed MHD ZEV transition. Most importantly, colleges with MHD should consider a Community of Practice model of partnering together and approaching early ZEV adopters such as the Port of SD, the City of San Diego, and MTS in order to work collaboratively and efficiently.

Additionally, programs should seek to align with manufacturers, especially local ones, as many of the state and federal grant opportunities require a workforce or educational partner. Many of these manufacturers are also willing to donate previous-generation ZEV models for instructional purposes.

Professional Development

It is recommended that investments be prioritized to develop faculty capacity and expertise in this subject area through OEM training, private training, and other opportunities that will help inform curriculum development. Transportation technology is rapidly changing and becoming increasingly more technologically advanced, which requires continuous professional development and program improvement to stay relevant.



MHD ZEV CONFERENCES

- ➔ Green Transportation Summit & Expo
- ➔ Advanced Clean Transportation (ACT) Expo
- ➔ Mobilize California Summit
- ➔ Zero Emission Bus Conference
- ➔ FORTH-Empowering Mobility

WHO IS DOING WHAT?

Imperial Valley College

Program: Diesel Farm Machinery & Heavy Equipment

Zero Emission Courses: N/A

Zero Emission Course Plans: Not currently

San Diego Miramar College

Program: Diesel Technology

Zero Emission Courses: N/A

Zero Emission Course Plans: Exploring

Palomar College

Program Name: Diesel Technology

Zero Emission Courses: Yes

Zero Emission Course Plans: One certificate comprised of 4 courses

CURRICULUM RECOMMENDATIONS

Curriculum recommendations are only suggestions and should be vetted by local advisory committees, curriculum committees, and any relevant factory partnerships or associations.

The following curriculum recommendations are based on interviews with medium- and heavy-duty vehicle industry advisors. A majority of these advisors are manufacturers as downstream dealers and end users are just now adding these vehicles to their inventories. Much like the light-duty ZEV market, training and workforce strategies are still in their infancy. These industry representatives recommend colleges take a phased approach that aligns with adoptions and deployment strategies. Employers would like to see colleges develop introductory technology courses to familiarize students with the basics of the platforms. Additionally, every industry advisor recommended safety courses be prioritized in the phase one rollout.



Suggested Curriculum Topics

Phase 1: Topics

- ➔ Introduction to ZEVs (EVs & Hydrogen Vehicle Platforms)
- ➔ High Voltage Electrical Safety & High Voltage Vehicle Safety Systems
- ➔ Basic ZEV Maintenance

Phase 2: Topics

- ➔ Electrical Courses
- ➔ Battery Management Systems
- ➔ Hybrid Vehicles REgenerative braking Systems
- ➔ Converter Systems
- ➔ Permanent Magnet Electrical Machines
- ➔ AC Induction Electrical Machines
- ➔ Energy Management Systems
- ➔ Transaxles, Gears, & Cooling Systems



Program Name Change Consideration

All regional medium- and heavy-duty transportation programs currently have “diesel” in the title or leading the title. Programs should consider changing their names to align more with the industry and changing technologies. This could be as simple as naming the program Medium- and Heavy-Duty Transportation or something similar.

Education & Awareness

Sustainability related training programs provide a unique opportunity for colleges to educate beyond training alone. Colleges should consider becoming a demonstration and awareness site through both training and infrastructure. Many of the strategies that have been published or are being drafted include these topics as an identified need to accelerate progress. Some of the benefits of this consideration would include funding through alignment, new avenues for marketing and outreach, program connectivity, and the potential for increased public traffic on campus.

Electric Vehicle Charging Infrastructure

Programs should include charging infrastructure in their program and lab planning as this will have a facilities impact and likely require capital improvement planning. Our team has experience navigating EV charging infrastructure at schools through our electric school bus projects and would be able to provide technical assistance with any infrastructure needs related to this subject.

Apprenticeships

Apprenticeship programs should be considered now or in the future while state funding is still accessible to help facilitate program development. As previously mentioned, both pre-apprenticeship and apprenticeship programs are being recommended in multiple ZEV strategies to help facilitate workforce needs and support connecting workers to high-quality jobs and lifelong employability.



TECHNICAL SKILLS

The below technical skills were gathered through OEM or employer interviews and 50 survey responses. Many of the skills and training needs have not been identified by end-users or OEMs as a result of how new this technology is. Programs should continue to work with ZEV advisors to make sure all the KSAs are relevant as the technology matures.

- Hybrid
- HVAC
- Electric Motors, Wiring, Modules
- High-Voltage Batteries
- High-Voltage Safety & PPE
- Software Diagnosis & Uploading
- ADAS
- CNG
- Air Brakes
- Technical Documentation
- Thermal Management & Cooling Systems
- Pneumatics
- Quality Fundamentals
- Advanced Diagnostics Tools
- Emergency Response
- Telematics
- Battery Management Systems
- Thermal Management Systems

EXAMPLE PROGRAM

SAN BERNARDINO VALLEY COLLEGE: HEAVY/MEDIUM DUTY CLEAN VEHICLE TECHNOLOGY CERTIFICATE OF ACHIEVEMENT

REQUIRED COURSES		UNITS
AUTO 010	INTRODUCTION TO HYBRID & ELECTRIC VEHICLE TECHNOLOGY	4
ELECTR 110	DIRECT CURRENT CIRCUIT ANALYSIS	3
ELECTR 111	DIRECT CURRENT CIRCUIT LABORATORY	1
ELECTR 115	ALTERNATING CURRENT CIRCUIT ANALYSIS	3
ELECTR 116	ALTERNATING CURRENT CIRCUIT LABORATORY	1
ELECTR 087	TECHNICAL CALCULATIONS	4
HMDT 042	ZERO-EMISSION HEAVY-DUTY TRUCK	2
HMDT 034	DIESEL ALTERNATIVE FUELS	4
	TOTAL UNITS	22

EXAMPLE STUDENT LEARNING OUTCOMES

- Assemble a diesel engine and/or a Direct Current (DC) or Alternating Current (AC) electric motor in accordance with manufacturer instructions and specifications
- Perform routine servicing of heavy-duty vehicles by evaluating equipment conditions successfully in a manner consistent with industry practices and safety standards
- Troubleshoot an electrical system failure, diagnose the cause and correctly repair that failure in accordance with accepted industry standards

Program Link: <https://catalog.valleycollege.edu/degree-certificate-program-index/hmdt/heavt-medium-duty-clean-vehicle-technology-certificate-achievement/>

RESOURCES:

- **COE Labor Market Reports:** <https://myworkforceconnection.org/labor-market-information/labor-market-briefs/>
- **ZEV Task Force: Multi-State Medium- and Heavy-Duty Zero-Emission Vehicle Action Plan: A Policy Framework to Eliminate Harmful Truck and Bus Emissions** - <https://www.nescaum.org/documents/multi-state-medium-and-heavy-duty-zev-action-plan.pdf>
- **Medium- and Heavy-Duty Zero-Emission Vehicles in California Dashboard** - <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy>
- **California Zero-Emission Vehicle Market Development Strategy** - https://static.business.ca.gov/wp-content/uploads/2021/02/ZEV_Strategy_Feb2021.pdf
- **EV HUB Resource Library** - Research, Tools, and Resources Related to Transportation Electrification - https://www.atlasevhub.com/tools-resources/library/?fwp_resource_tag=medium-and-heavy-duty
- **Advanced Clean Trucks Fact Sheet** - <https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet>
- **Path to Zero Emission Trucks FAQ** - <https://ww2.arb.ca.gov/resources/fact-sheets/path-zero-emission-trucks-faq>
- **Drive to Zero** - Zero Emissions Truck Industry Analytics - <https://globaldrivetozero.org/zeti-analytics/>
- **California Energy Commission Dashboard Tools** - <https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/medium-and-heavy>
- **ZEV Truckstop - Zero-Emission Vehicle Information** - <https://ww2.arb.ca.gov/sites/default/files/truckstop/zev/zevinfo.html>

Equipment Trainers:

L.A.B Corporation: Lucas-Nulle Training Systems for Commercial Vehicles and Agricultural Machinery

See High-Voltage Systems and Electric Drives

Website: <https://www.lucas-nuelle.us/2768/apg/17765/High-voltage-systems-and-electric-drives-.htm>

Rep: David Bjurlin. Cell 480-319-1168. Email: David@labcorp.edu Web: www.LABCorpEdu.Com

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REPORT CONTRIBUTORS

California Community College's - Centers of Excellence (COE)

California Energy Commission (CEC)

Battle Motors

Green Transportation Summit & Expo (GTSE)

Mobilize California Summit

Palomar College

Port of San Diego

City of Orange County - Fleet Services

San Diego Miramar College

Tom's Truck Center

Transportation Power, Inc. (TransPower & Meritor)

CONTACT US



2120 Columbia St. STE 1
San Diego, CA 90715



509-768-0917



rocketonegroup@gmail.com

www.rocket1group.com



11138 Del Amo Blvd. Suite 268
Lakewood, CA 90715



562-246-8224



info@wrkforce.org

www.wrkforce.com

2022