ELECTRIC VEHICLES: THE MARKET AND ITS FUTURE WORKFORCE NEEDS

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August 2012

This report was commissioned by the Pacific Gateway Workforce Investment Network.

The LAEDC Economic and Policy Analysis Group offers objective economic and policy research for public agencies and private firms. The group focuses on economic impact studies, regional industry analyses, economic forecasts and issue studies, particularly in water, transportation, infrastructure and environmental policy.

Every reasonable effort has been made to ensure that the data contained herein reflect the most accurate and timely information possible and they are believed to be reliable.

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MARKET AND INFRASTRUCTURE

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1 Introduction

New emissions regulations and advances in technology have led to the emergence of hybrid and electric vehicles. There are three classifications of electric vehicles: hybrid-electric vehicles (HEV), which have a smaller combustion engine that is supplemented by the energy stored in the battery; plug-in hybrid electric vehicles (PHEV), which have an electric motor in addition to an internal combustion engine; and all-electric vehicles (EV), which have only an electric motor. Plug-in electric vehicle refers to both PHEVs and EVs.

While most individuals understand that HEVs and PEVs are more beneficial to the environment from the reduced consumption of fossil fuel and little to no emissions, widespread adoption has been slow in coming due to several negative perceptions held by potential customers. Successful wide-spread adoption depends upon effectively addressing each concern.

Incentives for purchase, such as rebates, tax exemptions, utility rate reductions, special parking privileges and HOV stickers have helped facilitate adoption by increasing the perceived benefits of ownership for electric vehicles. Incentives beyond the consumer level include grants or advanced financing to fund the adoption of alternative and electric vehicles in transportation fleets and

Photo Credit: Cars with Chords

further research and development. Laws and regulations will also push consumers and public and private entities to move towards more environmentally-friendly options in their vehicle choices.

Electric vehicle charging stations are necessary for most plug-in hybrid vehicles and all battery-electric vehicles. As PEVs become more prominent, a charging infrastructure is required to overcome the issue of limited range.

Still, the future of this sector is promising, as consumer awareness and preferences for lower emitting vehicles grow. ❖

2 Electric Vehicles Market

Consumer Perceptions

Consumer behavior is complex. While most individuals understand that HEVs and PEVs are more beneficial to the environment because of their reduced consumption of fossil fuels and fewer emissions, widespread adoption has been slow in coming due to several negative perceptions held by potential customers. For some consumers, these perceived inconveniences may outweigh the perceived benefits of owning a PEV.

Persistent concerns that exist in regards to PEVs are their reliability, the upfront price differential between EVs and conventional vehicles, range, the availability of supporting infrastructure and services and vehicle safety. Successful wide-spread adoption of electric vehicles will depend upon understanding these perceptions and effectively addressing each one. As PEVs become more commonplace, social influence will also influence potential customers in their decisions to purchase a vehicle.

Reliability

HEV and PEVs must adhere to the same quality standards as conventional gasoline engine vehicles. Modern electric vehicles have been in production since the 1990s and both electric drive systems and batteries have proved to be reliable. Additionally, they tend to have less moving parts, require less routine maintenance, and their regenerative braking systems (HEV and PHEV) wear less. In reality, these vehicles have proven to be more reliable compared to conventional vehicles.

Price Differential

Exhibit 2-1 shows prices of selected 2010 model hybrid-electric vehicles and their incremental price over the combustible engine version. While an upfront price differential does exist (largely due to the high cost of the electric battery) the increased reliability and reduced maintenance costs associated with HEVs and PEVs lower the total cost of ownership of the vehicle in comparison to conventional vehicles. Savings from reduced fossil fuel consumption lowers the cost of ownership even further.

Photo Credit: Ariel Adams

Exhibit 2-1
Hybrid Vehicle Prices and Incremental Pricing 2010

Model	HEV Price	Incremental Pricing
Cadillac Escalade	$ 80,575	$ 6,525
Chevy Silverado	43,080	11,768
Chevy Tahoe	52,123	6,675
Ford Escape	31,990	7,793
Ford Fusion	27,950	3,925
GMC Sierra	43,450	9,808
GMC Yukon	56,265	6,145
Honda Civic	23,800	3,403
Mercury Mariner	30,980	5,510
Mercury Milan	28,180	3,010
Nissan Altima	26,780	1,780
Toyota Camry	26,150	1,930
Toyota Highlander	38,060	7,798
Toyota Prius	24,735	n/a
Average	n/a	$ 5,852

Source: AOL Autos

Range

According to the U.S. Bureau of Transportation Statistics, the average American drives less than 40 miles in one day's time. The average range of EVs

is about twice that, and PHEV and HEVs have a significantly higher range, reaching hundreds of miles. In instances where this statistic doesn't apply, new technological advancement in the EV field has offered solutions.

There are several ways to address the daily practicability concerns stemming from range limits of PEVs. New lithium-ion battery technology has increased efficiency in power storage, allowing for smaller batteries or increased power storage in batteries of equal size. Electric vehicle infrastructure is becoming more commonplace; many municipalities and private businesses are installing vehicle charge stations for their patrons, and advances in quick or fast charge technology has reduced the time required to charge an EV battery. Finally, battery exchange programs are another option in increasing the range and life of PEVs. All of these features are working in tandem to make PEVs more competitive with their combustible engine counterparts.

In addition to the specifications of their manufacture, driving conditions and driving style also impact the range of PEVs.

Supporting Infrastructure

Electric vehicle charging stations are necessary for most plug-in hybrid vehicles and all battery-electric vehicles. When a consumer purchases a PEV, the supporting EVSE is installed at their residence, and this is where the majority of the battery charging will take place. As PEV vehicles have become more prominent, municipalities and public and private entities have started to install public charging stations at the site of their operations. Drivers of PEVs can charge their vehicle while they are tending to other business, thereby increasing the vehicle's daily range. The increased number of publicly available EVSE and new quick charge stations are how electric vehicles are competing with the convenience of conventional vehicles that have quick refuel times and the widespread availability of gasoline stations.

Electric vehicle charging stations are a necessary component of the PEV infrastructure, but supporting infrastructure includes services as well. A workforce trained in the service of PEVs is also required, including: automotive technicians and mechanics trained in HEV and PEV maintenance and repair; electricians trained in the proper installation of different types of EVSE; and first responders trained to respond in emergency situations involving HEVs and PEVs with high-voltage batteries. Specialized education and training programs are being developed and offered in all of these areas through trade and technical schools, community colleges, universities and courses provided by the manufacturers of vehicles and EVSE (typically arranged through employers).

Vehicle Safety

Potential PEV customers may have concerns for vehicle safety with the presence of a high-voltage electric battery. The fears of what may happen if the vehicle malfunctions, is involved in a collision, how it reacts to extreme weather (heat and cold), or what may happens in wet conditions, all exist as deterrents to potential customers. In response to these concerns, HEV and PEV manufacturers have housed the electric batteries in sealed enclosures that have met all vehicle safety testing standards, and have insulated all high-voltage lines. Additionally, they have developed a safety mechanism that deactivates the electrical systems in case of emergency. For added safety, manufacturers provide model specific instructions for first responders to train them on how to respond to emergency situations safely and deactivate the high-voltage systems to reduce risk of injury to the driver and the responder.

Social Influence

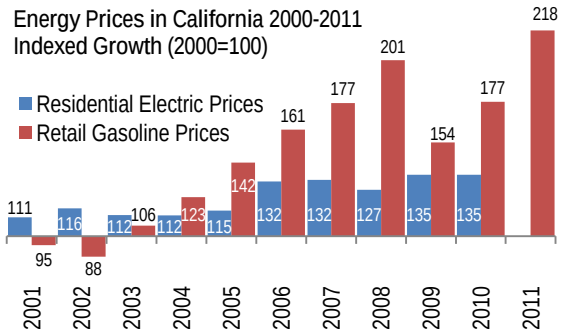
As electric vehicles gain popularity, the bandwagon effect does affect consumer behavior. Social influence results from the perceptions of the individual consumer and society as a whole with regards to certain values or lifestyles associated with PEVs and their owners. Potential consumers may associate with these and they may want to be a part of a larger group of individuals that they deem as like-minded.

Energy Costs and their Influence

The price of energy will impact consumer behavior; high and volatile gasoline prices will reduce the number of vehicle miles traveled and influence the types of vehicles purchased by consumers.

Electric vehicles are cheaper to drive due to the reduced consumption of gasoline and the lower and less volatile price of electricity. Exhibit 2-2 displays the average annual prices for retail gasoline (all grades) and residential electric rates from 2001 through 2011, indexed to 2000 prices. Compared to electricity, gasoline shows much more price volatility.

Exhibit 2-2
Energy Prices in California 2000-2011
Indexed Growth (2000=100)



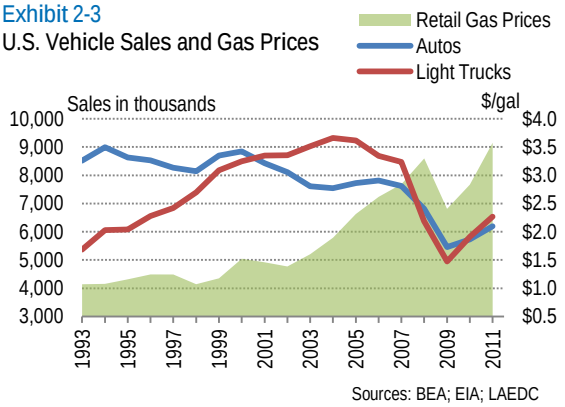
* 2011 CA electric prices n/a

Sources: DOE; EIA; LAEDC

In addition to lower fuel consumption, the presence of the electric battery has allowed the mechanical engine to be smaller compared to conventional vehicles. Smaller engines in HEV and PHEVs are lighter and as a result get better fuel gas mileage.

As fuel costs rise, consumers look for ways to reduce their out of pocket expenses related to transportation. Exhibit 2-3 shows the annual per gallon cost of gasoline at retail gas stations for all types of fuel as well as annual vehicle sales in the U.S. split between automobiles and light trucks. Light trucks include trucks, SUVs and minivans.

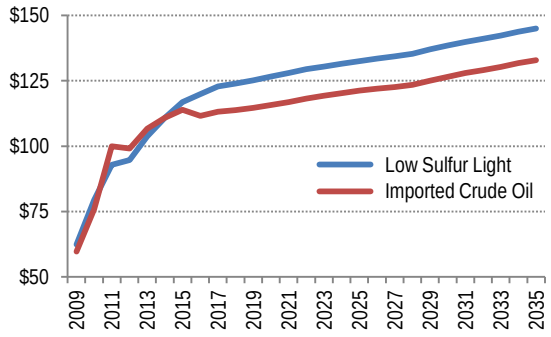
Exhibit 2-3
U.S. Vehicle Sales and Gas Prices



Sources: BEA; EIA; LAEDC

Gasoline prices are forecasted to continue their increase over time as other parts of the world become more developed and contribute to increased demand. The EIA produces an annual energy outlook that makes long-term price projections based upon a constructed reference case. Exhibit 2-4 shows the price per barrel projections of both low sulfur light oil and imported crude oil from 2009 through 2035. Prices are in constant 2010 dollars, meaning that the projected nominal pricing per barrel has been adjusted to account for expected levels of inflation.

Exhibit 2-4
Long-Term Price Projections for Oil
(2010 dollars per barrel)



Continuous increases in the price per barrel for oil will result in increased costs faced by the consumer in operating conventional combustible engine vehicles. The more these operating costs rise, the more consumers will entertain purchasing electric vehicles since their perceived benefits of ownership will also increase as cost savings to the consumer.

Incentives for Purchase

To further facilitate the adoption of electric vehicles and to help overcome existing concerns consumers have in regards to range, reliability and the availability of supporting services and infrastructure, many incentives are being offered by both public and private entities.

The purpose of these incentives is to increase the perceived benefits of ownership for electric vehicles. They come in a variety of forms such as: financial incentives for purchase from government entities, including rebates, tax exemptions and vouchers; utility rate reductions for alternative vehicle owners; and increased driving perks, such as special parking privileges or HOV stickers that exempt EV drivers from being denied access to HOV lanes due to single or inadequate occupancy.

Currently, light-duty PEVs on the market are eligible for a federal tax credit of up to $7,500 through the Qualified Plug-In Electric Drive Motor Vehicle Tax Credit program. The credit will be available through 2104 unless PEV manufacturers reach a predetermined cap quantity of PEVs produced prior to the end date.

Incentives exist beyond the consumer level; they are available as grants or advanced financing awarded that fund additional research and development, the adoption of alternative and

electric vehicles in transportation fleets to reduce emissions, and to expedite the roll out of the infrastructure required to support electric vehicles.

These incentives exist as opportunities for the early adoption of alternative fuel vehicles; however, laws and regulations are in place that will also push consumers and public and private entities to move towards more environmentally friendly options in their vehicle choices.

The U.S. Department of Energy provides a complete listing of the available incentives, laws and regulations related to alternative fuel vehicles. Below is a listing of those incentives that apply in California..

Federal Incentives

- Advanced Biofuel Production Grants and Loan Guarantees
- Advanced Biofuel Production Payments
- Advanced Energy Research Project Grants
- Advanced Technology Vehicle (ATV) Manufacturing Incentives
- Alternative Fuel Tax Exemption
- Biobased Transportation Research Funding
- Biodiesel Education Grants
- Biomass Research and Development Initiative
- Value-Added Producer Grants (VAPG
- Cellulosic Biofuel Producer Tax Credit
- Ethanol Infrastructure Grants and Loan Guarantees
- Fuel Cell Motor Vehicle Tax Credit
- Hydrogen Fuel Excise Tax Credit
- Hydrogen Fuel Infrastructure Tax Credit
- Hydrogen Fuel Mixture Excise Tax Credit
- Idle Reduction Equipment Excise Tax Exemption
- Improved Energy Technology Loans
- Qualified Plug-In Electric Drive Motor Vehicle Tax Credit

California Incentives

- Alternative Fuel and Advanced Vehicle Career Training
- Hybrid Electric Vehicle Purchase Vouchers
- Plug-In Hybrid and Zero Emission Light-Duty Vehicle Rebates
- Alternative Fuel and Vehicle Incentives
- High Occupancy Vehicle (HOV) Lane Exemption
- Alternative Fuel Vehicle (AFV) and Fueling Infrastructure Grants
- Emissions Reductions Grants
- Heavy-Duty Vehicle Emissions Reduction Grants
- Natural Gas Vehicle (NGV) Home Fueling Infrastructure Incentive - South Coast
- Low Emissions School Bus Grants
- Alternative Fuel and Advanced Technology Research and Development
- Advanced Transportation Financing

- Compressed Natural Gas (CNG) Tax Exemption for Transit Use
- Electric Vehicle Supply Equipment (EVSE) Incentive - Bay Area
- Vehicle Emissions Reduction Grants - Sacramento

Utility/Private Incentives

- Propane Vehicle Rebates - Western Propane Gas Association (WPGA)
- Electric Vehicle Supply Equipment (EVSE) Incentive - Coulomb Technologies
- Electric Vehicle Supply Equipment (EVSE) Rebate - LADWP
- Electric Vehicle Supply Equipment (EVSE) Incentive - ECOtality
- Alternative Fuel Vehicle (AFV) and Hybrid Electric Vehicle (AFV) Insurance Discount

- Employer Invested Emissions Reduction Funding - South Coast
- Technology Advancement Funding - South Coast
- Alternative Fuel and Advanced Vehicle Rebate - San Joaquin Valley
- Alternative Fuel Vehicle (AFV) and Fueling Infrastructure Incentives - San Joaquin Valley
- Heavy-Duty Diesel Vehicle Vouchers - San Joaquin Valley
- Low Emission Vehicle Incentives and Technical Training - San Joaquin Valley
- Air Quality Improvement Program Funding - Ventura County

- Plug-In Electric Vehicle Charging Rate Reduction - SMUD
- Plug-In Electric Vehicle Charging Rate Reduction - LADWP
- Plug-In Electric Vehicle Charging Rate Reduction - SCE
- Clean Vehicle Electricity and Natural Gas Rate Reduction - PG&E
- Plug-In Electric Vehicle and Natural Gas Infrastructure Charging Rate Reduction - SDG&E
- Natural Gas Rate Reduction - SoCalGas
- Biofuel Volume Rebate Program - Propel Fuels

Federal Laws and Regulations

- Aftermarket Alternative Fuel Vehicle (AFV) Conversions
- Alternative Fuel Definition
- Alternative Fuel Definition - Internal Revenue Code
- Alternative Fuel and Vehicle Labeling Requirements
- Fuel Economy Test Procedures and Labeling
- Greenhouse Gas (GHG) Reporting Requirement
- Import Duty for Fuel Ethanol
- Procurement Preference for Electric and Hybrid Electric Vehicles
- Renewable Fuel Standard (RFS) Program
- Renewable Fuels Assessment
- Tier 2 Vehicle and Gasoline Sulfur Program
- Vehicle Acquisition and Fuel Use Requirements for Federal Fleets
- Vehicle Acquisition and Fuel Use Requirements for Private and Local Government Fleets
- Vehicle Acquisition and Fuel Use Requirements for State and Alternative Fuel Provider Fleets
- Vehicle Fuel Economy and Greenhouse Gas Emissions Standards
- Vehicle Incremental Cost Allocation

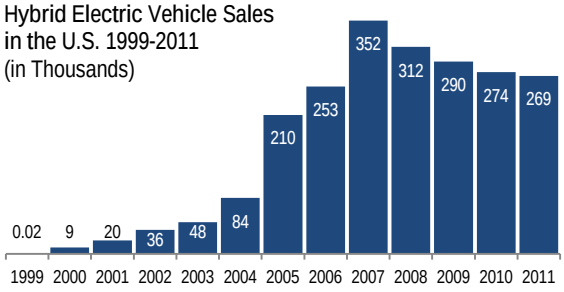
California Laws and Regulations

- Plug-In Electric Vehicle Parking Regulation
- Electricity Provider Definition
- Common Interest Development Electric Vehicle Supply Equipment (EVSE) Regulations
- Access to Plug-In Electric Vehicle Registration Records
- Vehicle Miles Traveled Tax Feasibility Evaluation
- Plug-In Electric Vehicle Infrastructure Information Resource
- Plug-In Electric Vehicle Infrastructure Evaluation
- Plug-In Electric Vehicle Charging Requirements
- Low Carbon Fuel Standard
- State Transportation Plan
- Low Emission Vehicle (LEV) Standards
- Zero Emission Vehicle (ZEV) Production Requirements
- Regional Climate Change Initiative
- Alternative Fuel and Plug-in Hybrid Electric Vehicle Retrofit Regulations
- Alternative Fuel Vehicle Retrofit Emissions Inspection Process
- Alternative Fuel Tax
- Fleet Vehicle Procurement Requirements
- Vehicle Acquisition and Petroleum Reduction Requirements
- Alternative Fuel and Vehicle Policy Development
- Hydrogen Fuel Specifications
- Heavy-Duty Truck Idle Reduction Requirements
- Idle Reduction Requirement at Schools
- Heavy-Duty Vehicle Greenhouse Gas Emissions Regulations
- Mobile Source Emissions Reduction Requirements
- Tire Inflation Requirement
- Fuel-Efficient Tire Program Development
- Low-Speed Vehicle Access to Roadways
- Neighborhood Electric Vehicle (NEV) Access to Roadways
- Fleet Emissions Reduction Requirements - South Coast

EV and HEV Market

Hybrid and electric vehicles have experienced an increase in popularity over the past decade, and as such have had increased sales. Exhibit 2-5 shows the annual sales of hybrid electric vehicles in the U.S. from 2000 through 2011.

Exhibit 2-5
Hybrid Electric Vehicle Sales in the U.S. 1999-2011
(in Thousands)

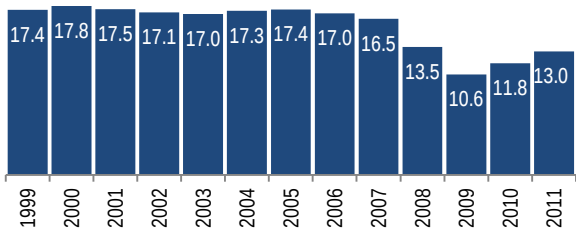


Source: US DOE, National Renewable Energy Lab

Peak sales for hybrid vehicles were 352,000 in 2007, just prior to the recession. Since then hybrid vehicle sales have declined, exhibiting the same downward trend as conventional vehicle sales from 2007 through 2009.

This data can be compared to total auto sales in the U.S for the same period (Exhibit 2-6).

Exhibit 2-6
U.S. Total Vehicle Sales
(in millions)



Sources: BEA

While total vehicle sales experienced an increase in sales in 2010 and 2011, sales of hybrid electric vehicles continued to decline. This is likely related to the expiration of federal tax credits in 2010 and the slightly higher sticker prices of hybrid vehicles amidst a period of slow economic recovery.

Exhibit 2-7 provides additional detail of the makes and models of the hybrid electric vehicles sold in 2011. The vehicles are listed in the order that they were released in the market.

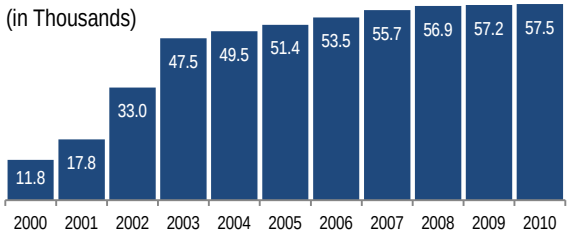
Exhibit 2-7
Hybrid Electric Vehicles Sales in U.S.

Model	2011	Total Sold 2000-2011
Honda Insight	15,549	70,984
Toyota Prius	136,463	1,091,564
Honda Civic	4,703	209,216
Ford Escape	10,089	116,556
Honda Accord	-	27,086
Lexus RX400h	10,723	113,632
Toyota Highlander	4,549	114,058
Mercury Mariner	-	12,806
Lexus GS 450h	282	5,163
Toyota Camry	9,241	178,805
Nissan Altima	3,236	36,510
Saturn Vue	-	10,029
Lexus LS600hL	84	2,315
Saturn Aura	-	1,638
Chevy Tahoe	519	8,990
GMC Yukon	598	5,362
Chevy Malibu	24	6,684
Cadillac Escalade	819	4,788
Chrysler Aspen	-	79
Dodge Durango	-	9
Ford Fusion	11,286	47,656
Mercury Milan	-	2,884
Lexus HS 250h	2,864	20,226
Sierra/Silverado	1,165	5,156
BMW ActiveHybrid 7	338	440
BMW X6	43	248
Ford Lincoln MKZ	5,739	6,931
Honda CR-Z	11,330	16,579
Mazda Tribute	484	1,054
Mercedes ML450	1	628
Mercedes S400	309	1,110
Porsche Cayenne	1,571	1,777
Lexus CT 200h	14,381	14,381
Hyundai Sonata	19,673	19,673
Buick Lacrosse	1,801	1,801
Buick Regal	123	123
Nissan Infiniti M35h	378	378
Porsche Panamera		0
VW Touareg Hybrid	390	390
Kia Optima		0
Total	268,755	2,157,726

Source: US DOE, National Renewable Energy Lab

Sales data that isolates electric vehicles is not available; however, the number of vehicles in use is available in the U.S. and by state. Exhibit 2-8 shows the number of electric vehicles in use from 2000 through 2011.

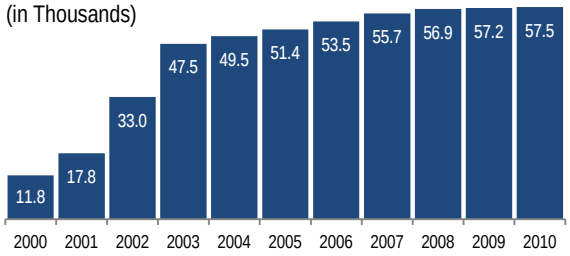
Exhibit 2-8
Electric Vehicles in Use in the U.S. 2000-2011 (in Thousands)



Source: US DOE, National Renewable Energy Lab

Peak levels for all electric vehicles in use were not realized until 2008, 2009 and 2010, in the midst of the recession. In 2011, there were 57,462 electric vehicles in use. Federal rebate programs, while they have expired on hybrid vehicles, are now available for plug-in hybrids and all electric vehicles.

Exhibit 2-9
Electric Vehicles in Use in the U.S. 2000-2011 (in Thousands)



Source: US DOE, National Renewable Energy Lab

California continues to lead the nation in electric vehicle use, with more than half of all electric vehicles on the road in use in the state.

Photo Credit: Green Prophet

Exhibit 2-10
Electric Vehicles in Use in California

Year	California	U.S.	CA share of U.S.
2004	20,773	49,536	41.9%
2005	25,892	51,398	50.4%
2006	28,818	53,526	53.8%
2007	30,273	55,730	54.3%
2008	30,242	56,901	53.1%
2009	31,545	57,185	55.2%
2010	33,217	57,462	57.8%
Total	200,760	381,738	52.6%

Source: US DOE, National Renewable Energy Lab

The sales of hybrid electric vehicles have increased significantly over the last decade, posting a mild decline from its peak level in 2007 due to the onset of the recession late in that year. While sales of all electric vehicles are difficult to obtain, the reported number of electric vehicles in use implies that the trend of sales over the last decade for these vehicles has also been increasing.

In terms of the saturation level of electric vehicles in California versus the entire market, the state represents a significant share of all electric vehicles reported to be in use. This can be attributed to several factors, including environmental consciousness, availability of the required infrastructure, offered incentives for purchase, government policies that promote EVs and higher public awareness of electric vehicles due to increased adoption of alternative vehicles by local consumers. ❖

3 Electric Vehicles Infrastructure

All types of electric vehicles have electric batteries that require a charge to operate. This is done a variety of ways depending upon the model. Hybrid-electric vehicles use internal systems to charge the battery, namely the internal combustion engine and regenerative braking. Plug-in electric vehicles use those as well, but additionally can be charged by plugging in to an outside power source. All electric vehicles are charged by connecting to an outside power source.

The outside power sources are referred to as electric vehicle supply equipment (EVSE), or charging stations. Electric vehicle charging stations are necessary for most plug-in hybrid vehicles and all battery-electric vehicles. As PHEV and all-electric vehicles become more prominent, charging infrastructure is required to overcome the issue of limited range.

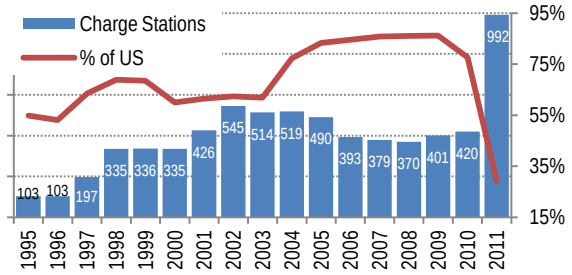
Electric vehicle supply equipment (EVSE) comes in several varieties, each with different power requirements, equipment and charge times. All EVSE is installed by electricians who undergo specialized training to ensure the installation of these high-voltage stations are permitted and meet the proper code and safety requirements. Exhibit 3-1 shows the four types of EVSE and the associated characteristics and charge times.

Exhibit 3-2 displays the growth of EVSE in California from1995 through 2011.

Photo Credit: LA DWP

In spite of a large increase in installations in 2011, California's share of national EVSE fell dramatically as installations proliferated across the nation.

Exhibit 3-2
Electric Charging Stations in CA, 1995-2011



Sources: AFDC; LAEDC

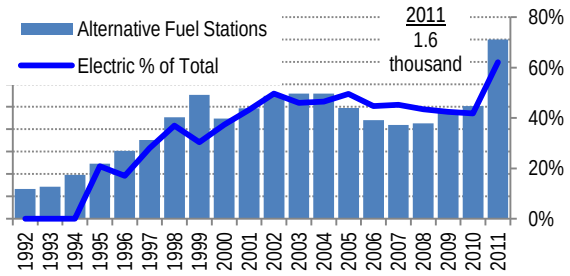
Exhibit 3-1
EVSE Types and Characteristics

	Level 1	Level 2	Level 3 (in development)	DC Fast Charging
Primary Use	Residential	Residential and Public	Public	Public
Current Type	AC	AC	AC	DC
Amperage (amps)	Up to 15 amps	Up to 80 amps	to be determined	Up to 200 amps
Voltage (V)	120V	240V	to be determined	480V
Kilowatts (kW)	Up to 1.8 kW	Up to 19.2 kW	to be determined	50 to 150 kW
Charging Time (fully depleted)	6 to 20 hours	3 to 8 hours	Under 30 minutes	Under 30 minutes

Source: US DOE

Exhibit 3-3 shows the number of alternative fuel stations in California, along with the share that EVSE represents. EVSE has been consistently increasing since 1995 and now represents 62 percent of all alternative fuel stations in California.

Exhibit 3-3
Alternative Fuel Stations in CA, 1992-2011



Sources: AFDC; LAEDC

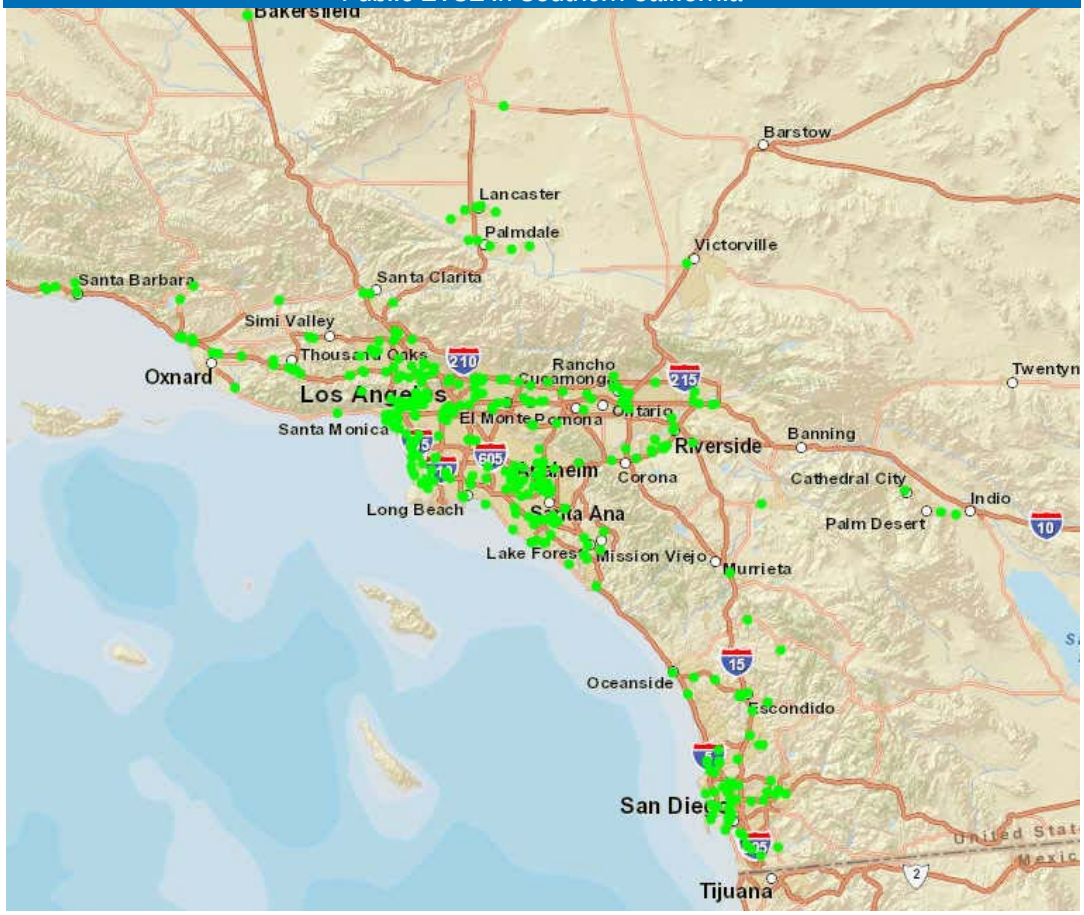
Most PEV owners charge their vehicle at night at an installed residential charging station. However, public charging stations, including quick charge stations, are becoming more commonplace to support existing PEVs and to provide enough charging infrastructure to advance more widespread adoption by consumers.

Exhibits 3-4 through 3-7 on the following pages display the location of public EVSE infrastructure in the state of California, in the Southern California region and in Los Angeles County.

Exhibit 3-4
Public EVSE in California

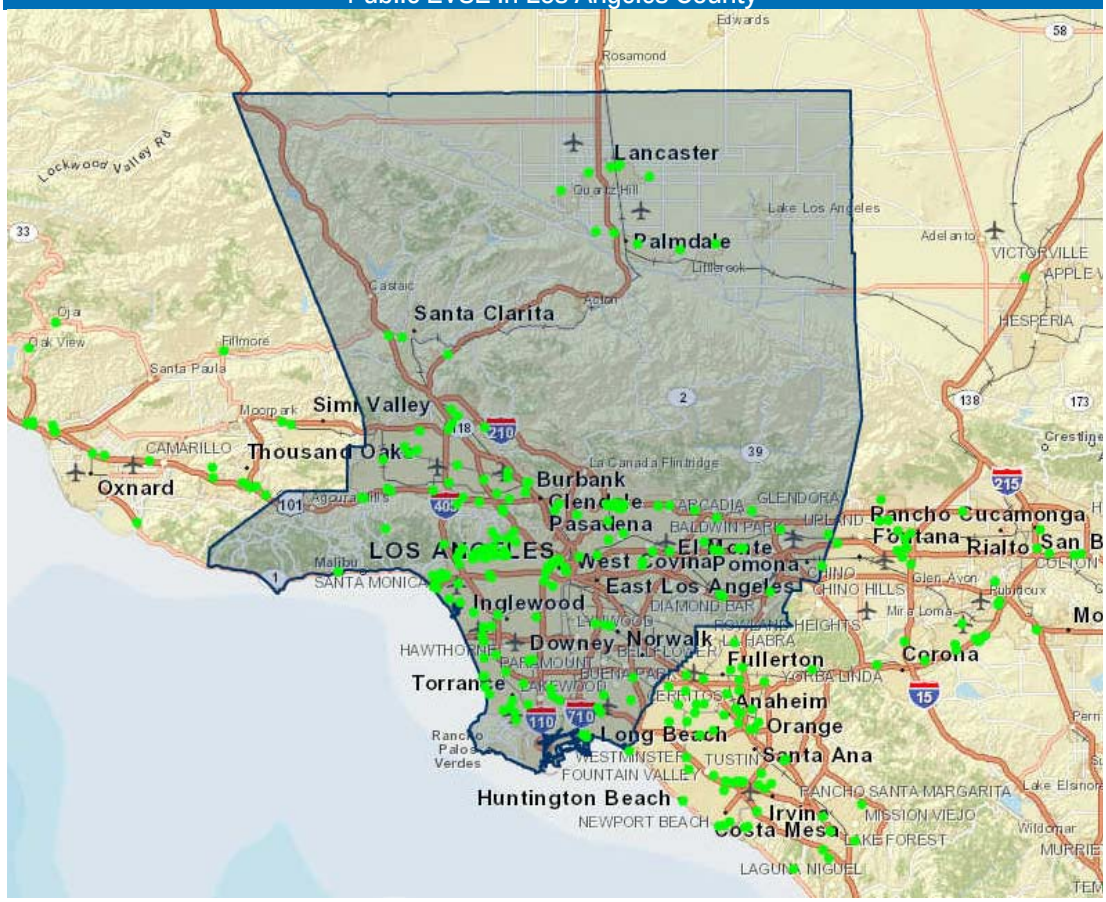
Sources: U.S. DOE; ESRI

Exhibit 3-5
Public EVSE in Southern California



Sources: U.S. DOE; ESRI

Exhibit 3-6
Public EVSE in Los Angeles County



Sources: U.S. DOE; ESRI

Exhibit 3-7 below shows the locations of planned future EVSE installations in the state.

Exhibit 3-7
Planned EVSE in California

Sources: U.S. DOE; ESRI

ARRA and PEV Infrastructure

The American Recovery and Reinvestment Act (ARRA) of 2009 had a large impact on the rollout of ESVE infrastructure here in California and across the nation. Numerous PEV and EVSE projects were made possible by ARRA funding via the Transportation Electrification Initiative administered by the Department of Energy. The goal of the initiative was to expedite the production and deployment of electric vehicles due to their societal benefits; reduced consumption of petroleum; lower GHG emissions; and potential job creation related to the development of PEV and EVSE technology and the following manufacturing, sales and support.

ChargePoint America and ECOtality North America both received ARRA funding through the Transportation Electrification Initiative to deploy EVSE throughout the U.S. and in California. ChargePoint installed 4,600 Charge-Point Networked Charging Stations at residential and public sites across the nation including Sacramento, the San Jose/San Francisco Bay Area, and Los Angeles. ECOtality installed roughly 14,000 Level II EVSE across the U.S. and 300 DC Quick Charge stations in 16 major cities, including California's major metropolitan areas. According to the U.S. Department of Energy, at the end of 2011, there were over 1,100 public chargers installed in California; over the next few years they estimate that number to grow exponentially.

Clean Cities

The U.S. Department of Energy has started the Clean Cities program, comprised of over 100 coalitions of cities and other transportation-related organizations, including utilities, vehicle manufacturers and government agencies.

The main focus of Clean Cities is to help deploy alternative forms of transportation including electric vehicles. They work to convert government fleets to alternative fuel vehicles, including PEVs, which are more fuel efficient and have lower emission. This helps meet federal, state and local government fleet requirements. Additionally, Clean Cities Coalitions work to provide the support for alternative fueling infrastructure, including EVSE.

Clean Cities coalitions in Los Angeles County include Los Angeles City, Long Beach City, and Antelope Valley City. Other Clean Cities Coalitions throughout Southern California include: the Southern California Coalition; Coachella Valley Region Coalition; Western Riverside County Coalition; and the San Diego Region Coalition. Exhibit 3-8 provides a few key statistics for each Clean Cities Coalition member within Los Angeles County.

Exhibit 3-8

Clean Cities Coalitions in Los Angeles County

	Los Angeles	Long Beach	Antelope Valley
Population	$10,325,787	$498,016	$366,083
Area	1,156 sq. mi.	50 sq. mi.	1,313 sq. mi.
Alternative Fueling Stations	352	11	17
Biodiesel (B20 and above)	*2*	-	-
Natural Gas	*62*	*4*	*2*
Ethanol (E85)	*4*	-	-
Electric	*235*	*6*	*12*
Hydrogen	*10*	-	-
Propane	*39*	*1*	*3*
2010 Petrol Savings (gas gal equiv)	22,496,426	10,049,730	1,673,259
Alternative Fuel Vehicles	*36%*	*50%*	*50%*
Afvs Fuel Blends	*36%*	*50%*	*50%*
Idle Reductions	*18%*	-	-
VMT Reductions	*9%*	-	-
Fuel Economy Improvements	*1%*	*1%*	-

Source: U.S. DOE

4 Continued Investment

Incentives

Opportunities for continued investment exist in the availability of incentives related to the purchase of electric vehicles and their charging stations. Continuing to extend incentives to both consumers and public agencies will aid in a more rapid and widespread adoption.

Incentives extended to consumers to purchase hybrid electric and all-electric vehicles have enticed early adopters despite the price differential that exists between them and conventional vehicles. While incentives for traditional hybrid electric vehicles have expired, similar incentives still exist for plug-in hybrid and all electric vehicles.

The EVSE infrastructure required for plug-in electric vehicles cost thousands of dollars depending upon its specifications. Level 2 EVSE, the same type used in residential EVSE installations, range in price from $1,000 to $7,000. Additional hardware is required for high-powered DC fast-charge EVSE, and it reflects in the pricing—costs range from $20,000 to $50,000.

Extending discounts and incentives will lower charging station costs. Federal tax credits are available for up to $7,500 for the vehicle purchase and an additional credit for residential charging stations. Currently a 30 percent federal tax credit (up to $1,000) is available for qualified residential fueling EVSE.

California also offers consumers a tax credit of up to $2,500 for the purchase of an electric vehicle and as an added bonus these are eligible for a limited number of HOV stickers which allow access to HOV lanes regardless of vehicle occupancy.

Offering subsidies and grants, as was done with ARRA, to install public charging infrastructure will accelerate the adoption of electric vehicles by

consumers. The prohibitive price associated with large scale EVSE installations by municipalities can be a barrier to rapid rollouts. Any policy that promotes electric vehicles must address the supporting infrastructure if consumers are expected to participate in early adoption of electric vehicles on any sizeable scale. Larger availability of charging infrastructure will help alleviate consumer concerns with range.

By continuing to offer consumers incentives to purchase plug-in hybrid and electric vehicles, the existing cost differential between those vehicles and conventional vehicles will be reduced and result in an increase in the perceived benefits associated with electric vehicle ownership. The concerns of early adoption will be outweighed by potential increased savings in long term cost for operating the vehicle.

Infrastructure

Opportunities for continued investment exist in regards to plug-in electric and all electric vehicle infrastructure in several avenues, battery replacement programs and charge station and battery switching infrastructure.

Although the current PEV battery technology provides a longer life than earlier verions, batteries will eventually wear out since they have a finite number of charging cycles. Nissan and General Motors are offering warranties for Leaf and Volt batteries that are eight-year or 100,000-miles in term. Batteries replaced outside of the warranty are expected to be pricey, but they should become more affordable as technology advances and economies of scale are realized from mass production. Investing more into warranty or battery replacement programs is a way to help alleviate consumer concerns about electric vehicle reliability and future costs of ownership.

Publicly accessible EVSE infrastructure comes in two varieties: Level 2 EVSE and DC Fast-charge. Level 2 EVSE, also used in residential installations, are lower in cost but require longer charge times. The ideal location is a place where drivers typically will spend a few hours of their time, such as their residence or place of work. DC Fast-charge stations should be placed where drivers park for less than a half hour. Increasing the number of public charging stations can help to amerliorate consumer concerns regarding range and help to accelerate their adoption.

An additional strategy for electric vehicle infrastructure is the placement of switchable battery stations. Better Place is a company which proposes this type of electric vehicle infrastructure. With the cost of infrastructure, batteries and the electricity used to charge being financed with pay-per-mile service contracts, battery service networks may be able to compete with the existing gasoline fueling infrastructure. Switching stations can be installed along highways so that long distance drivers can use their electric vehicles without fears of range.

Public electric vehicle infrastructure faces high upfront costs with an uncertain return on investment; however, eventually public EVSE will convert to a pay-for-use system, which will create a revenue stream to offset the cost of operation with the potential to even create new revenue.

Public and private entities facing environmental and sustainability goals, government mandates and requirements, provide employee benefits, or looking to promote their public image can look to EVSE installations as a way to achieve them.

Training

Most of the workforce involved in the electric vehicle industry, whether it is in the design, production, sale, service or infrastructure, requires some sort of specialized education or training. As such, opportunities for continued investment exist in preparing the workforce for positions in these new automotive technologies. These opportunities include increased availability of training programs for automotive technicians and mechanics, electricians who install electric vehicle infrastructure and first responders who are responsible for safely caring for EV drivers on the road in the event of an emergency.

In addition to these training programs, higher-level educational institutions can develop

specialized programs that educate the next generation of the high-skill workforce in electric vehicles and their related technology. Relevant disciplines of study include various subfields of engineering, chemistry, materials science and transportation planning to name a few. Lack of funding at colleges and universities is a significant barrier to implementing multi-disciplined hybrid and EV related programs. However, multiple funding sources are available and have been utilized by several institutions in the state of California, including the U.S. Department of Energy's Graduate Automotive Technology Education (GATE) program and the California Energy Commission's Public Interest Energy Research (PIER) program.

U.S. Department of Energy GATE

The U.S. Department of Energy has a program tailored specifically for graduate students in the sciences and engineering disciplines that are interested in electric or other types of alternative fuel vehicles called the Graduate Automotive Technology Education (GATE) program.

The University of California at Davis was a past recipient of the GATE award (2005), which allowed them to establish the UC Davis Fuel Cell, Hydrogen, and Hybrid Vehicle (FCH2V) GATE Center of Excellence. GATE awards provide funding over a period of five years. UC Davis funding through this program terminated in 2010; however, the establishment of educational programs specializing in alternative fuel technologies primed the way for this institution to receive additional grants and awards in electric vehicle technology.

The GATE program awarded seven institutions across the nation $6.4 million at the end of 2011 to support automotive technology programs focusing on hybrid propulsion, energy storage, and lightweight materials. None of the most recent awards were given to institutions located in California. Exhibit 4-1 identifies the institutions currently funded by the GATE program, along with their program focus.

California Energy Commission PIERS

The California Energy Commission's Public Interest Energy Research (PIER) program awards up to $84 million in annually to conduct energy research and fund development and demonstration projects. This is the largest state program across the U.S. with this purpose. Thus far, UC Davis and its Institute of Transportation Studies has received multiple awards, including a $3 million award that provided funding for a plug-in hybrid electric vehicle (PHEV) research center and renewal funding that allowed that research to expand to include all electric vehicles (UC Davis Plug-In Hybrid & Electric Vehicle Research Center). Most recently (June 2012), a $2.77 million grant to research the comparative value, benefits and drawbacks of all types of alternative transportation fuels and fuel uses in California.

Specialized Training

Additional opportunities for continued investment related to specialized training for individuals in the field of electric vehicles, their support and infrastructure exists for automotive service technicians and mechanics, for electricians in the installation and maintenance of infrastructure and for first responders.

Community college programs are being developed to address the workforce needs of the electric vehicle industry, but there are opportunities to implement more of these programs across California. For example, only a handful of programs exist in Los Angeles County, the most populous county in the nation.

Several Workforce Investment Boards in California have implemented programs to train or retrain individuals to find work in the EV field. These public entities have partnered with both private industry and local community college districts to understand which skills are required and which positions are most in need of getting filled. These public-private partnerships allow CalWIBS to work along with members of industry to coordinate workforce training and then connect newly trained individuals with job opportunities within the industry. ❖

Exhibit 4-1

Graduate Automotive Technology Education (GATE) Centers of Excellence Awards in 2011

Institution	Target	Program Focus
Ohio State University	graduate students in engineering	Efficient energy conversion, advanced energy storage, lightweight body and chassis systems, and vehicle systems control, including vehicle-grid and vehicle-infrastructure connectivity.
Regents University of Michigan	PhD and MS students in Automotive Systems Engineering (ASE) at University of Michigan - Dearborn	Electric drive vehicles, including battery EVs, extended-range EVs, HEVs, and PHEVs.
Regents University of Colorado	graduate students at University of Colorado, Colorado Springs and University of Colorado, Boulder; a partnership	Innovative Drivetrains in Electric Automotive Technology Education (IDEATE) project; it will provide eight Research Fellowships and industry-supported research projects.
Purdue University	graduate students in engineering and science (research)	Hoosier Heavy Hybrid Center of Excellence; will address technical challenges and opportunities unique to medium and heavy-duty hybrid vehicles.
Clemson University	graduate students in engineering	GATE Center of Excellence in Sustainable Vehicle Systems will focus on challenges in advanced vehicle design and development, including life-cycle impact of vehicles, energy use and emissions, reliability, manufacturing, cost-of-ownership, customer preference and public policy
Pennsylvania State University	graduate students in engineering	Coordinate lab and training resources among several research units: Larson Institute, the Department of Mechanical Engineering, Department of Engineering Science and Mechanics, and Department of Energy and Mineral Engineering. Individual energy storage centers and the Hybrid and Hydrogen Vehicle Research Laboratory.
University of Alabama at Birmingham	graduate students in UAB School of Engineering	Expand its GATE Center of Excellence in Lightweight Materials and Manufacturing Technologies into a multi-disciplinary entity; specializing in Materials, Mechanical, Biomedical and Civil Engineering

Source: US DOE

Photo Credit: Flickr MR38

WORKFORCE

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5 Training Programs

Many of the workers employed in the design, manufacture, distribution, operation and service of electric vehicles are those who have worked in similar roles for traditional combustible engine vehicles. As electric vehicles and other forms of alternative fuel vehicles become more prevalent, new occupations with unique skill sets are emerging, resulting in the need for specialized training. The types of occupations related to electric vehicles and their infrastructure and the existing training programs available in Los Angeles County are identified to illustrate the readiness of the region to participate in this particular industry.

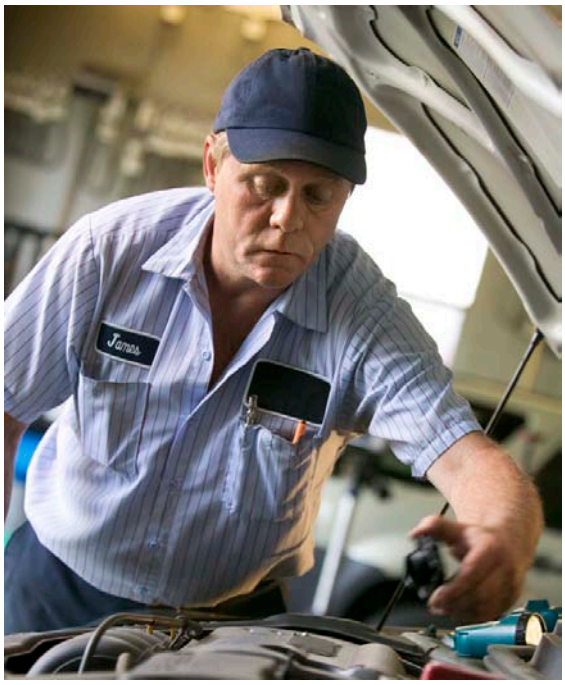
Workforce Training

The workforce required for the electric vehicle and infrastructure industry has diverse occupations across many industries with varying levels of education, training and experience. However, most occupations working in the EV industry will require some kind of specialized training or work experience, particularly in manufacturing, electrical contracting, maintenance, and by emergency responders.

Training programs in California are provided either through employers, PEV and EVSE manufacturers, technical schools, community colleges and universities. Below is a listing of the training programs currently available in California and particularly Los Angeles County, followed by a description of specialized training available for individuals interested in EVSE infrastructure through the Electric Vehicle Infrastructure Training Program (EVITP) and for first responders.

Los Angeles County

The following are specialized training programs available in Los Angeles County in regards to all types of electric vehicles (HEV and PEV) and their infrastructure.



Cerritos College

Located in Norwalk, Cerritos College offers the Alternative Fuels Service Technician certificate program and an automotive service technology associate degree program through its Advanced Transportation Technology & Energy Center (ATTE), funded in part by the state of California to promote alternative fuel vehicles and alternative fuel sources.

The certificate program includes two required introductory courses: Introduction to Electric Vehicles, and Advanced Technology Electric Vehicles. Combined, the classes cover vehicle conversions and electric vehicle design, operation, service and safety. The Associate of Arts degree builds upon the certificate programs.

Cerritos College became a Career Technical Education (CTE) Strategic Hub for the California Community College's Economic and Workforce Development Program. The CTE's role is to build educational pathways in alternative fuels at the secondary and post-secondary level.

El Camino College

El Camino College in Torrance offers the Alternative Fuel First Responder Training program through its Business Training Center's Alternative and Renewable Fuel and Vehicle Technology Program, funded in part by the state of California to promote alternative fuel vehicles and alternative fuel sources.

First responder training prepares individuals for the proper handling of situations where alternative fuel vehicles are present. Alternative fuel vehicles covered include electrical, hybrids, and those using compressed natural gas (CNG), and hydrogen. The program includes classroom instruction and hands-on demonstrations with alternative fuel vehicles. Courses range from eight to 24 hours. Some courses can be held at an employer's business location.

El Camino College is acting as the lead in a partnership with 10 other community colleges in California to provide this training, including Rio Hondo College, College of the Desert, Cerritos College, Long Beach City College, Kern College District, Barstow Community College, City College of San Francisco, Riverside Community College, College of the Canyons, and San Diego Miramar College.

Long Beach City College

In recent years, Long Beach City College developed its Advanced Transportation Technology Center to introduce students to courses covering alternative fuels, hybrid-electric vehicles and electric vehicles.

A Career Certificate in alternative fuels can be acquired through LBCC once all required courses are completed. Additionally, there is also a Career Certificate in electric vehicles as well as an Associate degree option.

Other related courses offered in automotive technology can lead to a license as an Intern Technician, Basic Area Technician or Advanced Emissions Specialist. While most of the classes are designed for professionals, both aspiring professionals and the general public are welcomed to enroll.

Los Angeles Trade-Technical College

Los Angeles Trade-Technical College offers electric vehicle technical training in its Diesel, Alternative Fuel and Hybrid Vehicle Technologies department. A certificate of achievement program in Hybrid & Electric Plug-In Vehicle Technology is available.

The Certificate of Achievement requires twelve units of specific courses that cover basic, intermediate and advanced level hybrid and electric plug-in vehicle configurations used in transportation industries, including automotive, transit and trucking.

Pierce College

Located in Woodland Hills, Pierce College offers two automotive technology skills certificate programs and one automotive service technology associate degree program through its industrial technology department. New construction on the Pierce College campus includes an alternative fuel lab, emissions lab, and a hybrid electric cars lab.

The skills certificate programs include: Automotive Alternative Diagnostic Technician and Automotive Basic Hybrid Service Technician. The Associate of Science degree program includes two required introductory courses: Introduction to Alternative Fuels and Hybrid Service and Safety. Combined, the classes cover alternative fuels (i.e. biofuels, gaseous fuels and hybrid/electric) and alternative fuel vehicle design, operation, service and safety.

A Civic CNG natural gas vehicle, a Civic hybrid and two donated Norwegian Kewet electric vehicles are used in these classes. Additionally, the automotive fabrication class at Pierce College has converted combustible engine vehicles into an electric car, including a 1974 Volkswagen.

Rio Hondo College

Rio Hondo College offers a variety of options in electric vehicle technical training. There are four certificates of achievement programs in Automotive Technology with a fifth Plug-in Vehicle Technician Certification program coming soon. Each Certificate of Achievement requires 32 units of specific courses and may be completed in 12 months.

Rio Hondo also offers an Associate of Science degree in Automotive Technology, which requires 62 units for completion and typically takes approximately two academic years. The AS degree has the same course requirements as the Certificate of Achievement but requires the completion of general education courses.

Additionally, Rio Hondo now provides safety training for first responders. The emphasis of the safety training is on electric vehicles already on the road including: Chevy Volt, Nissan Leaf, Mitsubishi iMiEV and Tesla.

Electric Vehicle Infrastructure Training Program (EVITP)

Electric vehicle charging stations are necessary for most plug-in hybrid vehicles and all battery-electric vehicles. The Electric Vehicle Infrastructure Training Program (EVITP) was developed in response to the demand for qualified individuals who were skilled in the installation and maintenance of EVSE infrastructure.
Developed by a consortium of public and private industry organizations and associations, EVITP is a non-profit national training and certification program that trains licensed or certified electricians on the specialized requirements of EVSE installation and maintenance to support PEVs; there was no training program available prior to the development of EVITP.

EVITP is a course that is 24 to 30 hours in duration, made up of a series of modules that cover numerous subjects relevant to both commercial (public) and residential EVSE including: load requirements; codes, regulations and standards; renewable energy; technical charging applications; electric vehicles; and field installation practices. All courses are taught by licensed or certified commercial, industrial or master level electricians, electrical administrators, registered professional electrical engineers or International Association of Electrical Inspectors (IAEI) certified electrical inspectors. Upon the successful completion of all modules and the competency examination, participants will receive a professional EVITP certification.

The California Community College Chancellor's Office and their Advanced Transportation and Technology Education campuses are in partnership with EVITP.

Exhibit 5-1
EVITP Industry Collaborators

General Motors
Smith Electric Vehicles
AeroVironment, Inc.
Coulumb Technologies
General Electric
National Fire Protection Association
International Association of Electrical Inspectors
Schneider Electric
DTE Energy
SPX Industries
PEPE Stations
ClipperCreek
Exergonix
UC Davis PHEV Research Center
Orlando Utilities Commission
SoCal Edison
American Electric Power
Hubbell
Commonwealth Edison
Leviton
Legard/ Pass & Seymour
Kansas City Power & Light
Duke Energy
Ameren Missouri
Milbank Manufacturing
CA Community Colleges Chancellor's Office: Advanced Transportation Technology and Energy Program
NECA-IBEW

Source: EVITP

Other Programs in California

California has a multitude of training programs available in regards to electric vehicles and their infrastructure.

City College of San Francisco

City College of San Francisco (CCSF) has five certificate programs available in Automotive Technology in addition to two associate degree programs.

The five certificate programs are Brake and Suspension Specialist, Engine Repair Specialist, General Auto Technician, Transmission Specialist and General Automotive Diagnostician. These programs require 16 units of specific courses, with the exception of General Automotive Diagnostician, which requires 48 units.

To earn an associates degree, students may choose to take 18 general education units along with 32 automotive units for an Automotive Mechanics Associates degree or 34 units of motorcycle technical training for a Motorcycle Technician degree.

At the end of 2009, the US Department of Energy awarded a 3-year, $500,000 grant to CCSF for training in maintenance and repair for hybrid vehicles. This funding has led to workshops hosted by CCSF to cover topics such as: biodiesel, compressed natural gas, electric cars, and hydrogen and hybrid vehicles.

California Institute for Nanotechnology

Located in San Jose, the California Institute for Nanotechnology offers a program to become a Certified Electric Vehicles Technician.

The program is 16 weeks in length and requires the completion of in-class coursework with an emphasis on advanced electric car theory as well as hands-on workshops on EV maintenance Program subject matter includes development of electric vehicles, high voltage safety and practice, hybrid engines, lithium ion battery technology in addition to name a few.

The program is for the general public. Open to anyone with a high school diploma and seven years of work experience or an associate degree with a minimum of five years work experience, it also includes a track to accommodate full time workers.

Photo Credit: US DOE, Clean Cities Program

Evergreen Valley College

Located in San Jose, Evergreen Valley College offers five automotive technology certificate programs and two automotive technology associate degree programs.

The certificate programs include: Certificate of Specialization and Achievement, Engine Service – Level I, Drivetrain and chassis – Level II, Fuel and Electrical – Level III, and the Advanced Automotive Training and Achievement: the American Honda Program.

The two Associate of Science degrees offered are through the Automotive Technician and the Ford Asset programs. These associate degree programs include two required courses that introduce students to electric vehicles: Introduction to Alternative Fuel and Hybrid/Electric Vehicles and Hybrid Electric Vehicle Maintenance and Repair. Combined, the classes cover biofuels, gaseous fuels and hybrid/electric vehicle safety.

Nissan North America

Nissan North America opened a training center in Livermore, CA. It is the first facility built by Nissan designed with the specific task

of providing dealership technicians with the complex training required for working with electronic vehicles (EVs) safely.

The facility will utilize the 23,000 square feet of space to house three classrooms, sixteen bays and eight hoists to teach and allow the technicians to practice EV repairs. There will also be product training for more conventional vehicles.

The facility is intended to train and support Nissan employees from throughout the Northwest region which includes Northern California, Colorado, Wyoming, Utah, Idaho, Hawaii, Montana and Nevada.

SAE International

SAE International is an international association of engineers and technical experts focused on developing voluntary consensus standards and promoting continual learning. This is accomplished through the cooperation of more than 128,000 engineers and technical experts.

SAE International now hosts an annual Hybrid Vehicle Technologies Symposium in Southern California informing industry professionals on new issues concerning hybrid vehicles. The symposium consists of multiple panel discussions and lectures throughout a weekend covering important topics including hybrid development, market penetration, regulatory and warranty issues, customer expectations and manufacturing in the United States versus manufacturing abroad.

Yuba College

Located in Marysville in Northern California, Yuba College offers an impressive array of programs in automotive technology, including ten certificates of training, eight certificates of achievement and five associate degree programs. The required courses prepare automotive hybrid technicians with relevant EV theory and valuable hands-on training.

Automotive technology has benefitted from an increase in funding in recent years due to a renewed focus on training low-income, unemployed and dislocated workers. In addition, Yuba College offers vehicle safety training for hybrid electric vehicles geared towards various first responders including tow truck drivers, police officers, firefighters, and emergency medical technicians.

Workshops include introductions to all types of hybrid electric vehicles (HEVs) including biofuels, gaseous fuels, and fuel cell and electric vehicles. The workshops also include training on first responder approach, hybrid hazards, hybrid safety equipment and high-voltage handling.

University of California Davis

The University of California Davis Plug-In Hybrid Electric Vehicle Research Center was formed in early 2007. Since then, the Center has expanded its focus to include not only plug-in hybrids, but all-electric vehicles.

The California Energy Commission's Public Interest Energy Research (PIER) Program is funding the Center to conduct research on environmental impacts, vehicle technology, commercialization issues and vehicle technology as well as providing policy guidance for the state.

The Center created a Plug-In Hybrid Electric Vehicle (PHEV) Research Roadmap to guide and prioritize research projects. The various projects contributed to a large number of reports, journal articles and dissertations. There are currently more than twenty papers on batteries, infrastructure, environmental benefits and energy impacts.

With renewed funding from the California Energy Commission, the Center will begin new projects that focus on consumers, clean electricity, second-use of batteries, fuel economy and a PHEV pick-up truck study. The new study will include partnering with various organizations such as Chrysler Corp, Oak Ridge National Laboratories (ORNL), BMQ, Nissan, the US Department of Energy, San Diego Gas and electric and ECOtality.

At the end of the year, the Center will release a Strategic Plan for the Electrification of Transportation in California. This Strategic Plan has emerged from a consensus building initiative that has incorporated over thirty high level stakeholders in California.

The stakeholders formed the California PEV Collaborative to create and implement this strategic plan. The group boasts members of the California Legislature, the governor's office, five automakers, four California utilities, three heads of state agencies and other important stakeholders.

National Alternative Fuels Training Consortium

Headquartered at West Virginia University, the National Alternative Fuels Training Consortium (NAFTC) is the only alternative fuel and advanced technology vehicle training organization that operates nationwide. Its focus is to provide a training infrastructure for alternative fuels, alternative fuel and advanced technology vehicles and other associated technologies.

NAFTC has 46 National Training Centers (NTC) that provide post-secondary education and training, five of which are located in California. The California NTCs are located at El Camino College, Fresno City College, Modesto Junior College, Rio Hondo Community College and Yuba College. In addition to its NTCs, the NAFTC also provides secondary level curriculum to Associate Training Centers (ATC), educational facilities such as high schools, technical centers and other similar organizations.

Consortium training is not limited to educational institutions. The military, government agencies such as the U.S. Posatal Service and the U.S. Department of Energy's Clean Cities Programs, and private firms with their own vehicle fleets all utilize NAFTC material to train to their employees.

First Responders

Hybrid-electric and all electric vehicles introduce new hazards to emergency responders. To keep pace with evolving technology, the emergency response community has increased its efforts to understand and mitigate the potential hazards associated with these electronic propulsion systems.

A few government agencies have been working at making information about electric vehicle more accessible for first responders. The National Renewable Energy Laboratory Picture Information Exchange (NREL PIX) offers an extensive library of illustrations that can be downloaded and reviewed for training purposes. The U.S. Fire Administration has published a short list of general considerations for first responders when dealing with electric vehicles. The Nation Fire Academy (NFA) provides and promotes EV and HEV education for fire service personal through NFA "Endorsed Courses" and seminars.

Government agencies are not the only organizations educating first responders. Many automobile manufacturers have assisted in creating resources to educate emergency responders. Most automobile manufacturers create and provide free emergency response guides for their models. For example, an online Electric Vehicle Safety Training for the 2011 Chevrolet Volt for first responders is being offered by the National Fire Protection Association's (NFPA), Chevrolet and On Star. ❖

6 Occupations for Electric Vehicles

The North American Industry Classification System (NAICS) classifies businesses based upon the type of economic activity performed without regard to the diverse types of job duties requisite to operations. Each firm, based upon its methods of production, requires employees who possess differing types of education, training and experience, such as office administration, managers, accountants, assemblers, sales representatives, and so on. To gain further insight into the characteristics of the workforce composition within industries, the Standard Occupational Classification (SOC) system was developed. It organizes workers into occupational classifications according to their job duties, required skills, education and training.

Just as a business establishment classified under its primary NAICS classification code will employ workers in a variety of occupations, one occupational classification (SOC code) will be employed across many industries. For example, registered nurses are employed in hospitals, by state and local governments, by primary and secondary schools and by insurance carriers directly. Similarly, the workforce required for the design, manufacture, distribution, operation and service of electric vehicles has the skills, experience and education to be employed across several industries.

However, as electric vehicle and other forms of alternative fuel vehicles have become more prevalent, existing occupational classifications may not be able to properly capture data specific to new and emerging occupations. Hence, data specific to electric vehicles, while in the process of being developed, is not yet available.

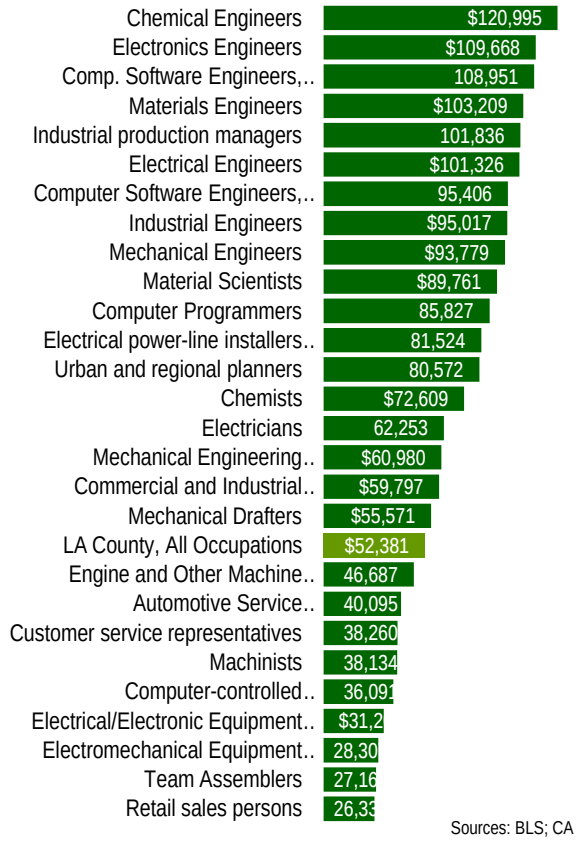
Nevertheless, through industry research the Bureau of Labor Statistics has identified those occupational classifications that are present within the electric vehicles industry. Many occupations in the manufacturing of electric vehicles are also found in vehicle charging station manufacturing.

Exhibit 6-1 presents a list of these occupations along with estimates of their total employment in Los Angeles County. Note that the employment estimates include employment in industries other than those related to electric vehicles.

Exhibit 6-2 details the average annual wages for each occupation.

A detailed data sheet for each individual occupation follows, in alphabetical order. These sheets show the current employment for each occupation in Los Angeles County, the annual average wage, the education and skills requirements, and the recent growth in the number of jobs. Also shown is the industry distribution for workers in the occupation. ❖

Exhibit 6-2
Electric Vehicle Related Occupations
Average Annual Wages in Los Angeles County
(As of 1st Quarter 2012)



Sources: BLS; CA EDD

Exhibit 6-1
Occupations Needed for Electric Vehicles in LA County

Standard Occupational Classification	2010 Employment
Retail sales persons	116,470
Customer service representatives	55,660
Team Assemblers	23,200
Computer Software Engineers, Applications	14,110
Automotive Service Technicians/Mechanics	13,860
Computer Software Engineers, Systems Software	13,220
Electricians	9,200
Computer Programmers	9,120
Machinists	8,980
Mechanical Engineers	5,900
Electronics Engineers	5,450
Electrical Engineers	5,330
Industrial Engineers	5,200
Industrial production managers	4,640
Electrical/Electronic Equipment Assemblers	3,760
Computer-controlled machine/tool operators	3,170
Urban and regional planners	1,910
Chemists	1,810
Mechanical Drafters	1,270
Materials Engineers	1,240
Commercial and Industrial Designers	1,230
Electromechanical Equipment Assemblers	1,190
Electrical power-line installers and repairers	1,070
Mechanical Engineering Technicians	840
Chemical Engineers	420
Engine and Other Machine Assemblers	310
Material Scientists	310
Total EV Related Occupations	308,870
% of All Occupations	*8.1%*
Total All Occupations	3,822,810

Source: BLS

Directory of Occupations

Automotive Service Technicians and Mechanics (SOC 49-3023)

Diagnose, adjust, repair, or overhaul automotive vehicles. Excludes "Automotive Body and Related Repairers" (49-3021), "Bus and Truck Mechanics and Diesel Engine Specialists" (49-3031), and "Electronic Equipment Installers and Repairers, Motor Vehicles" (49-2096).

Function Related to Electric Vehicles and their Infrastructure

Automotive Service Technicians and Mechanics participate in the maintenance of hybrid and electric vehicles. They perform inspections, routine maintenance and repairs using both computerized equipment and hand tools. Automotive Service Technicians and Mechanics work in repair shops that service conventional gasoline vehicles and will gain specialized training in high-voltage electrical systems, lithium batteries and electrical generators in order to also service hybrid and electric vehicles. Additionally, they may be skilled in electric vehicle conversions or may perform installations of systems to increase conventional vehicle fuel efficiency.

Education, Training and Experience

While entry-level positions require postsecondary training at a vocational school or community college, a certain level of on-the-job training is required before workers can work autonomously. Automotive Service Technicians and Mechanics who work in auto dealerships or large repair shops often require certification from the National Institute for Automotive Service Excellence (ASE). Customized training specific to hybrid and electric vehicles is required due to the complexity of electric vehicles and additional training are required to remain knowledgeable about the maintenance and repair as EV technology changes.

Industry Distribution of Automotive Service Technicians and Mechanics in LA County

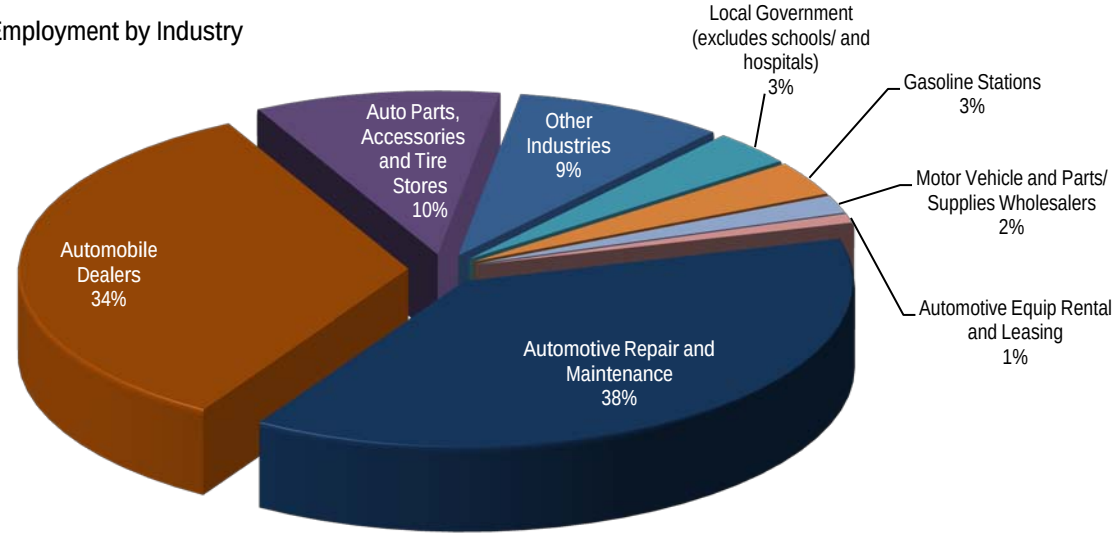
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
8111	Automotive Repair and Maintenance	37.9%	5,260
4411	Automobile Dealers	33.6%	4,651
4413	Automotive Parts, Accessories, and Tire Stores	10.2%	1,418
9993	Local Government (excluding schools and hospitals)	3.4%	476
4471	Gasoline Stations	3.4%	468
4231	Motor Vehicle and Parts/ Supplies Wholesalers	1.8%	244
5321	Automotive Equipment Rental and Leasing	0.9%	123
9992	State Government (excluding schools and hospitals)	0.8%	108
4911	Postal Service	0.6%	81
5613	Employment Services	0.6%	78
4884	Support Activities for Road Transportation	0.4%	55
4521	Department Stores	0.4%	51
7112	Spectator Sports	0.4%	50
4251	Wholesale Electronic Markets and Agents and Brokers	0.3%	45
4841	General Freight Trucking	0.3%	41
	Other Industries	*5.1%*	*711*
Total*	Across All Industries	100.0%	13,860

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Automotive Service Technicians and Mechanics in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
13,860 Jobs 0.36% of total	$40,095 Below LAC average	Post-Secondary Vocational Education	50 Jobs Annually 0.4% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Chemical Engineers (SOC 17-2041)

Design chemical plant equipment and devise processes for manufacturing chemicals and products, such as gasoline, synthetic rubber, plastics, detergents, cement, paper, and pulp, by applying principles and technology of chemistry, physics, and engineering.

Function Related to Electric Vehicles and their Infrastructure

Chemical Engineers participate in the research and development and the design process for electric vehicles and their infrastructure. Electric vehicle batteries use chemical processes to store of power; therefore, chemical engineers apply their knowledge and expertise to EV commercial applications such as battery testing and the battery manufacturing process. Additionally, they may also design equipment used in the manufacturing process.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education courses are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Chemical Engineers in LA County

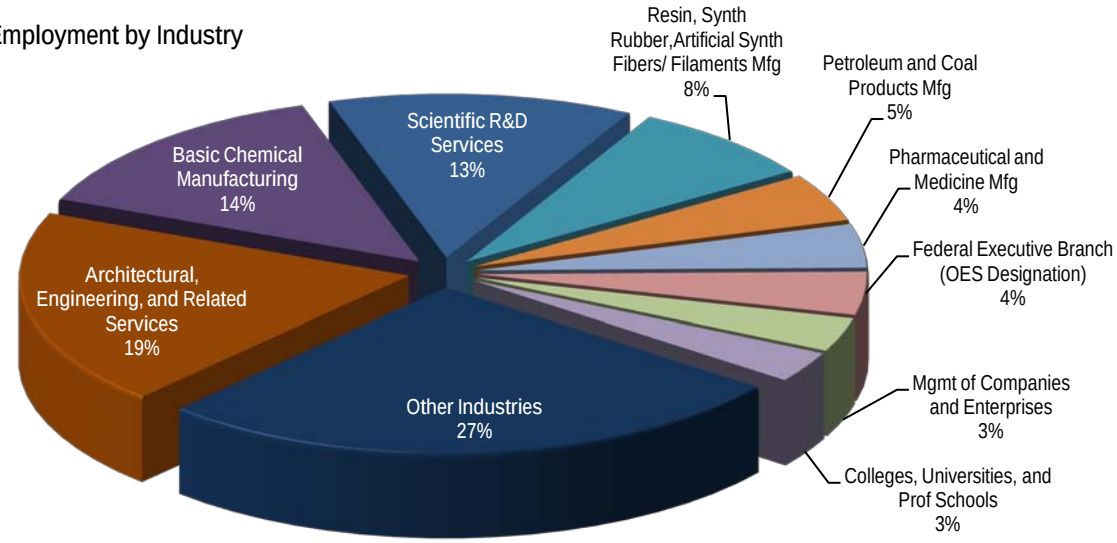
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5413	Architectural, Engineering, and Related Services	19.3%	81
3251	Basic Chemical Manufacturing	13.9%	58
5417	Scientific R&D Services	12.7%	53
3252	Resin, Synthetic Rubber, Artificial Synthetic Fibers/ Filaments Manufacturing	7.9%	33
3241	Petroleum and Coal Products Manufacturing	4.7%	20
3254	Pharmaceutical and Medicine Manufacturing	4.3%	18
9991	Federal Executive Branch (OES Designation)	4.2%	18
5511	Managements of Companies and Enterprises	3.3%	14
6113	Colleges, Universities, and Professional Schools	3.0%	13
5416	Management, Scientific, and Technical Consulting Services	2.6%	11
3259	Other Chemical Product and Preparation Manufacturing	2.2%	9
2111	Oil and Gas Extraction	2.1%	9
3261	Plastics Product Manufacturing	2.0%	9
4246	Chemical and Allied Products Merchant Wholesalers	2.0%	8
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	1.9%	8
3255	Paint, Coating, and Adhesive Manufacturing	1.5%	7
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	1.4%	6
4251	Wholesale Electronic Markets and Agents and Brokers	1.1%	5
	Other Industries	*9.8%*	*41*
Total*	Across All Industries	100%	420

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

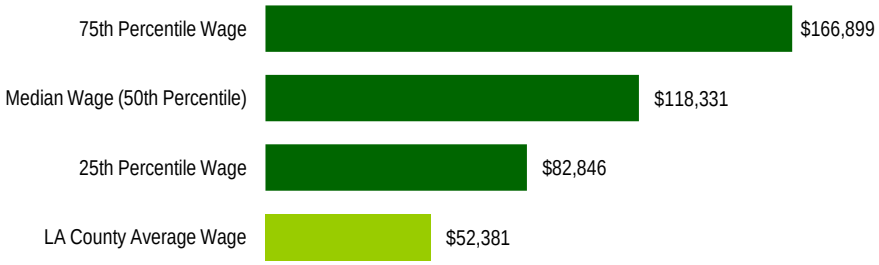
Chemical Engineers in Los Angeles County (2011)

Employment	Average Wage*	Job Entry Requirement	Occupation Growth
			
420 Jobs 0.1% of total	$120,995 Exceeds LAC average	Bachelor's Degree	+80 Jobs Annually 27.1% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Chemists (SOC 19-2031)

Conduct qualitative and quantitative chemical analyses or experiments in laboratories for quality or process control or to develop new products or knowledge. Excludes "Geoscientists, Except Hydrologists and Geographers" (19-2042) and "Biochemists and Biophysicists" (19-1021).

Function Related to Electric Vehicles and their Infrastructure

Chemists participate in research and development for electric vehicles. Electric vehicle batteries use chemical processes to store of power; therefore, chemists apply their knowledge of the chemical makeup, properties and reactions of substances to improve EV battery technology. They discover new chemicals to use in EV batteries or new ways to improve current battery technology. They work with other classifications of scientists and varying types of engineers to develop new and better EV technologies.

Education, Training and Experience

Computer skills are required to perform these duties, which include modeling, testing, integration and data analysis. While positions involved in the research and development of new products do require a doctorate, some positions for individuals with a bachelor's or master's degree are available in other EV applications. Most do not require licensure or additional certifications.

Industry Distribution of Chemists in LA County

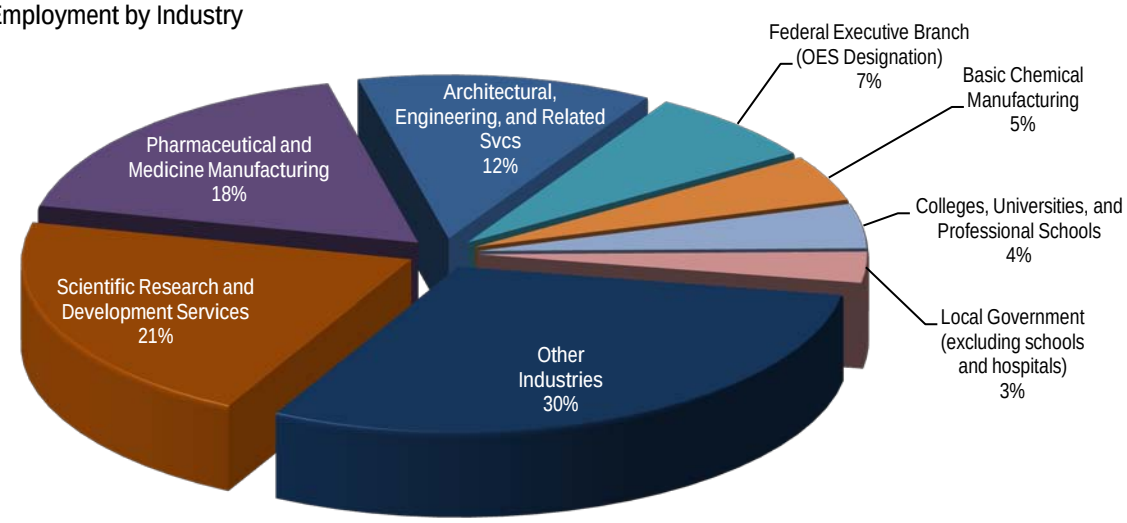
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5417	Scientific Research and Development Services	20.9%	378
3254	Pharmaceutical and Medicine Manufacturing	17.6%	319
5413	Architectural, Engineering, and Related Services	12.3%	222
9991	Federal Executive Branch (OES Designation)	7.3%	132
3251	Basic Chemical Manufacturing	4.5%	82
6113	Colleges, Universities, and Professional Schools	4.4%	79
9993	Local Government (excluding schools and hospitals)	3.0%	55
5511	Management of Companies and Enterprises	2.6%	48
5613	Employment Services	2.6%	46
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	2.5%	45
9992	State Government (excluding schools & hospitals)	2.5%	45
3255	Paint, Coating, and Adhesive Manufacturing	2.2%	39
3259	Other Chemical Product and Preparation Manufacturing	1.6%	30
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	1.6%	29
3241	Petroleum and Coal Products Manufacturing	1.2%	23
5416	Management, Scientific, and Technical Consulting Services	1.2%	21
5622	Waste Treatment and Disposal	0.9%	17
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	0.9%	16
4246	Chemical and Allied Products Merchant Wholesalers	0.8%	15
	Other Industries	*9.4%*	*169*
Total*	Across All Industries	100%	1,810

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Chemists in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,810 Jobs 0.05% of total	$72,609 Exceeds LAC average	Bachelor's Degree	-150 Jobs Annually -7.4% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Commercial and Industrial Designers (SOC 27-1021)

Develop and design manufactured products, such as cars, home appliances, and children's toys. Combine artistic talent with research on product use, marketing, and materials to create the most functional and appealing product design.

Function Related to Electric Vehicles and their Infrastructure

Commercial and Industrial Designers participate in the design and development process of electric vehicles. They are responsible for the general design of the vehicle and its main components, taking into consideration consumer preferences and the company's capabilities for production. They render drawings and diagrams, utilizing computer-aided design and drafting (CADD) systems, to illustrate the requirements of electric vehicles including its function, quality, styling, and safety features.

Education, Training and Experience

Computer skills are required to perform these duties. Entry-level positions require at least a bachelor's degree in the discipline of engineering or industrial design. A certain level of on-the-job training is required to perform their job duties. They work with engineers and scientists and other occupations employed in the production process.

Industry Distribution of Mechanical Engineers in LA County

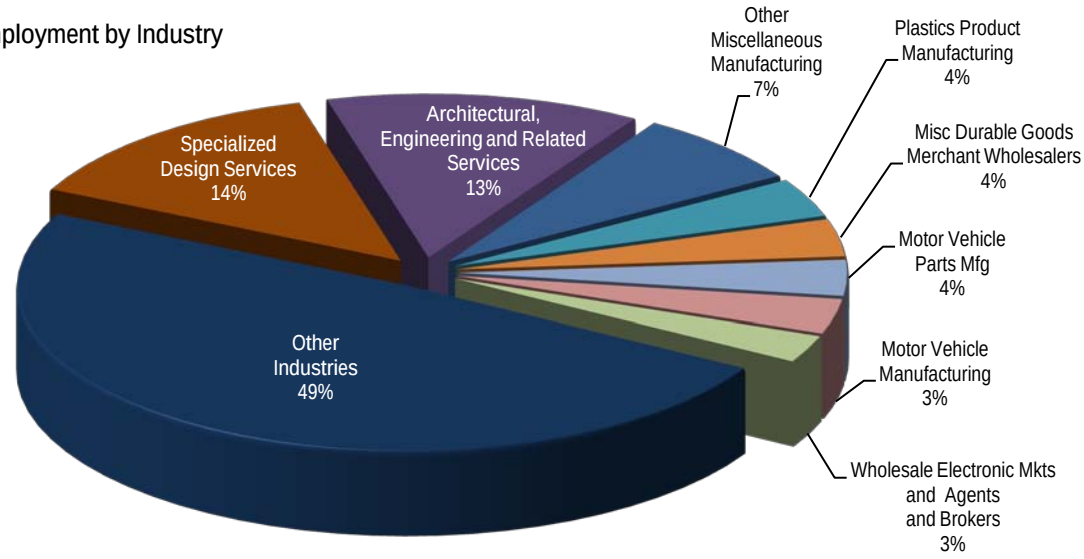
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5414	Specialized Design Services	13.6%	167
5413	Architectural, Engineering and Related Services	13.1%	161
3399	Other Miscellaneous Manufacturing	7.3%	90
3261	Plastics Product Manufacturing	3.8%	47
4239	Miscellaneous Durable Goods Merchant Wholesalers	3.7%	45
3363	Motor Vehicle Parts Manufacturing	3.5%	43
3361	Motor Vehicle Manufacturing	3.4%	42
4251	Wholesale Electronic Markets and Agents/Brokers	2.7%	33
3222	Converted Paper Product Manufacturing	2.6%	32
4232	Furniture and Home Furnishing Merchant Wholesalers	2.4%	29
3339	Other General Purpose Machinery Manufacturing	1.9%	23
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1.6%	19
3391	Medical Equipment and Supplies Manufacturing	1.6%	19
5416	Management, Scientific, and Technical Consulting Services	1.6%	19
3371	Household and Institutional Furniture and Kitchen Cabinet Manufacturing	1.4%	18
4541	Electronic Shopping and Mail-Order Houses	1.4%	18
3352	Household Appliance Manufacturing	1.4%	17
3364	Aerospace Product and Parts Manufacturing	1.3%	16
3372	Office Furniture (including Fixtures) Manufacturing	1.3%	16
	Other Industries	*30.4%*	*374*
Total*	Across All Industries	100.0%	1,230

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Commercial and Industrial Designers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,230 Jobs 0.03% of total	$59,797 Exceeds LAC average	Bachelor's Degree	270 Jobs Annually 33.5% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Computer-Controlled Machine and Tool Operators (SOC 51-4011)

Operate computer-controlled machines or robots to perform one or more machine functions on metal or plastic work pieces.

Function Related to Electric Vehicles and their Infrastructure

Computer-Controlled Machine and Tool Operators participate in the manufacture of electric vehicles, their components and their infrastructure. Manufacturing programs are downloaded into computer-controlled machines for the manufacture of metal and plastic parts. Computer-Controlled Machine and Tool Operators set the tools and materials on the machine before launching it; they are responsible for overseeing the production of the machined component. Additionally, Computer-Controlled Machine and Tool Operators may be charged with maintenance and minor repairs of the equipment.

Education, Training and Experience

Entry-level positions require moderate-term on-the-job training. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required for electric vehicle manufacturing.

Industry Distribution of Computer-Controlled Machine and Tool Operators in LA County

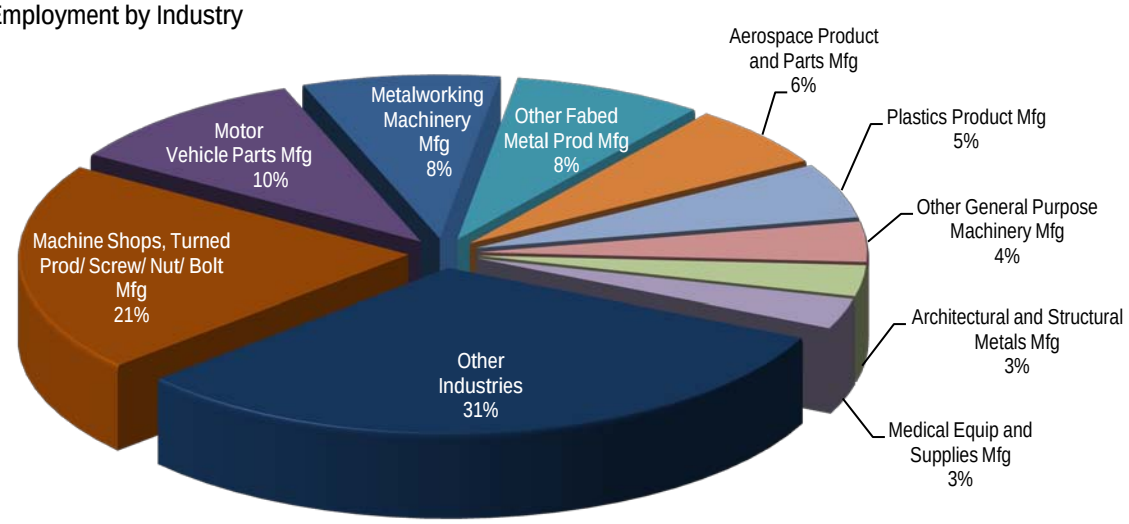
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3327	Machine Shops, Turned Prod/Screw/Nut/Bolt Manufacturing	20.6%	653
3363	Motor Vehicle Parts Manufacturing	10.3%	328
3335	Metalworking Machinery Manufacturing	8.2%	261
3329	Other Fabricated Metal Product Manufacturing	7.9%	251
3364	Aerospace Product and Parts Manufacturing	6.1%	195
3261	Plastics Product Manufacturing	5.4%	172
3339	Other General Purpose Machinery Manufacturing	4.0%	125
3323	Architectural and Structural Metals Manufacturing	3.0%	96
3391	Medical Equipment and Supplies Manufacturing	3.0%	94
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2.9%	92
3344	Semiconductor and Other Electronic Component Manufacturing	2.6%	82
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2.3%	74
3321	Forging and Stamping	2.3%	73
3315	Foundries	2.0%	62
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Mfg	1.8%	56
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	1.6%	51
3399	Other Miscellaneous Manufacturing	1.6%	51
3332	Industrial Machinery Manufacturing	1.5%	46
3359	Other Electrical Equipment and Component Manufacturing	1.1%	35
	Other Industries	*11.8%*	*374*
Total*	Across All Industries	100.0%	3,170

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

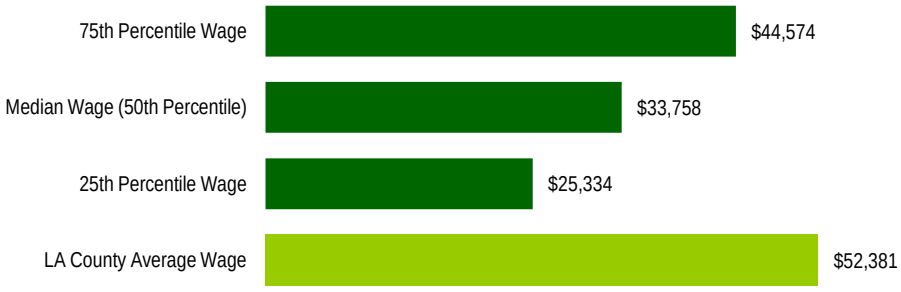
Computer-Controlled Machine and Tool Operators in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
3,170 Jobs 0.08% of total	$36,091 Below LAC average	Moderate-Term On-the-Job Training	5 Jobs Annually 0.2% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Customer Service Representatives (SOC 43-4051)

Interact with customers to provide information in response to inquiries about products and services and to handle and resolve complaints. Excludes individuals whose duties are primarily installation, sales, or repair

Function Related to Electric Vehicles and their Infrastructure

Customer Service Representatives participate in the post-sale support of electric vehicles and their infrastructure. They act as intermediaries between electric vehicle manufacturers and automotive service technicians and mechanics; they field customer inquiries and complaints made by customers and charged with the response and resolution of these issues.

Education, Training and Experience

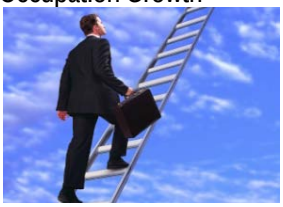
Entry-level positions require a high school diploma or equivalent with minimal on-the-job training; however, a certain level of work experience is required for higher-level customer service positions. Good communication and problem solving skills are requisite to their job duties, with workers who are both friendly and conduct themselves professionally being the most sought after by employers.

Industry Distribution of Customer Service Representatives in LA County

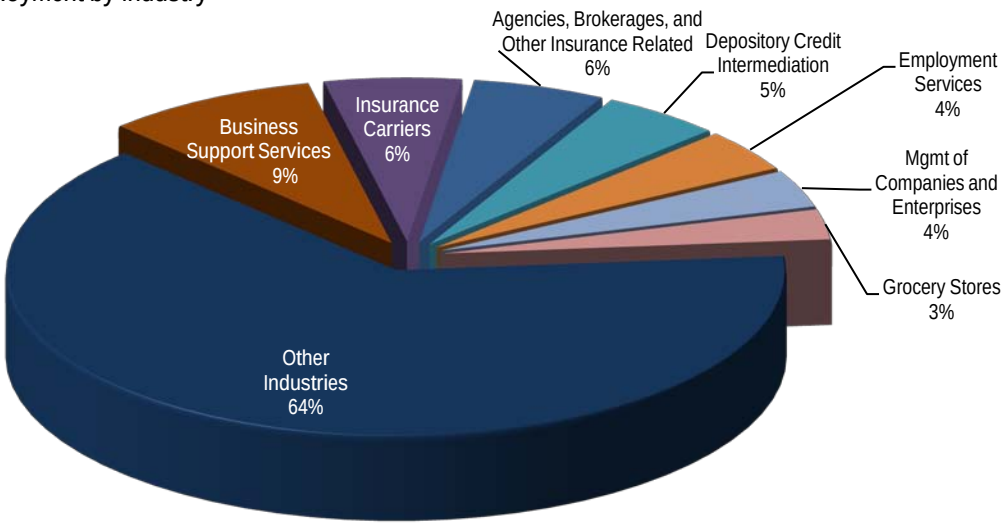
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5614	Business Support Services	8.9%	4,947
5241	Insurance Carriers	5.7%	3,180
5242	Agencies, Brokerages, and Other Insurance Related	5.5%	3,069
5221	Depository Credit Intermediation	5.0%	2,784
5613	Employment Services	4.2%	2,327
5511	Management of Companies and Enterprises	3.7%	2,051
4451	Grocery Stores	3.0%	1,650
5171	Wired Telecommunications Carriers	2.4%	1,315
5222	Nondepository Credit Intermediation	2.3%	1,297
4529	Other General Merchandise Stores	2.0%	1,089
9993	Local Government (excluding schools and hospitals)	1.9%	1,033
5416	Management, Scientific, and Technical Consulting Services	1.7%	953
5172	Wireless Telecommunications Carriers (except Satellite)	1.5%	843
4251	Wholesale Electronic Markets and Agents and Brokers	1.5%	831
5415	Computer Systems Design and Related Services	1.5%	816
4234	Professional and Commercial Equipment and Supplies Merchant Wholesalers	1.4%	798
6221	General Medical and Surgical Hospitals	1.4%	792
4541	Electronic Shopping and Mail-Order Houses	1.4%	789
5611	Office Administrative Services	1.4%	774
	Other Industries	*43.7%*	*24,322*
Total*	Across All Industries	100.0%	55,660

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Customer Service Representatives in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
55,660 Jobs 1.46% of total	$38,260 Below LAC average	Moderate-Term On-the-Job Training	320 Jobs Annually 0.6% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electrical and Electronic Equipment Assemblers (SOC 51-2022)

Assemble or modify electrical or electronic equipment, such as computers, test equipment telemetering systems, electric motors, and batteries.

Function Related to Electric Vehicles and their Infrastructure

Electrical and Electronic Equipment Assemblers participate in the manufacture of electric vehicles, their components and their infrastructure. Their main focus is on electronic equipment more so than mechanical parts; therefore they build electric components of the vehicle including computers, electronic control devices, electric motors and electronic sensors, in addition to components of the electric charging stations. Electrical and Electronic Equipment Assemblers may operate automated systems to assemble parts that are too small or fragile in nature.

Education, Training and Experience

While most entry-level positions require short-term on-the-job training, more work experience, usually several years of working as an assembler, is required for supervisory positions. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required for electric vehicle manufacturing.

Industry Distribution of Electrical and Electronic Equipment Assemblers in LA County

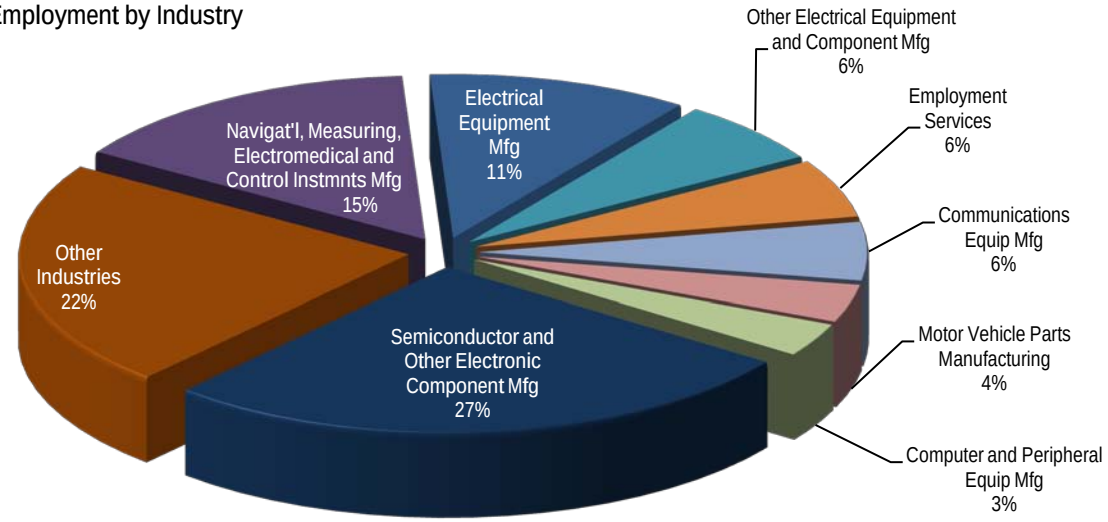
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3344	Semiconductor and Other Electronic Component Manufacturing	27.0%	1,014
3345	Navigational, Measuring, Electromedical and Control Instruments Manufacturing	15.1%	567
3353	Electrical Equipment Manufacturing	10.9%	409
3359	Other Electrical Equipment and Component Manufacturing	6.3%	238
5613	Employment Services	5.8%	216
3342	Communications Equipment Manufacturing	5.7%	216
3363	Motor Vehicle Parts Manufacturing	3.7%	138
3341	Computer and Peripheral Equipment Manufacturing	3.3%	124
3364	Aerospace Product and Parts Manufacturing	2.4%	90
3351	Electric Lighting Equipment Manufacturing	2.0%	75
3339	Other General Purpose Machinery Manufacturing	2.0%	75
3391	Medical Equipment and Supplies Manufacturing	1.5%	58
4236	Electrical and Electronic Goods Merchant Wholesalers	1.5%	58
3399	Other Miscellaneous Manufacturing	1.5%	56
3343	Audio and Video Equipment Manufacturing	1.4%	51
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Mfg	1.1%	42
5413	Architectural, Engineering, and Related Services	1.1%	40
3332	Industrial Machinery Manufacturing	1.0%	37
4234	Professional and Commercial Equipment and Supplies Merchant Wholesalers	1.0%	37
	Other Industries	*5.8%*	*219*
Total*	Across All Industries	100.0%	3,760

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

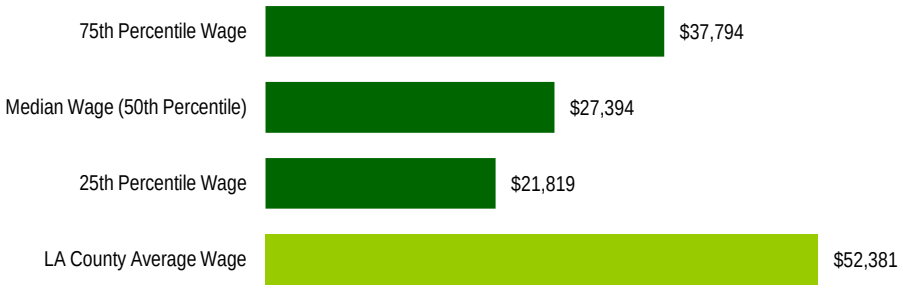
Electrical and Electronic Equipment Assemblers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
3,760 Jobs 0.10% of total	$31,206 Below LAC average	Short-Term On-the-Job Training	-315 Jobs Annually -7.5% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electrical Engineers (SOC 17-2071)

Research, design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use. Excludes "Computer Hardware Engineers" (17-2061).

Function Related to Electric Vehicles and their Infrastructure

Electrical Engineers participate in the development and the design process for electric vehicles and their electrical systems, predominantly the vehicle's electrical circuitry. The electrical circuitry is the system responsible for the transmission of gas engine generated electricity to the battery, and then the distribution of that charge from the battery to other electrical components throughout the vehicle, including the electric motor. In addition to product design and development, the job duties of Electrical Engineers include testing and overseeing the manufacturing process.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, a certain level of work experience or a graduate degree is required for positions that work autonomously. Many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education course are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Electrical Engineers in LA County

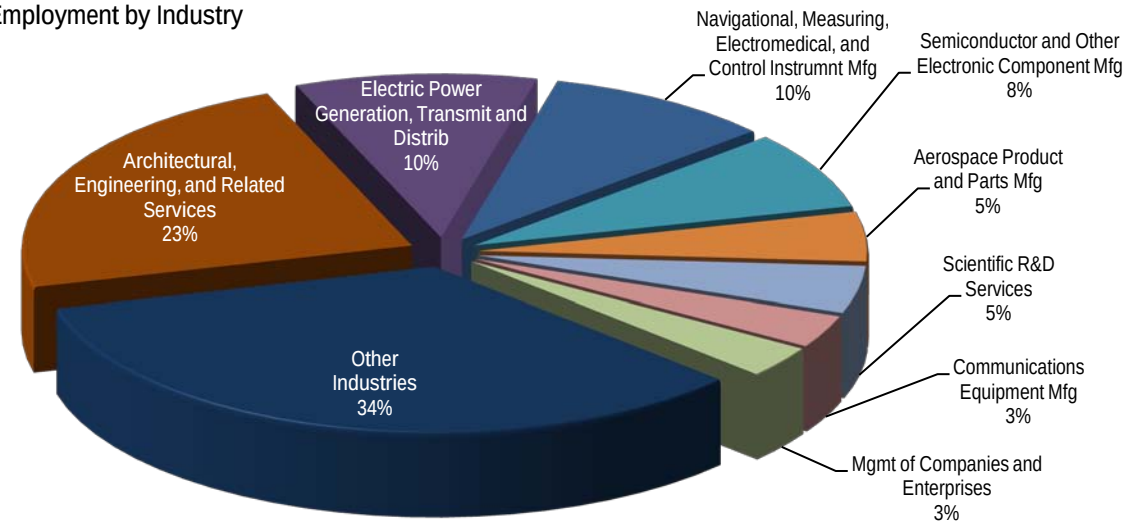
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5413	Architectural, Engineering, and Related Services	23.0%	1,224
2211	Electric Power Generation, Transmission and Distribution	10.1%	537
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	9.5%	507
3344	Semiconductor and Other Electronic Component Manufacturing	7.7%	408
3364	Aerospace Product and Parts Manufacturing	4.9%	260
5417	Scientific Research and Development Services	4.6%	247
3342	Communications Equipment Manufacturing	3.2%	170
5511	Management of Companies and Enterprises	3.1%	165
9991	Federal Executive Branch (OES Designation)	2.9%	154
5415	Computer Systems Design and Related Services	2.9%	153
3353	Electrical Equipment Manufacturing	2.5%	134
9993	Local Government (excluding schools and hospitals)	2.1%	109
3339	Other General Purpose Machinery Manufacturing	1.6%	84
2382	Building Equipment Contractors	1.5%	80
5613	Employment Services	1.4%	75
4236	Electrical and Electronic Goods Merchant Wholesalers	1.3%	71
5416	Management, Scientific, and Technical Consulting Services	1.3%	71
	Other Industries	*17.9%*	*881*
Total*	Across All Industries	100%	5,330

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

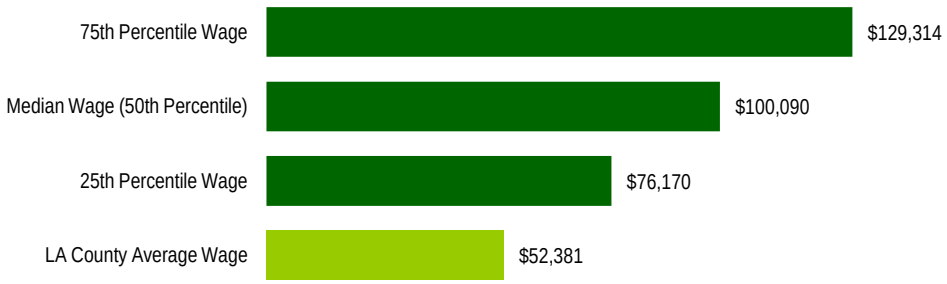
Electrical Engineers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
5,330 0.14% of total	$101,326 Exceeds LAC average	Bachelor's Degree	645 Jobs Annually 14.9% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electrical Power-Line Installers and Repairers (SOC 49-9051)

Install or repair cables or wires used in electrical power or distribution systems. May erect poles and light or heavy duty transmission towers. Excludes "Electrical and Electronics Repairers, Powerhouse, Substation, and Relay" (49-2095).

Function Related to Electric Vehicles and their Infrastructure

Electrical Power-Line Installers and Repairers participate in the installation of infrastructure to support electric vehicles. Electric charging stations are necessary for plug-in hybrid and all electric vehicles and these charging stations require increased electric grid capacity to support them. Electric Power-Line Installers and Repairers are responsible for the installation and maintenance of the power grid, which transmits electricity from generation sources to the end user. They replace existing lines with those capable of handling increased loads required by electric vehicle owners. Additionally, they erect new power-lines and connect them to the existing power grid.

Education, Training and Experience

Basic math and reading skills are requisite for entry-level positions; therefore, a high school diploma or its equivalent is required. Long-term on-the-job training is required for positions above entry level, with employers providing between one and five years of training.

Industry Distribution of Electrical Power-Line Installers and Repairers in LA County

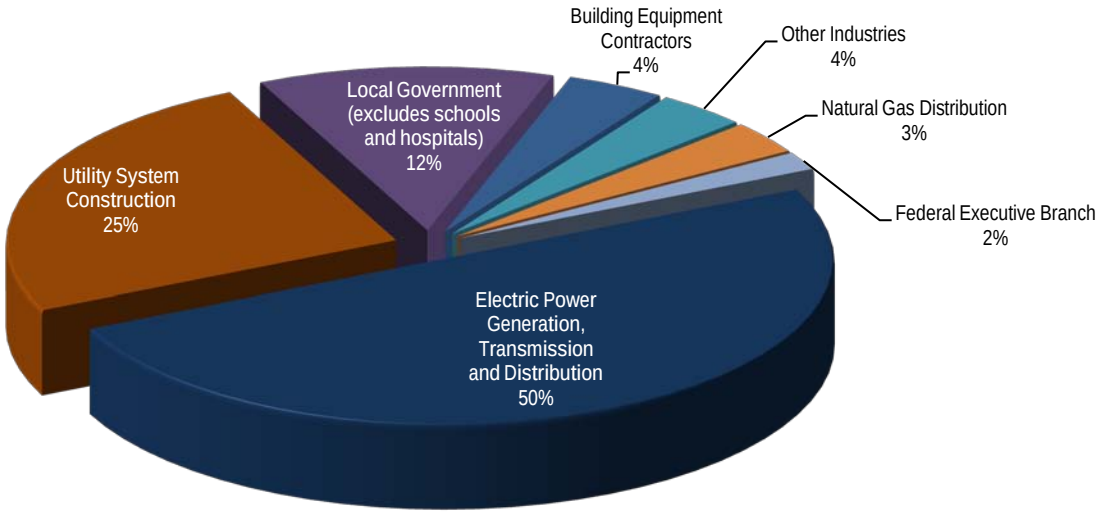
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
2211	Electric Power Generation, Transmission and Distribution	50.0%	535
2371	Utility System Construction	24.9%	266
9993	Local Government (excluding schools and hospitals)	12.3%	132
2382	Building Equipment Contractors	4.1%	43
2212	Natural Gas Distribution	3.2%	35
9991	Federal Executive Branch (OES Designation)	1.8%	19
5511	Management of Companies and Enterprises	1.3%	14
5171	Wired Telecommunications Carriers	1.3%	13
5613	Employment Services	0.3%	3
5617	Services to Buildings and Dwellings	0.2%	2
5419	Other Professional, Scientific, and Technical Services	0.2%	2
5619	Other Support Services	0.2%	2
5413	Architectural, Engineering, and Related Services	0.2%	2
9992	State Government (excluding schools and hospitals)	0.1%	1
4862	Pipeline Transportation of Natural Gas	0.0%	0
5179	Other Telecommunications	0.0%	0
5417	Scientific Research and Development Services	0.0%	0
2389	Other Specialty Trade Contractors (not disclosed)	-	-
Total*	Across All Industries	100.0%	1,070

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Electrical Power-Line Installers and Repairers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,070 Jobs 0.03% of total	$81,524 Exceeds LAC average	Long-Term On-the-Job Training	0 Jobs Annually 0.0% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electricians (SOC 47-2111)

Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems, or electrical control systems. Excludes "Security and Fire Alarm Systems Installers" (49-2098).

Function Related to Electric Vehicles and their Infrastructure

Electricians participate in the installation of infrastructure to support electric vehicles. Electric charging stations are necessary for plug-in hybrid and all electric vehicles to support them. Electricians are responsible for the installation of both residential and public electric vehicle charging stations and other necessary electrical equipment. They connect the charging station equipment to power-lines and perform maintenance and repairs to installed electric charging stations.

Education, Training and Experience

Entry-level positions require a high school diploma or its equivalent. An apprenticeship is also required before working independently, which will last a minimum of three years and include classroom training in addition to supervised on-the-job training from an experienced electrician. Many times a licensure, passed by examination, is required by state and local governments to ensure proper knowledge of local building codes, electrical theory and the National Electric Code. Additional certifications, specific to each different type of charging station, are required to be an authorized installer; these are obtained via specialized training provided by each manufacturer.

Industry Distribution of Electricians in LA County

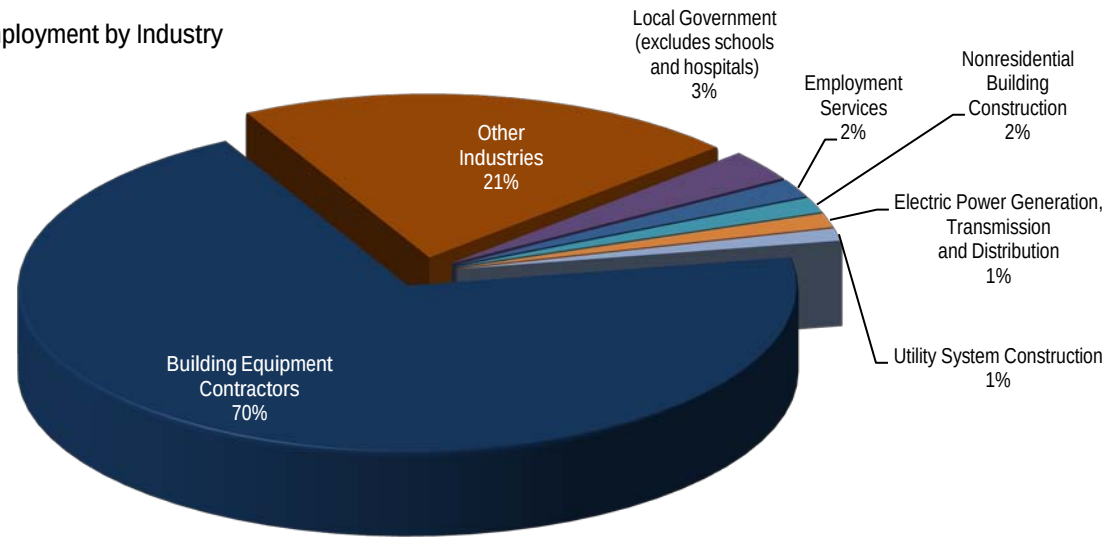
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
2382	Building Equipment Contractors	70.0%	6,439
9993	Local Government (excluding schools and hospitals)	3.0%	281
5613	Employment Services	1.8%	165
2362	Nonresidential Building Construction	1.5%	139
2211	Electric Power Generation, Transmission and Distribution	1.4%	128
2371	Utility System Construction	1.2%	113
3366	Ship and Boat Building	1.1%	99
6113	Colleges, Universities, and Professional Schools	1.0%	92
9991	Federal Executive Branch (OES Designation)	0.9%	83
3363	Motor Vehicle Parts Manufacturing	0.8%	76
2121	Coal Mining	0.7%	63
2361	Residential Building Construction	0.6%	58
6221	General Medical and Surgical Hospitals	0.6%	57
3361	Motor Vehicle Manufacturing	0.6%	54
9992	State Government (excluding schools and hospitals)	0.6%	52
6111	Elementary and Secondary Schools	0.5%	50
	Other Industries	*13.6%*	*1,253*
Total*	Across All Industries	100.0%	9,200

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Electricians in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
9,200 Jobs 0.24% of total	$62,253 Exceeds LAC average	Long-Term On-the-Job Training	-805 Jobs Annually -7.7% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electromechanical Equipment Assemblers (SOC 51-2023)

Assemble or modify electromechanical equipment or devices, such as servomechanisms, gyros, dynamometers, magnetic drums, tape drives, brakes, control linkage, actuators, and appliances.

Function Related to Electric Vehicles and their Infrastructure

Electromechanical Equipment Assemblers participate in the manufacture of electric vehicles, their components and their infrastructure. Their main focus is on mechanical parts more so than electronic equipment; therefore, they build electromechanical components of electric vehicles such as electric generators, electric motors and gasoline engines.

Education, Training and Experience

While most entry-level positions require short-term on-the-job training, more work experience is required for supervisory positions. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required for electric vehicle and charge station manufacturing.

Industry Distribution of Electromechanical Equipment Assemblers in LA County

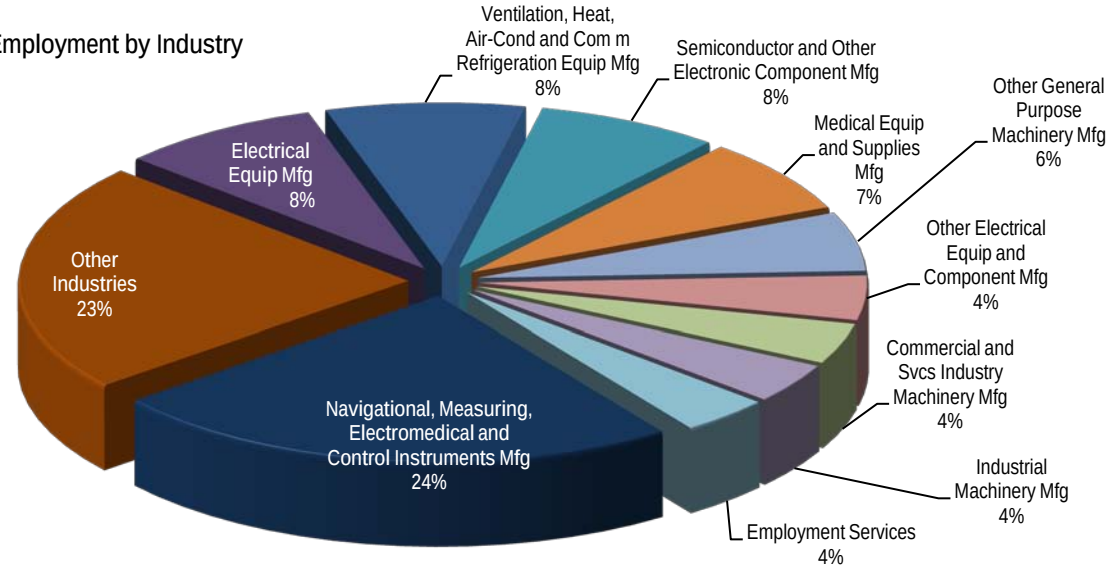
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3345	Navigational, Measuring, Electromedical and Control Instruments Manufacturing	23.9%	284
3353	Electrical Equipment Manufacturing	8.4%	100
3334	Ventilation, Heating, Air-Conditioning and Commercial Refrigeration Equipment Mfg	8.3%	99
3344	Semiconductor and Other Electronic Component Manufacturing	7.7%	91
3391	Medical Equipment and Supplies Manufacturing	7.4%	88
3339	Other General Purpose Machinery Manufacturing	5.8%	69
3359	Other Electrical Equipment and Component Manufacturing	4.4%	52
3333	Commercial and Service Industry Machinery Manufacturing	4.0%	47
3332	Industrial Machinery Manufacturing	3.9%	47
5613	Employment Services	3.7%	45
3341	Computer and Peripheral Equipment Manufacturing	2.9%	34
3363	Motor Vehicle Parts Manufacturing	2.9%	34
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2.6%	30
3342	Communications Equipment Manufacturing	2.6%	30
3399	Other Miscellaneous Manufacturing	1.8%	21
3364	Aerospace Product and Parts Manufacturing	1.8%	21
3329	Other Fabricated Metal Product Manufacturing	1.2%	15
3335	Metalworking Machinery Manufacturing	1.1%	14
5413	Architectural, Engineering, and Related Services	0.9%	11
	Other Industries	*4.8%*	*58*
Total*	Across All Industries	100.0%	1,190

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

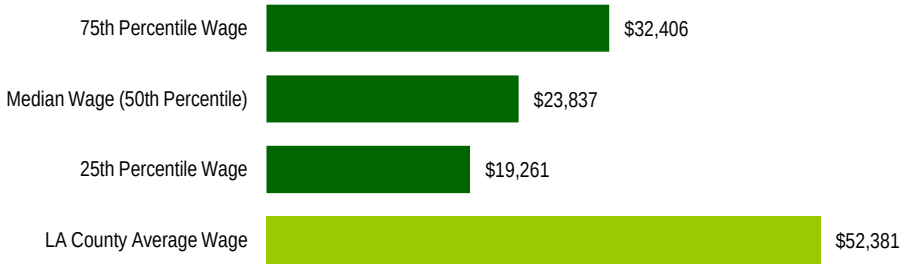
Electromechanical Equipment Assemblers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,190 Jobs 0.03% of total	$28,307 Below LAC average	Short-Term On-the-Job Training	60 Jobs Annually 5.5% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Electronics Engineers (Except Computer) (SOC 17-2072)

Research, design, develop, or test electronic components and systems for commercial, industrial, military, or scientific use employing knowledge of electronic theory and materials properties. Design electronic circuits and components for use in fields such as telecommunications, aerospace guidance and propulsion control, acoustics, or instruments and controls. Excludes "Computer Hardware Engineers" (17-2061).

Function Related to Electric Vehicles and their Infrastructure

Electrical Engineers participate in the development and the design process for the electrical components in electric vehicles. Electrical components of EVs include heating and air-conditioning systems and lighting systems, including visual displays; however, they do not work on the vehicle's electrical circuitry. In addition to product design and development, the job duties of Electronics Engineers include testing of these electrical components.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, a certain level of work experience or a graduate degree is required for positions that work autonomously. Many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education course are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Electronics Engineers in LA County

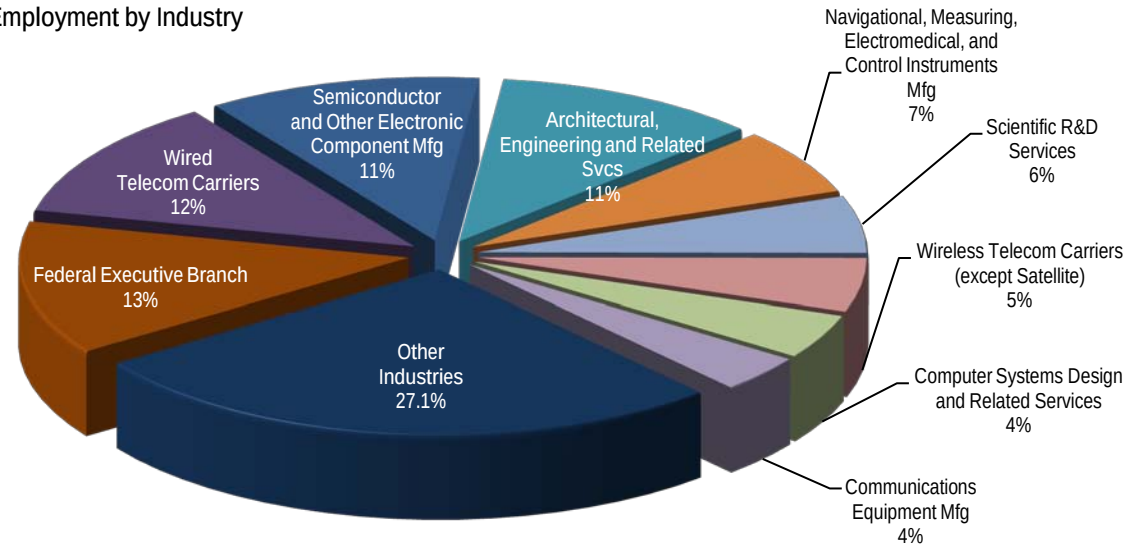
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
9991	Federal Executive Branch (OES Designation)	13.1%	715
5171	Wired Telecommunications Carriers	11.9%	647
3344	Semiconductor and Other Electronic Component Manufacturing	11.4%	622
5413	Architectural, Engineering, and Related Services	11.1%	603
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	6.5%	356
5417	Scientific Research and Development Services	5.6%	307
5172	Wireless Telecommunications Carriers (except Satellite)	5.3%	287
5415	Computer Systems Design and Related Services	4.4%	238
3342	Communications Equipment Manufacturing	3.6%	198
4236	Electrical and Electronic Goods Merchant Wholesalers	2.8%	152
3364	Aerospace Product and Parts Manufacturing	2.3%	124
5416	Management, Scientific, and Technical Consulting Services	2.1%	113
5511	Management of Companies and Enterprises	1.9%	103
4234	Professional and Commercial Equipment and Supplies Merchant Wholesalers	1.9%	101
5179	Other Telecommunications	1.7%	95
6113	Colleges, Universities, and Professional Schools	1.7%	92
	Other Industries	*9.7%*	*527*
Total*	Across All Industries	100.0%	5,450

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

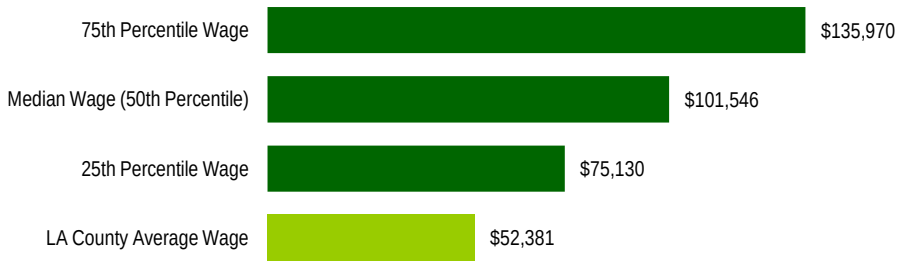
Electronics Engineers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
5,450 Jobs 0.14% of total	$109,668 Exceeds LAC average	Bachelor's Degree	10 Jobs Annually 0.2% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Engine and Other Machine Assemblers (SOC 51-2031)

Construct, assemble, or rebuild machines, such as engines, turbines, and similar equipment used in such industries as construction, extraction, textiles, and paper manufacturing.

Function Related to Electric Vehicles and their Infrastructure

Engine and Other Machine Assemblers participate in the manufacture of electric vehicles, their components and their infrastructure. They build the gasoline combustible engines in hybrid electric vehicles in addition to other vehicle components.

Education, Training and Experience

Entry-level positions require short-term on-the-job training; more work experience is required for supervisory positions. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required for electric vehicle and charge station manufacturing.

Industry Distribution of Engine and Other Machine Assemblers in LA County

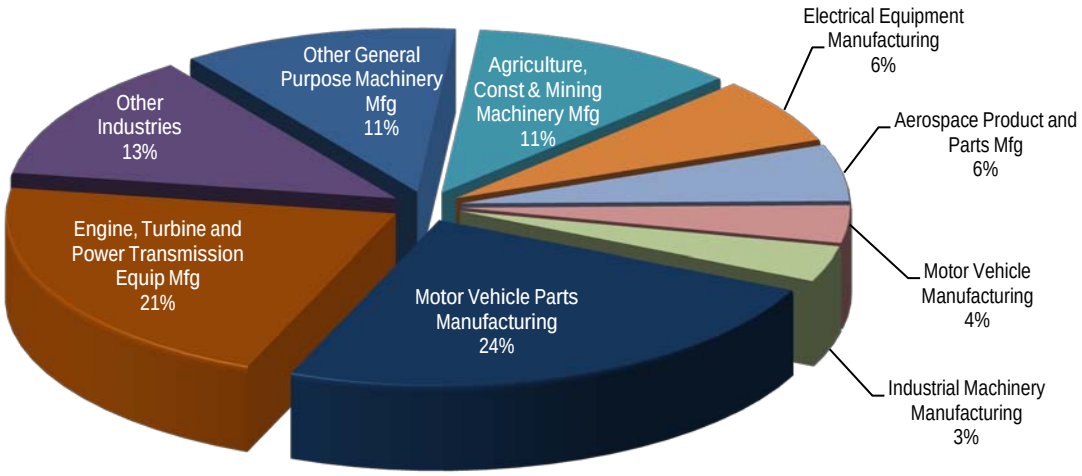
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3363	Motor Vehicle Parts Manufacturing	24.2%	75
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	21.3%	66
3339	Other General Purpose Machinery Manufacturing	11.5%	36
3331	Agriculture, Construction, and Mining Machinery Manufacturing	11.1%	34
3353	Electrical Equipment Manufacturing	6.5%	20
3364	Aerospace Product and Parts Manufacturing	5.6%	17
3361	Motor Vehicle Manufacturing	3.7%	11
3332	Industrial Machinery Manufacturing	3.5%	11
5613	Employment Services	2.4%	8
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Mfg	2.4%	7
4238	Machinery, Equipment, and Supplies Merchant Wholesalers	1.6%	5
3335	Metalworking Machinery Manufacturing	1.3%	4
5416	Management, Scientific, and Technical Consulting Services	0.9%	3
3333	Commercial and Service Industry Machinery Manufacturing	0.7%	2
3366	Ship and Boat Building	0.7%	2
8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	0.6%	2
3369	Other Transportation Equipment Manufacturing	0.5%	2
7112	Spectator Sports	0.4%	1
3327	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	0.3%	1
	Other Industries	*0.6%*	*2*
Total*	Across All Industries	100.0%	310

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Engine and Other Machine Assemblers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
310 Jobs 0.01% of total	$46,687 Below LAC average	Short-Term On-the-Job Training	-125 Jobs Annually -25.6% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Industrial Engineers (SOC 17-2112)

Design, develop, test, and evaluate integrated systems for managing industrial production processes, including human work factors, quality control, inventory control, logistics and material flow, cost analysis, and production coordination. Excludes "Health and Safety Engineers, Except Mining Safety Engineers and Inspectors" (17-2111).

Function Related to Electric Vehicles and their Infrastructure

Industrial Engineers develop the methods of production for electric vehicles. They allocate resources, including, capital, energy, labor, technology and other production inputs to maximize output. Industrial Engineers also modify existing automotive manufacturing plants to accommodate new requirements specific to the manufacture of electric vehicles.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, a certain level of work experience or a graduate degree is required for positions that work autonomously. Many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education course are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Industrial Engineers in LA County

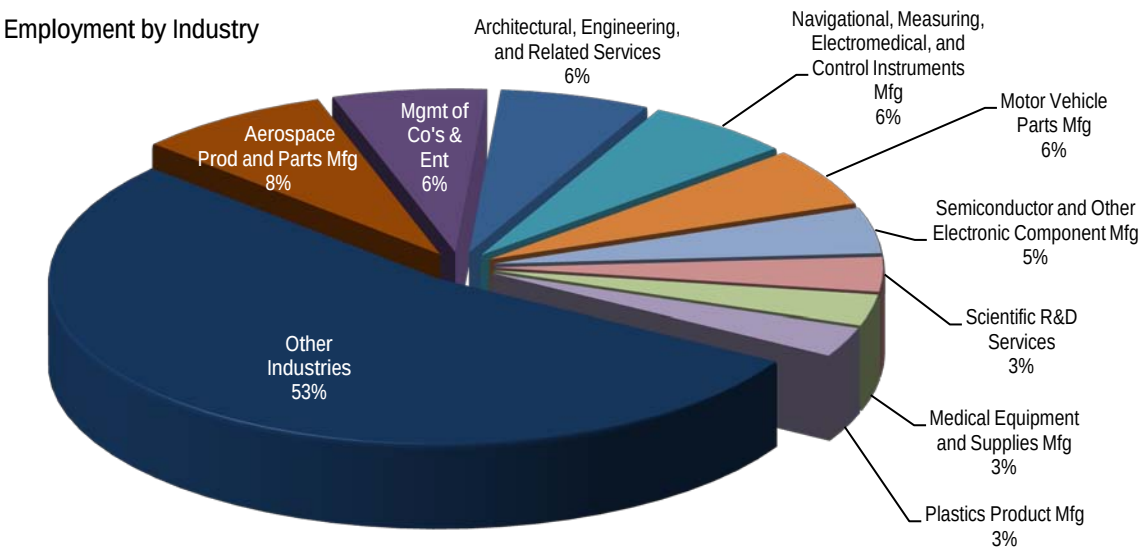
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3364	Aerospace Product and Parts Manufacturing	8.1%	421
5511	Management of Companies and Enterprises	6.4%	334
5413	Architectural, Engineering, and Related Services	6.2%	325
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	6.1%	319
3363	Motor Vehicle Parts Manufacturing	5.8%	299
3344	Semiconductor and Other Electronic Component Manufacturing	4.5%	235
5417	Scientific Research and Development Services	3.4%	177
3391	Medical Equipment and Supplies Manufacturing	3.0%	158
3261	Plastics Product Manufacturing	2.9%	153
3361	Motor Vehicle Manufacturing	2.3%	120
3329	Other Fabricated Metal Product Manufacturing	2.1%	111
3254	Pharmaceutical and Medicine Manufacturing	2.0%	104
3331	Agriculture, Construction, and Mining Machinery Manufacturing	1.9%	101
3339	Other General Purpose Machinery Manufacturing	1.9%	100
5613	Employment Services	1.9%	99
5415	Computer Systems Design and Related Services	1.9%	97
5416	Management, Scientific, and Technical Consulting Services	1.4%	73
3353	Electrical Equipment Manufacturing	1.2%	64
	Other Industries	*36.7%*	*1,911*
Total*	Across All Industries	100.0%	5,200

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

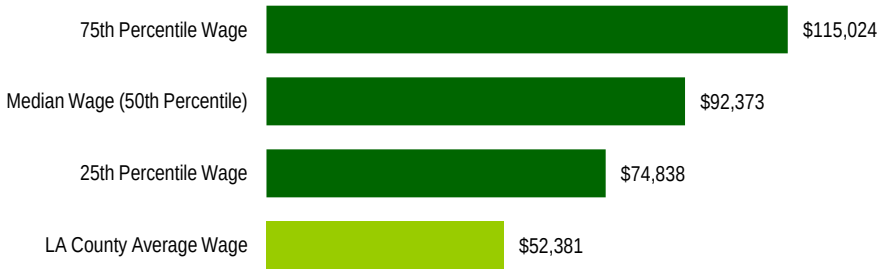
Industrial Engineers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
5,200 Jobs 0.14% of total	$95,017 Exceeds LAC average	Bachelor's Degree	-215 Jobs Annually -3.9% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Industrial Production Managers (SOC 11-3051)

Plan, direct, or coordinate the work activities and resources necessary for manufacturing products in accordance with cost, quality, and quantity specifications.

Function Related to Electric Vehicles and their Infrastructure

Industrial Production Managers participate in the production process of electric vehicles, their components and their infrastructure. They are responsible for the planning, direction, coordination, budget and schedule adherence, quality control and maximization of output for the production run at the plant level or split into areas in large manufacturing facilities. Additionally, they troubleshoot problems that arise during manufacturing.

Education, Training and Experience

Entry-level positions require a bachelor's degree in the discipline of engineering, often with a concentration in either industrial or mechanical engineering. A certain level of work experience in the automotive manufacturing industry, typically several years, is also required. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required.

Industry Distribution of Industrial Production Managers in LA County

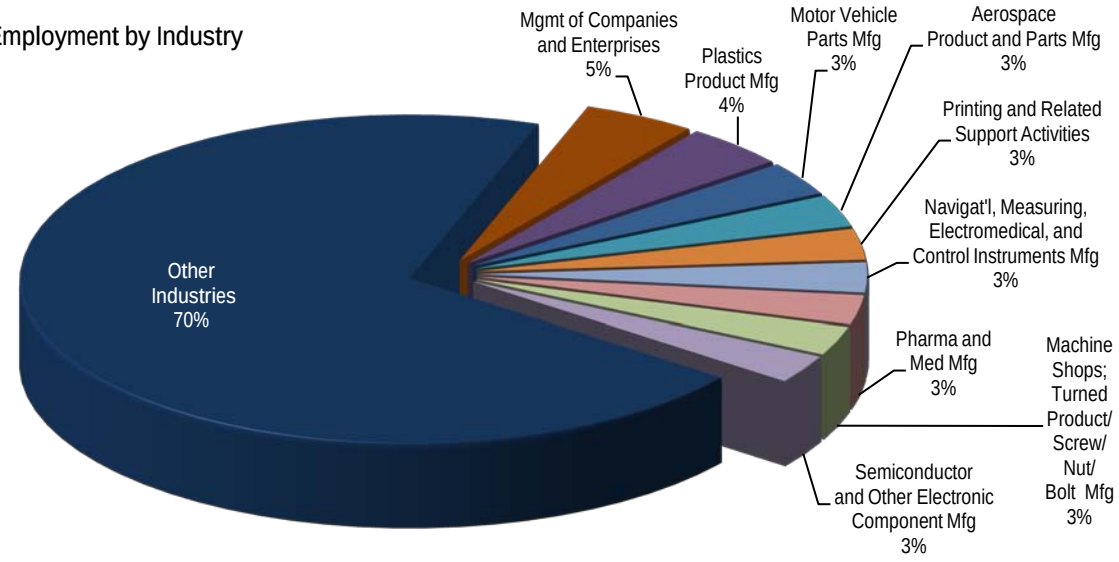
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5511	Management of Companies and Enterprises	4.7%	217
3261	Plastics Product Manufacturing	4.3%	199
3363	Motor Vehicle Parts Manufacturing	3.3%	155
3364	Aerospace Product and Parts Manufacturing	3.1%	146
3231	Printing and Related Support Activities	3.0%	141
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2.9%	137
3254	Pharmaceutical and Medicine Manufacturing	2.9%	133
3327	Machine Shops; Turned Product/ Screw/ Nut/ Bolt Manufacturing	2.8%	132
3344	Semiconductor and Other Electronic Component Manufacturing	2.8%	129
3323	Architectural and Structural Metals Manufacturing	2.4%	114
3222	Converted Paper Product Manufacturing	2.2%	101
3391	Medical Equipment and Supplies Manufacturing	2.0%	92
3329	Other Fabricated Metal Product Manufacturing	2.0%	91
3339	Other General Purpose Machinery Manufacturing	1.8%	85
3251	Basic Chemical Manufacturing	1.7%	81
3399	Other Miscellaneous Manufacturing	1.7%	78
3116	Animal Slaughtering and Processing	1.6%	76
3331	Agriculture, Construction, and Mining Machinery Manufacturing	1.5%	67
3335	Metalworking Machinery Manufacturing	1.4%	66
	Other Industries	*51.7%*	*2,401*
Total*	Across All Industries	100.0%	4,640

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

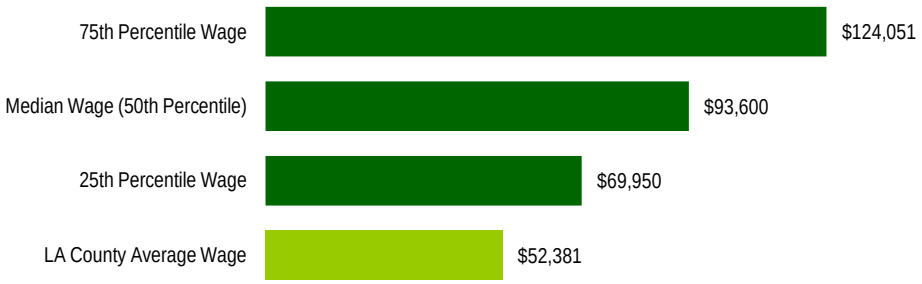
Industrial Production Managers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
4,640 Jobs 0.12% of total	$101,836 Exceeds LAC average	Bachelor's Degree	-160 Jobs Annually -3.3% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Machinists (SOC 51-4041)

Set up and operate a variety of machine tools to produce precision parts and instruments. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures.

Function Related to Electric Vehicles and their Infrastructure

Machinists participate in the manufacture of electric vehicles and their infrastructure. They produce precision metal parts for electric vehicles utilizing special machining tools such as grinders, lathes, presses and milling machines. Machinists can manufacture one-off parts used in electric vehicle prototypes and testing, large scale productions of machined parts are typically manufactured using automated machinery. Machinists supervise the manufacture of these precision parts as well as provide maintenance to the machines used in the process.

Education, Training and Experience

Entry-level positions require long-term on-the-job training. Many times the machinist trade is learned via an apprenticeship that lasts from three to five years under a skilled machinist.

Industry Distribution of Machinists in LA County

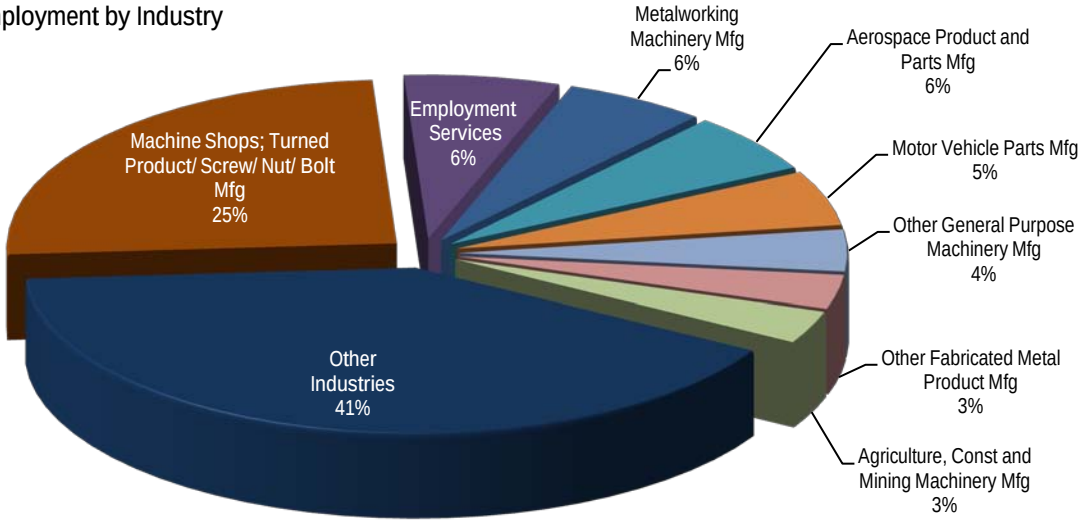
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3327	Machine Shops; Turned Product/ Screw/ Nut/ Bolt Manufacturing	25.1%	2,251
5613	Employment Services	6.5%	581
3335	Metalworking Machinery Manufacturing	5.9%	532
3364	Aerospace Product and Parts Manufacturing	5.9%	528
3363	Motor Vehicle Parts Manufacturing	5.4%	488
3339	Other General Purpose Machinery Manufacturing	4.1%	368
3329	Other Fabricated Metal Product Manufacturing	3.3%	299
3331	Agriculture, Construction and Mining Machinery Manufacturing	3.2%	288
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2.1%	190
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	2.1%	187
3332	Industrial Machinery Manufacturing	1.9%	173
3391	Medical Equipment and Supplies Manufacturing	1.9%	172
4821	Rail Transportation	1.8%	165
8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	1.7%	151
4238	Machinery, Equipment, and Supplies Merchant Wholesalers	1.6%	141
3323	Architectural and Structural Metals Manufacturing	1.5%	136
4235	Metal and Mineral (except Petroleum) Merchant Wholesalers	1.4%	126
3261	Plastics Product Manufacturing	1.2%	110
3321	Forging and Stamping	1.0%	92
	Other Industries	*22.3%*	*2,003*
Total*	Across All Industries	100.0%	8,980

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Machinists in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
8,980 Jobs 0.23% of total	$38,134 Below LAC average	Long-Term On-the-Job Training	-780 Jobs Annually -7.7% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Materials Engineers (SOC 17-2131)

Evaluate materials and develop machinery and processes to manufacture materials for use in products that must meet specialized design and performance specifications. Develop new uses for known materials. Includes those engineers working with composite materials or specializing in one type of material, such as graphite, metal and metal alloys, ceramics and glass, plastics and polymers, and naturally occurring materials. Includes metallurgists and metallurgical engineers, ceramic engineers, and welding engineers.

Function Related to Electric Vehicles and their Infrastructure

Materials Engineers participate in the development, processing and testing of materials used in electric vehicles. Lighter and stronger materials are requisite to fuel efficiency, vehicle safety and mechanical reliability. Additionally, Materials Engineers integrate the use of plant-based and recyclable materials, further reducing the environmental impact of electric vehicles.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, a certain level of work experience or a graduate degree is required for positions that work autonomously. Many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education course are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Materials Engineers in LA County

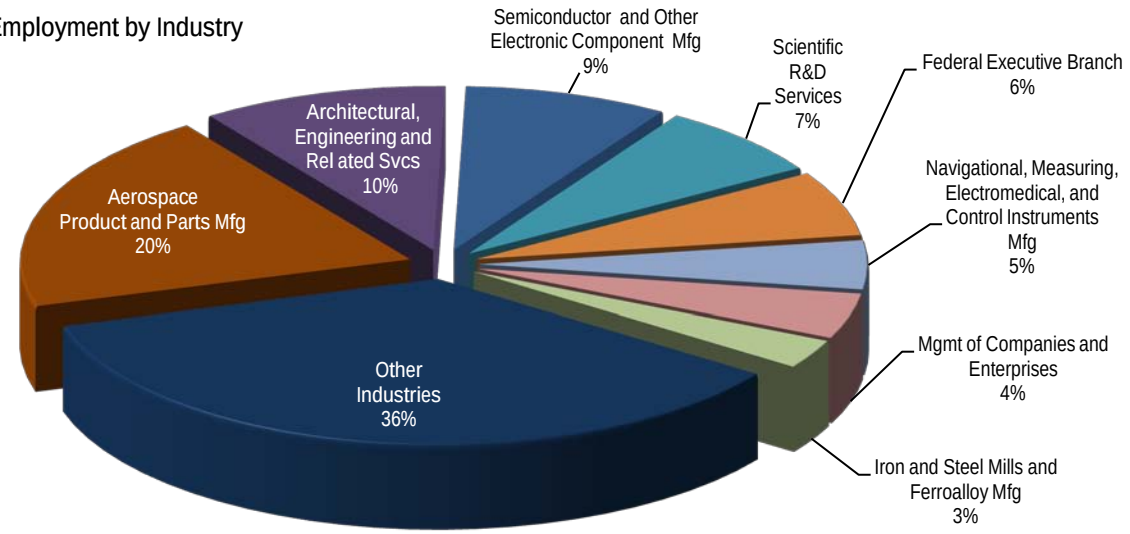
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
3364	Aerospace Product and Parts Manufacturing	19.8%	246
5413	Architectural, Engineering, and Related Services	10.3%	127
3344	Semiconductor and Other Electronic Component Manufacturing	8.5%	105
5417	Scientific Research and Development Services	7.2%	90
9991	Federal Executive Branch	6.4%	80
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	4.8%	60
5511	Management of Companies and Enterprises	4.4%	55
3311	Iron and Steel Mills and Ferroalloy Manufacturing	2.9%	35
3315	Foundries	2.7%	34
6113	Colleges, Universities, and Professional Schools	2.7%	33
3314	Nonferrous Metal (except Aluminum) Production and Processing	1.9%	24
3363	Motor Vehicle Parts Manufacturing	1.7%	21
3271	Clay Product and Refractory Manufacturing	1.4%	17
3312	Steel Product Manufacturing from Purchased Steel	1.2%	15
9992	State Government (excluding schools and hospitals)	1.2%	15
3261	Plastics Product Manufacturing	1.2%	15
	Other Industries	*21.7%*	*269*
Total*	Across All Industries	100.0%	1,240

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

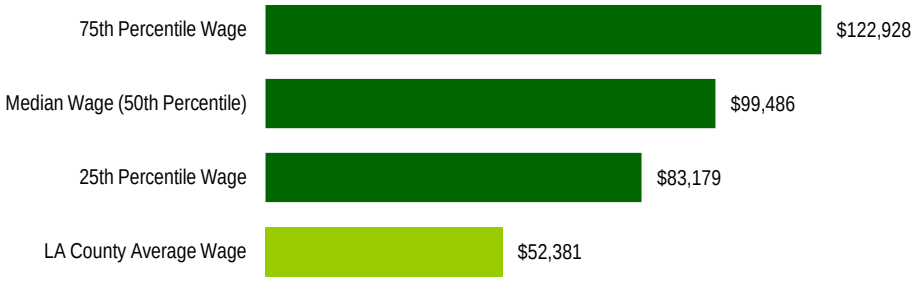
Materials Engineers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,240 Jobs 0.03% of total	$103,209 Exceeds LAC average	Bachelor's Degree	310 Jobs Annually 41.4% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Materials Scientists (SOC 19-2032)

Research and study the structures and chemical properties of various natural and synthetic or composite materials, including metals, alloys, rubber, ceramics, semiconductors, polymers, and glass. Determine ways to strengthen or combine materials or develop new materials with new or specific properties for use in a variety of products and applications. Includes glass scientists, ceramic scientists, metallurgical scientists, and polymer scientists

Function Related to Electric Vehicles and their Infrastructure

Materials Scientists participate in research and development for electric vehicles. They apply their knowledge of the structure and chemical properties of materials to EV battery technology, in addition to other vehicle components. Lighter and stronger materials are requisite to fuel efficiency, vehicle safety and mechanical reliability. Additionally, Materials Scientists have introduced the use of plant-based and recyclable materials for interior components such as seating, further reducing the environmental impact of the vehicle.

Education, Training and Experience

Computer skills are required to perform these duties, which include modeling, testing, integration and data analysis. While positions involved in the research and development of new products do require a doctorate, some positions for individuals with a bachelor's or master's degree are available in other EV applications. Most do not require licensure or additional certifications.

Industry Distribution of Materials Scientists in LA County

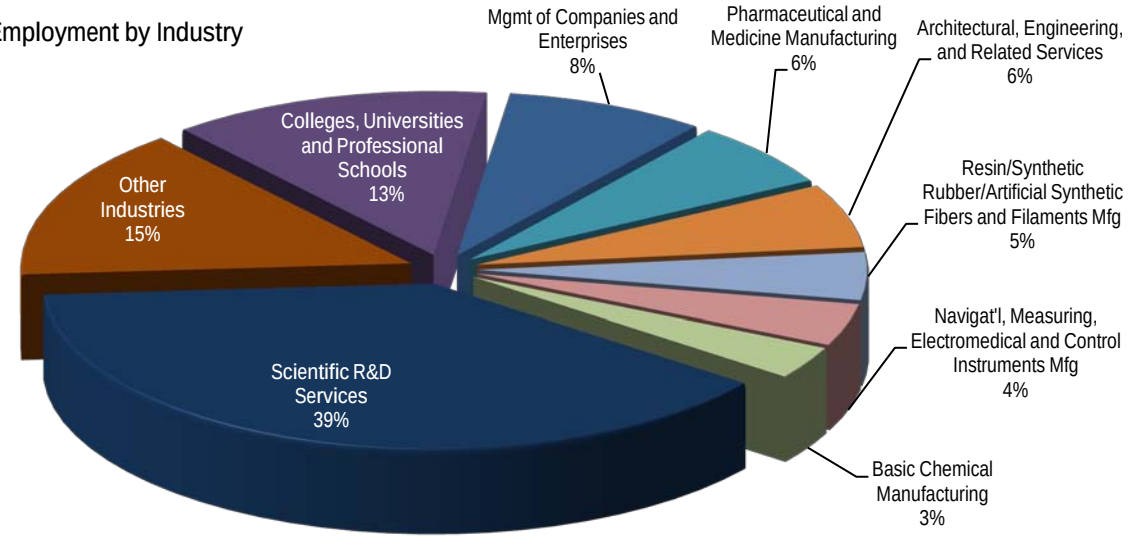
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5417	Scientific Research and Development Services	38.7%	120
6113	Colleges, Universities and Professional Schools	13.3%	41
5511	Management of Companies and Enterprises	8.3%	26
3254	Pharmaceutical and Medicine Manufacturing	6.4%	20
5413	Architectural, Engineering, and Related Services	6.3%	20
3252	Resin/Synthetic Rubber/Artificial Synthetic Fibers and Filaments Manufacturing	4.7%	15
3345	Navigational, Measuring, Electromedical and Control Instruments Manufacturing	4.1%	13
3251	Basic Chemical Manufacturing	3.2%	10
3344	Semiconductor and Other Electronic Component Manufacturing	2.3%	7
3255	Paint, Coating, and Adhesive Manufacturing	1.8%	5
3359	Other Electrical Equipment and Component Manufacturing	1.6%	5
3331	Agriculture, Construction, and Mining Machinery Manufacturing	1.5%	5
5416	Management, Scientific, and Technical Consulting Services	1.5%	5
3259	Other Chemical Product and Preparation Manufacturing	1.3%	4
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	1.0%	3
4242	Drugs and Druggists' Sundries Merchant Wholesalers	0.9%	3
4251	Wholesale Electronic Markets and Agents and Brokers	0.9%	3
	Other Industries	*2.2%*	*7*
Total*	Across All Industries	100.0%	310

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

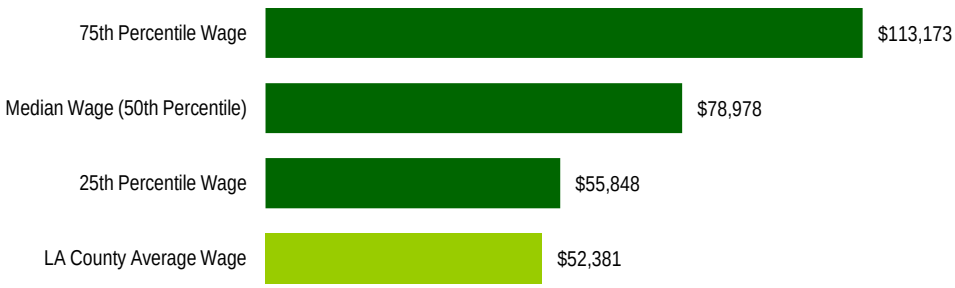
Materials Scientists in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
310 Jobs 0.01% of total	$89,761 Exceeds LAC average	Bachelor's Degree	85 Jobs Annually 48.8% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Mechanical Drafters (SOC 17-3013)

Prepare detailed working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information.

Function Related to Electric Vehicles and their Infrastructure

Mechanical Drafters make detailed mechanical drawings that demonstrate construction and assembly methods for the mechanical components of electric vehicles, the machinery used in their manufacture and maintenance and for their infrastructure, such as charging stations. They utilize **computer**-aided design and drafting (CADD) to prepare these technical drawings.

Education, Training and Experience

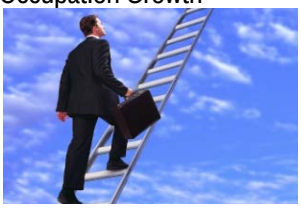
Computer skills are required to perform these duties. Entry-level positions require an associate's degree or a certification from a community college or technical school. Mechanical Drafters are closely supervised by higher-level employees such as engineers and scientists and a certain level of on-the-job training is required.

Industry Distribution of Mechanical Drafters in LA County

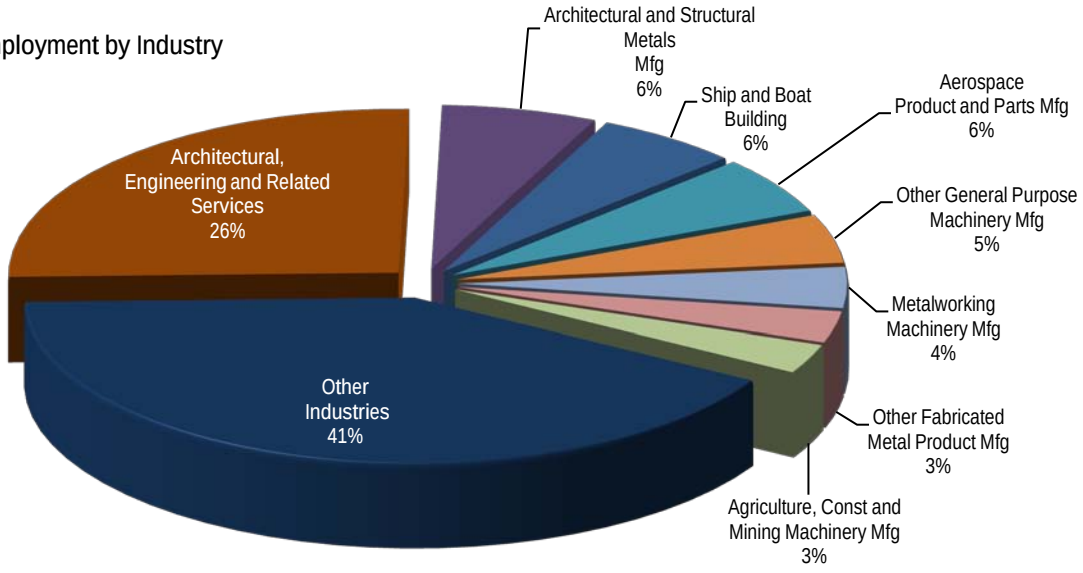
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5413	Architectural, Engineering and Related Services	25.8%	328
3323	Architectural and Structural Metals Manufacturing	6.5%	82
3366	Ship and Boat Building	6.0%	76
3364	Aerospace Product and Parts Manufacturing	5.7%	72
3339	Other General Purpose Machinery Manufacturing	4.8%	61
3335	Metalworking Machinery Manufacturing	4.0%	51
3329	Other Fabricated Metal Product Manufacturing	3.1%	39
3331	Agriculture, Const and Mining Machinery Manufacturing	2.9%	37
5613	Employment Services	2.7%	35
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2.5%	31
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Mfg	2.2%	28
2382	Building Equipment Contractors	2.1%	26
3363	Motor Vehicle Parts Manufacturing	2.0%	26
3332	Industrial Machinery Manufacturing	1.9%	25
3327	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	1.9%	24
3324	Boiler, Tank, and Shipping Container Manufacturing	1.8%	22
3353	Electrical Equipment Manufacturing	1.3%	16
5511	Management of Companies and Enterprises	1.3%	16
3261	Plastics Product Manufacturing	1.2%	16
	Other Industries	*20.4%*	*258*
Total*	Across All Industries	100.0%	1,270

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Mechanical Drafters in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,270 Jobs 0.03% of total	$55,571 Exceeds LAC average	Post-Secondary Vocational Education	85 Jobs Annually 7.4% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Mechanical Engineering Technicians (SOC 17-3027)

Apply theory and principles of mechanical engineering to modify, develop, test, or calibrate machinery and equipment under direction of engineering staff or physical scientists.

Function Related to Electric Vehicles and their Infrastructure

Mechanical Engineering Technicians support engineers with technical issues in the research, design, development and production of electric vehicles and their infrastructure. They are focused on applications, such as assembly and set up of mechanical equipment and preparation and conducting of experiments. Mechanical Engineering Technicians are also responsible for collecting, analyzing and recording data. They utilize computer-aided design and drafting (CADD) equipment and assist engineers and scientists in making prototypes. Additionally, Mechanical Engineering Technicians help engineers with construction, inspection and maintenance requirements.

Education, Training and Experience

Computer skills are required to perform these duties. Entry-level positions require an associate's degree or a certification from a community college or technical school. Mechanical Engineering Technicians are closely supervised by higher-level employees such as engineers and scientists and a certain level of on-the-job training is required.

Industry Distribution of Mechanical Engineering Technicians in LA County

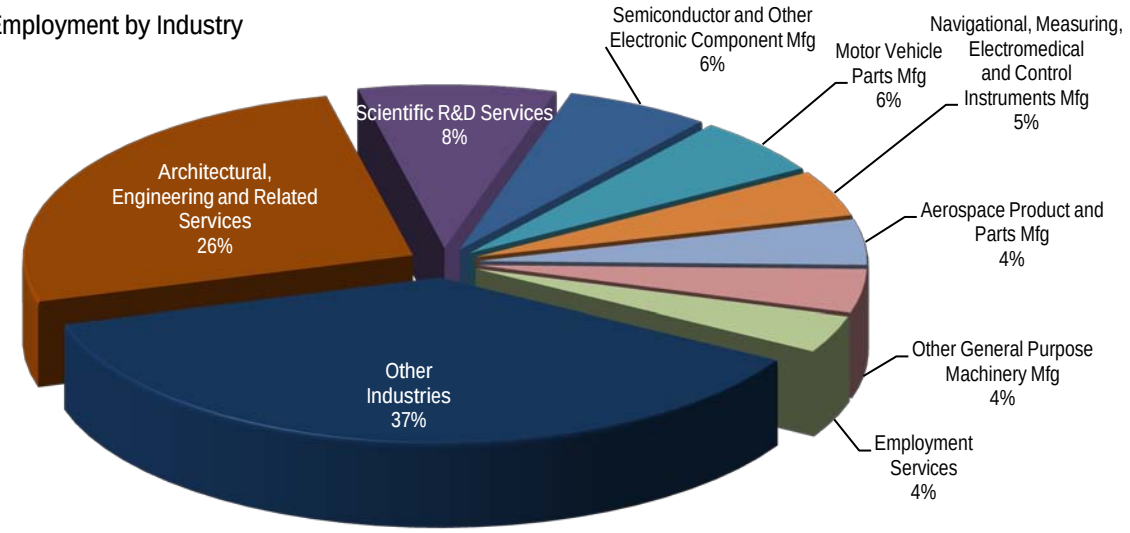
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5413	Architectural, Engineering and Related Services	26.0%	218
5417	Scientific Research and Development Services	8.2%	69
3344	Semiconductor and Other Electronic Component Manufacturing	6.0%	51
3363	Motor Vehicle Parts Mfg	5.6%	47
3345	Navigational, Measuring, Electromedical and Control Instruments Manufacturing	4.5%	38
3364	Aerospace Product and Parts Manufacturing	4.5%	38
3339	Other General Purpose Machinery Manufacturing	4.3%	36
5613	Employment Services	3.7%	31
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2.8%	24
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	2.4%	20
3391	Medical Equipment and Supplies Manufacturing	2.0%	17
3329	Other Fabricated Metal Product Manufacturing	1.8%	15
3353	Electrical Equipment Manufacturing	1.5%	13
6113	Colleges, Universities, and Professional Schools	1.5%	13
3335	Metalworking Machinery Manufacturing	1.5%	13
3332	Industrial Machinery Manufacturing	1.4%	12
3359	Other Electrical Equipment and Component Manufacturing	1.4%	12
	Other Industries	*20.8%*	*174*
Total*	Across All Industries	100.0%	840

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Mechanical Engineering Technicians in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
840 Jobs 0.02% of total	$60,980 Exceeds LAC average	Associate Degree	-5 Jobs Annually -0.6% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Mechanical Engineers (SOC 17-2141)

Perform engineering duties in planning and designing tools, engines, machines, and other mechanically functioning equipment. Oversee installation, operation, maintenance, and repair of equipment such as centralized heat, gas, water, and steam systems

Function Related to Electric Vehicles and their Infrastructure

Mechanical Engineers participate in the design process, the development and the testing of mechanical components of electric vehicles and their infrastructure. Mechanical components include the drivetrain, engine, steering and transmission, in addition to machines and tools used in manufacturing or repair. Mechanical Engineers may develop expertise related to one specific system or component.

Education, Training and Experience

Computer skills are required to perform these duties. While entry-level positions require a bachelor's degree, a certain level of work experience or a graduate degree is required for positions that work autonomously. Many times a professional engineer (PE) licensure is required for higher-level positions. Additional certifications may also be required for specific systems and technologies. Continuing education course are required to remain knowledgeable about changes in existing technology and the development of new technologies.

Industry Distribution of Mechanical Engineers in LA County

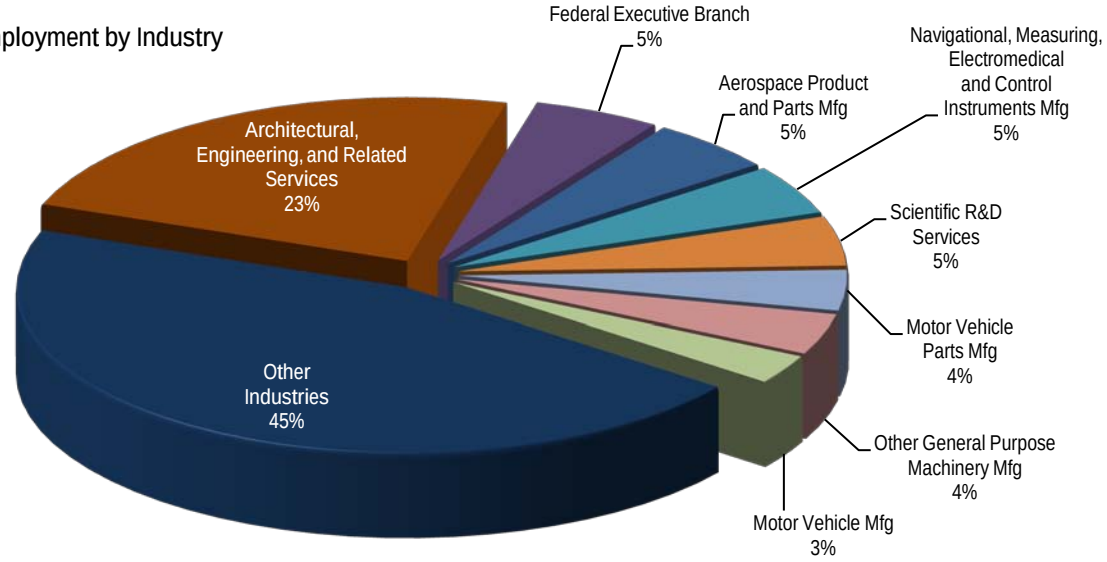
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5413	Architectural, Engineering, and Related Services	23.5%	1,386
9991	Federal Executive Branch	5.3%	312
3364	Aerospace Product and Parts Manufacturing	5.3%	310
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	4.9%	288
5417	Scientific Research and Development Services	4.9%	288
3363	Motor Vehicle Parts Manufacturing	4.0%	235
3339	Other General Purpose Machinery Manufacturing	4.0%	235
3361	Motor Vehicle Manufacturing	2.9%	169
3329	Other Fabricated Metal Product Manufacturing	2.6%	154
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2.5%	146
3344	Semiconductor and Other Electronic Component Manufacturing	2.2%	131
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	2.0%	121
3332	Industrial Machinery Manufacturing	2.0%	117
3335	Metalworking Machinery Manufacturing	1.8%	109
5613	Employment Services	1.6%	92
3251	Basic Chemical Manufacturing	1.5%	87
3261	Plastics Product Manufacturing	1.4%	86
3391	Medical Equipment and Supplies Manufacturing	1.3%	79
3327	Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	1.2%	74
	Other Industries	*25.1%*	*1,482*
Total*	Across All Industries	100.0%	5,900

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

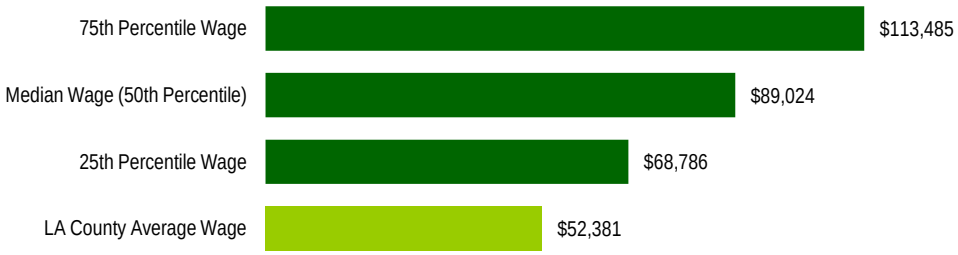
Mechanical Engineers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
5,900 Jobs 0.15% of total	$93,779 Exceeds LAC average	Bachelor's Degree	250 Jobs Annually 4.5% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Retail Salespersons (SOC 41-2031)

Sell merchandise, such as furniture, motor vehicles, appliances, or apparel to consumers. Excludes "Cashiers" (41-2011).

Function Related to Electric Vehicles and their Infrastructure

Retail Salespersons participate in the sale of electric vehicles and their infrastructure. They assist potential customers in the selection process by matching and explaining the vehicle features according to the consumer's needs. Additionally, Retail Salespersons handle the financial transactions to complete a sale, and typically earn a portion of their earning through a commission. Their schedule is typically irregular and may require long hours at times.

Education, Training and Experience

Entry-level positions require a high school diploma or equivalent with minimal on-the-job training; however, a certain level of work experience is required for higher-level sales positions. Good communication and problem solving skills are requisite to their job duties, with workers who are both friendly and conduct themselves professionally being the most sought after by employers.

Industry Distribution of Retail Sales Persons in LA County

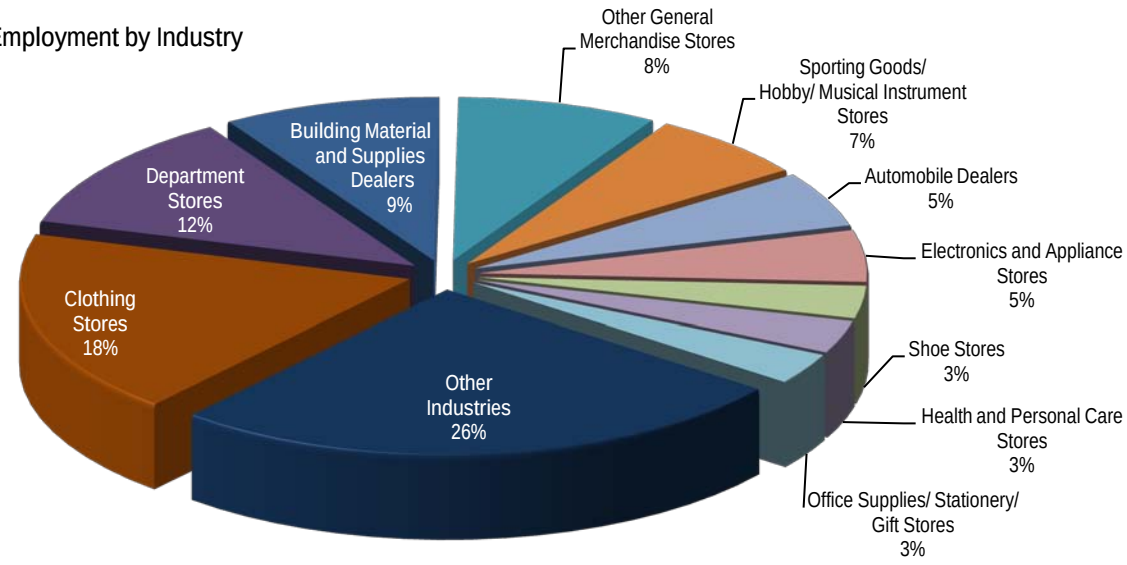
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
4481	Clothing Stores	18.1%	21,074
4521	Department Stores	11.7%	13,645
4441	Building Material and Supplies Dealers	9.1%	10,587
4529	Other General Merchandise Stores	8.4%	9,732
4511	Sporting Goods/Hobby/Musical Instrument Stores	6.7%	7,791
4411	Automobile Dealers	5.5%	6,378
4431	Electronics and Appliance Stores	5.1%	5,935
4482	Shoe Stores	3.2%	3,722
4461	Health and Personal Care Stores	3.2%	3,703
4532	Office Supplies/Stationery/Gift Stores	3.1%	3,568
4422	Home Furnishings Stores	2.6%	2,989
4539	Other Miscellaneous Store Retailers	2.4%	2,775
4483	Jewelry, Luggage, and Leather Goods Stores	2.1%	2,449
4421	Furniture Stores	2.0%	2,352
4413	Automotive Parts, Accessories, and Tire Stores	2.0%	2,308
4451	Grocery Stores	1.6%	1,807
4512	Book, Periodical, and Music Stores	1.5%	1,754
4533	Used Merchandise Stores	1.2%	1,422
4442	Lawn and Garden Equipment and Supplies Stores	0.9%	1,008
	Other Industries	*9.8%*	*11,471*
Total*	Across All Industries	100.0%	116,470

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

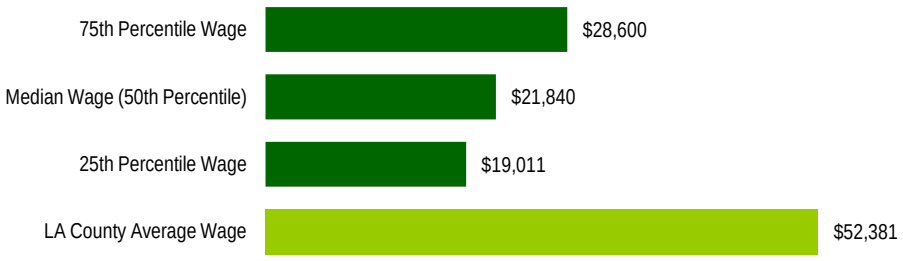
Retail Salespersons in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
116,470 Jobs 3.05% of total	$26,335 Below LAC average	Short-Term On-the-Job Training	790 Jobs Annually 0.7% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Software Developers (Applications) (SOC 15-1132)

Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team. May supervise computer programmers.

Function Related to Electric Vehicles and their Infrastructure

Software Developers participate in design and development of the software that controls hybrid and electric vehicles. They apply their knowledge and expertise of computer science and mathematics in both creating and evaluating the applications software used in the on-board computers. On-board computers determine the production, distribution, and storage of generated and charged electricity, depending upon the conditions of driving.

Education, Training and Experience

Computer skills are required to perform these duties. Entry-level positions require at least a bachelor's degree in the discipline of computer science or a related field of study. A certain level of work experience in computer programming and software design is required for higher-level positions.

Industry Distribution of Software Developers (Applications) in LA County

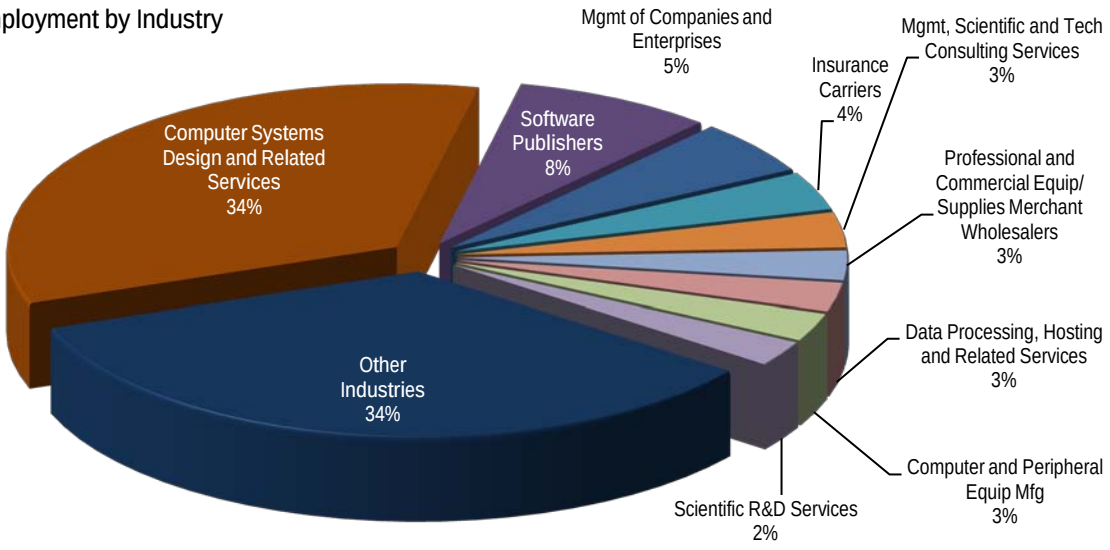
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5415	Computer Systems Design and Related Services	33.9%	4,787
5112	Software Publishers	8.3%	1,177
5511	Management of Companies and Enterprises	5.3%	752
5241	Insurance Carriers	3.8%	533
5416	Management, Scientific and Technical Consulting Services	3.5%	491
4234	Professional and Commercial Equip/ Supplies Merchant Wholesalers	2.9%	410
5182	Data Processing, Hosting and Related Services	2.8%	397
3341	Computer and Peripheral Equipment Manufacturing	2.8%	390
5417	Scientific Research and Development Services	2.5%	352
5413	Architectural, Engineering, and Related Services	2.3%	330
6113	Colleges, Universities, and Professional Schools	1.9%	266
5191	Other Information Services	1.8%	257
5231	Securities and Commodity Contracts Intermediation and Brokerage	1.7%	236
9992	State Government (excluding schools and hospitals)	1.5%	211
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	1.5%	208
3364	Aerospace Product and Parts Manufacturing	1.4%	203
5171	Wired Telecommunications Carriers	1.2%	168
9993	Local Government (excluding schools and hospitals)	1.2%	167
	Other Industries	*19.7%*	*2,777*
Total*	Across All Industries	100.0%	14,110

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

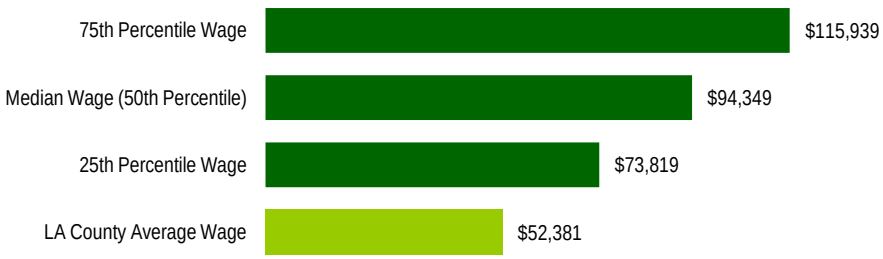
Software Developers (Applications) in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
14,110 Jobs 0.37% of total	$95,406 Exceeds LAC average	Bachelor's Degree	520 Jobs Annually 3.9% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Software Developers (Systems Software) (SOC 15-1133)

Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. May design embedded systems software. Apply principles and techniques of computer science, engineering, and mathematical analysis.

Function Related to Electric Vehicles and their Infrastructure

Software Developers participate in design and development of the software that controls hybrid and electric vehicles. They apply their knowledge and expertise of computer science and mathematics in both creating and evaluating the systems software used in the on-board computers. On-board computers determine the production, distribution, and storage of generated and charged electricity, depending upon the conditions of driving.

Education, Training and Experience

Computer skills are required to perform these duties. Entry-level positions require at least a bachelor's degree in the discipline of computer science or a related field of study. A certain level of work experience in computer programming and software design is required for higher-level positions.

Industry Distribution of Software Developers (Systems Software) in LA County

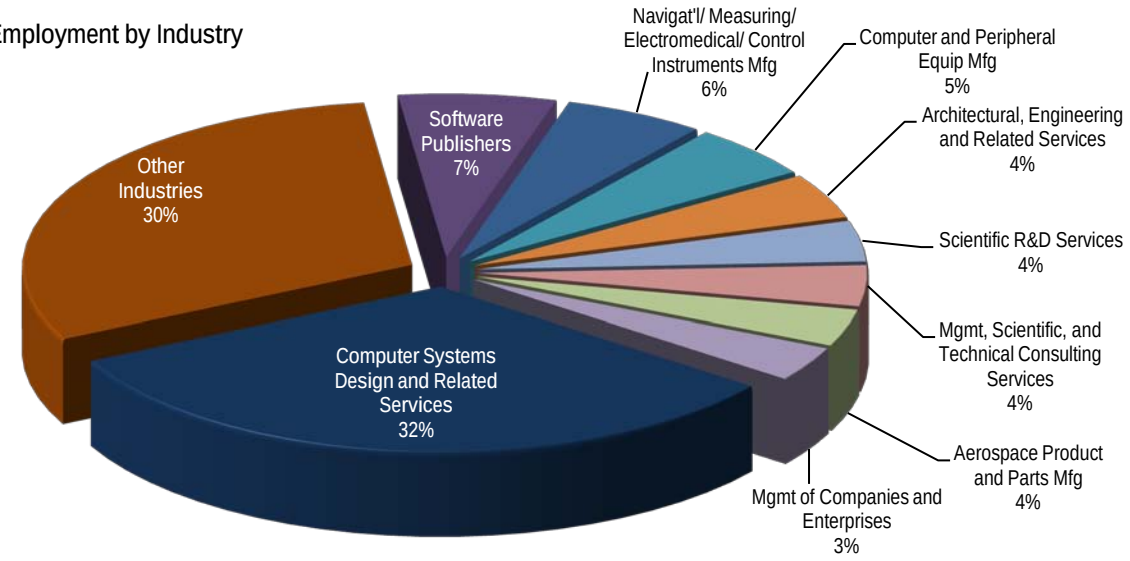
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5415	Computer Systems Design and Related Services	32.3%	4,273
5112	Software Publishers	6.6%	868
3345	Navigational/ Measuring/ Electromedical/ Control Instruments Manufacturing	5.9%	777
3341	Computer and Peripheral Equipment Manufacturing	5.3%	701
5413	Architectural, Engineering, and Related Services	4.5%	589
5417	Scientific Research and Development Services	4.0%	532
5416	Management, Scientific, and Technical Consulting Services	4.0%	531
3364	Aerospace Product and Parts Manufacturing	3.6%	477
5511	Management of Companies and Enterprises	3.4%	452
4234	Professional and Commercial Equipment and Supplies Merchant Wholesalers	2.9%	384
5182	Data Processing, Hosting, and Related Services	2.3%	309
5171	Wired Telecommunications Carriers	2.2%	290
5613	Employment Services	1.8%	239
3344	Semiconductor and Other Electronic Component Manufacturing	1.8%	233
3342	Communications Equipment Manufacturing	1.7%	227
5221	Depository Credit Intermediation	1.5%	194
5241	Insurance Carriers	1.2%	164
4236	Electrical and Electronic Goods Merchant Wholesalers	1.0%	127
	Other Industries	*14.0%*	*1,853*
Total*	Across All Industries	100.0%	13,220

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

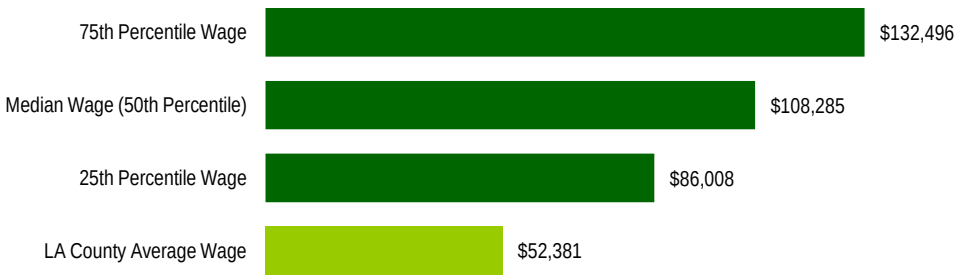
Software Developers (Systems Software) in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
13,220 Jobs 0.35% of total	$108,951 Exceeds LAC average	Bachelor's Degree	235 Jobs Annually 1.8% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Team Assemblers (SOC 51-2092)

Work as part of a team having responsibility for assembling an entire product or component of a product. Team assemblers can perform all tasks conducted by the team in the assembly process and rotate through all or most of them rather than being assigned to a specific task on a permanent basis. May participate in making management decisions affecting the work. Includes team leaders who work as part of the team. Assemblers who continuously perform the same task are classified elsewhere in 51-2000.

Function Related to Electric Vehicles and their Infrastructure

Team Assemblers participate in the manufacture of electric vehicles, their components and their infrastructure. Working as part of a team, they typically complete the final assembly for electric vehicles and may assemble other non-electric or non-mechanical components such as the vehicle's body frame or interior. Team Assemblers may alternate working on several types of assembly work.

Education, Training and Experience

Entry-level positions require sort-term on-the-job training; more work experience is required for supervisory positions. Customized manufacturing methods are required for the complexity of electric vehicles; therefore, additional on-the-job training may be required for electric vehicle manufacturing.

Industry Distribution of Team Assemblers in LA County

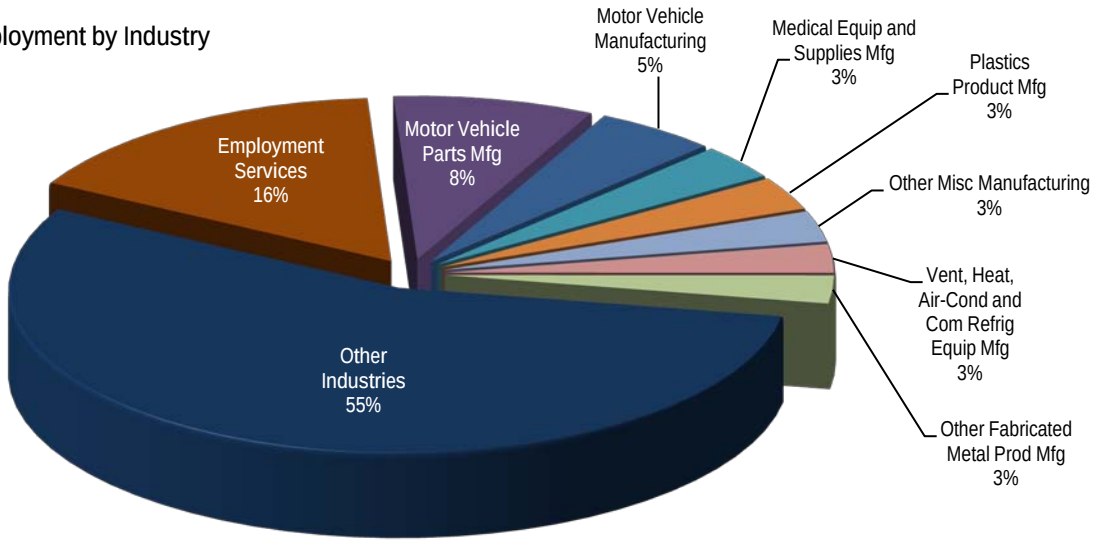
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
5613	Employment Services	16.0%	3,722
3363	Motor Vehicle Parts Manufacturing	8.4%	1,942
3361	Motor Vehicle Manufacturing	5.1%	1,179
3391	Medical Equipment and Supplies Manufacturing	3.4%	793
3261	Plastics Product Manufacturing	3.3%	762
3399	Other Misc Manufacturing	3.0%	707
3334	Vent, Heat, Air-Conditioning and Commercial Refrigeration Equipment Manufacturing	2.8%	651
3329	Other Fabricated Metal Product Manufacturing	2.8%	639
3339	Other General Purpose Machinery Manufacturing	2.7%	624
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2.6%	606
3362	Motor Vehicle Body and Trailer Manufacturing	2.6%	594
3219	Other Wood Product Manufacturing	2.5%	572
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2.4%	560
3352	Household Appliance Manufacturing	1.9%	451
3323	Architectural and Structural Metals Manufacturing	1.9%	446
3371	Household and Institutional Furniture and Kitchen Cabinet Manufacturing	1.9%	432
3344	Semiconductor and Other Electronic Component Manufacturing	1.6%	362
3364	Aerospace Product and Parts Manufacturing	1.4%	333
3359	Other Electrical Equipment and Component Manufacturing	1.3%	294
	Other Industries	*32.5%*	*7,531*
Total*	Across All Industries	100.0%	23,200

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

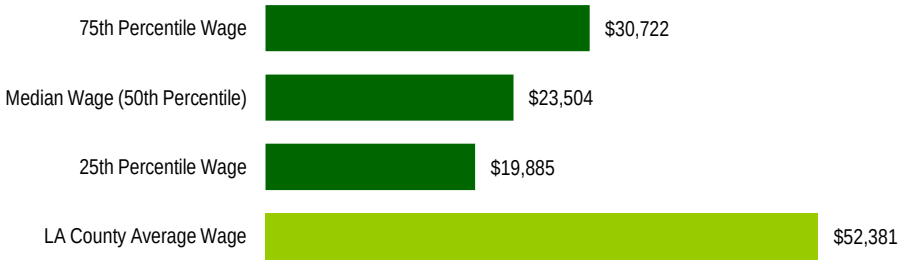
Team Assemblers in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
23,200 Jobs 0.61% of total	$27,169 Below LAC average	Moderate-Term On-the-Job Training	1,605 Jobs Annually 7.7% annually 2009-2011

Employment by Industry



Annual Earnings*



Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

Urban and Regional Planners (SOC 19-3051)

Develop comprehensive plans and programs for use of land and physical facilities of jurisdictions, such as towns, cities, counties, and metropolitan areas.

Function Related to Electric Vehicles and their Infrastructure

Urban and Regional Planners participate in the development of infrastructure to support electric vehicles. Electric charging stations are necessary for plug-in hybrid and all electric vehicles and these charging stations require increased electric grid capacity to support them. Urban and Regional Planners determine the number and location of electrical charging stations required to support a particular number of electric vehicles. Additionally, they participate in the planning and upgrading of municipal electric systems.

Education, Training and Experience

Entry-level positions typically require a master's degree in the discipline of urban or regional planning or a related field of study. A professional certification can be obtained from the American Institute of Certified Planners; it requires a designated combination of education and work experience in addition to the successful passing of an examination.

Industry Distribution of Urban and Regional Planners in LA County

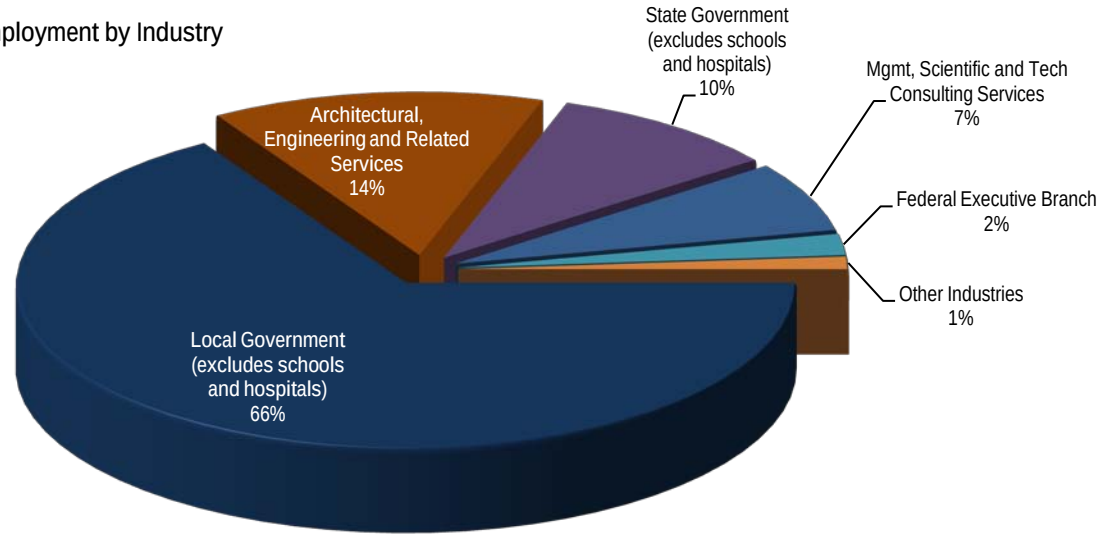
NAICS	Industry	Nat'l share % of SOC	Employment Distribution
9993	Local Government (excluding schools and hospitals)	66.3%	1,266
5413	Architectural, Engineering and Related Services	13.9%	265
9992	State Government (excluding schools and hospitals)	9.6%	184
5416	Mgmt, Scientific and Tech Consulting Services	6.9%	132
9991	Federal Executive Branch (OES Designation)	2.1%	40
5417	Scientific Research and Development Services	0.3%	6
6113	Colleges, Universities, and Professional Schools	0.3%	6
8133	Social Advocacy Organizations	0.3%	6
2211	Electric Power Generation, Transmission and Distribution	0.2%	3
5511	Management of Companies and Enterprises	0.2%	3
8132	Grantmaking and Giving Services (not disclosed)	-	-
Total*	Across All Industries	100.0%	1,910

Sources: BLS, CA EDD, estimates by LAEDC
*May not sum due to rounding

Urban and Regional Planners in Los Angeles County (2011)

Employment	Average Wage	Job Entry Requirement	Occupation Growth
			
1,910 Jobs 0.05% of total	$80,572 Exceeds LAC average	Master's Degree	0 Jobs Annually 0.0% annually 2009-2011

Employment by Industry



Annual Earnings*

Sources: CA EDD; BLS; LAEDC
* Annual wage data excludes benefits and other forms of compensation

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