CALIFORNIA ENERGY COMMISSION

California Energy Commission

STAFF REPORT

California Electric Vehicle Infrastructure Deployment Assessment: Senate Bill 1000 Report

Increasing Access to Electric Vehicle Infrastructure for All

Gavin Newsom, Governor
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Tiffany Hoang
Primary Author

Jennifer Allen
Project Manager

Mark Wenzel
Office Manager
ADVANCED VEHICLE INFRASTRUCTURE OFFICE

Hannon Rasool
Deputy Director
FUELS AND TRANSPORTATION DIVISION

Drew Bohan
Executive Director

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ABSTRACT

Senate Bill (SB) 1000 (Lara, Chapter 368, Statutes of 2018) directs the California Energy Commission (CEC) to examine electric vehicle (EV) infrastructure deployment in California. CEC staff assessed infrastructure distribution by geographical area, population density, and population income level, including low-, middle-, and high-income levels. Staff evaluated public Level 2 and direct current fast charger (DCFC) distribution by air districts and counties, county and census tract population density, county plug-in electric vehicle (PEV) density, and census tract median household income. The analysis indicates that public Level 2 and DCFCs are unevenly distributed across air districts and counties but appear to follow PEV uptake. Overall, fewer chargers are deployed in census tracts with high population density which may be attributed to land use and area. Fewer public Level 2 chargers are deployed per capita in low-income communities statewide. The results of ongoing assessments will inform CEC Clean Transportation Program (also known as Alternative and Renewable Fuel and Vehicle Technology Program) investments to enable better access to EV infrastructure for *all* Californians.

Keywords: Plug-in electric vehicles, zero-emission vehicles, charging infrastructure, charger deployment, charging access, equity, income, population density, spatial assessment

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EXECUTIVE SUMMARY

Zero-emission vehicles (ZEVs) are revolutionizing the transportation sector. Over half of all passenger vehicles sold globally and 31 percent of vehicle fleets on roads are expected to be electric vehicles (EVs) by 2040 (see 'References' section). California, with its ambitious goals to reduce climate emissions and improve air quality, continues to lead the way on ZEVs. Executive Order B-48-18 calls for the installation of 250,000 EV chargers, including 10,000 direct-current fast chargers (DCFCs) by 2025 to support 5 million ZEVs on California's roads by 2030. On September 23, 2020, Governor Gavin Newsom signed Executive Order N-79-2020 signaling the state's phaseout of gasoline-powered vehicles. This executive order directs state agencies to require all new cars and passenger trucks sold in California be ZEVs by 2035. Statewide efforts to electrify the transportation sector bring the possibility for direct and expansive societal benefits, including better air quality, fewer climate emissions, and greater economic opportunities. But strategic charging infrastructure installation is necessary to increase access for *all* Californians, including low-income households.

Senate Bill (SB) 1000 (Lara, Chapter 368, Statutes of 2018) directs the California Energy Commission (CEC), in consultation with the California Air Resources Board (CARB), to conduct assessments of EV infrastructure deployment. Staff will assess "whether charging station infrastructure is disproportionately deployed by population density, geographical area, or population income level, including low-, middle-, and high-income levels. This includes whether direct current fast charging stations are disproportionately distributed and whether access to these charging stations is disproportionately available." The results will inform CEC's Clean Transportation Program (also known as Alternative and Renewable Fuel and Vehicle Technology Program) investments.

The CEC's Clean Transportation Program has installed EV charging infrastructure through existing programs and will continue to do so in future funding opportunities. The California Electric Vehicle Infrastructure Project (CALeVIP), introduced in December 2017, provides incentives for the purchase and installation of EV infrastructure. As of July 2020, about 51 percent and 43 percent of cumulative rebate funding have been issued to install Level 2 and DCFCs, respectively, in disadvantaged communities. SB 1000 assessments will complement other analyses at the CEC to promote EV infrastructure deployment that meets market uptake and equity goals.

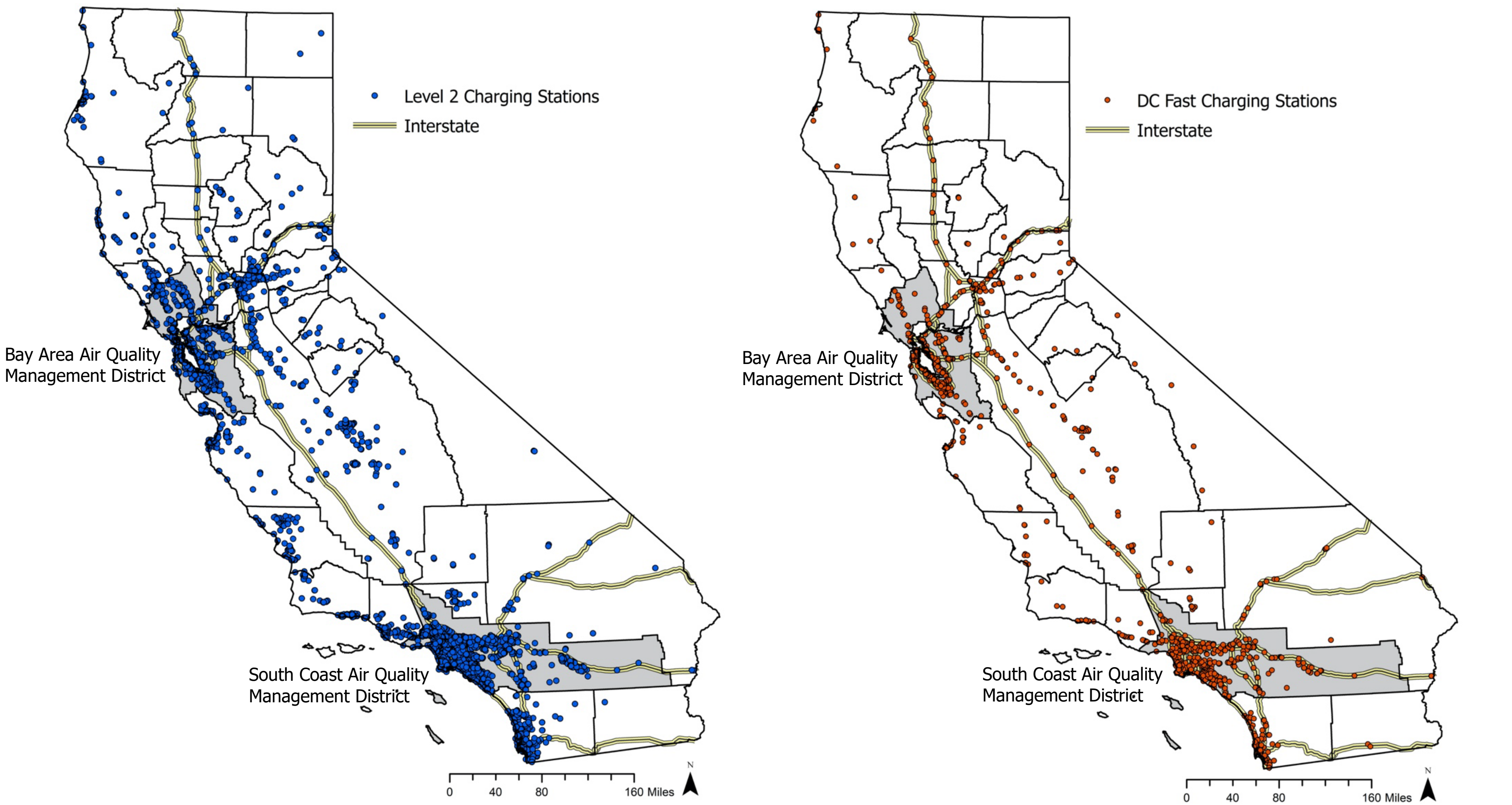
Analysis and Results

CEC staff analyzed EV infrastructure by the number of public Level 2 chargers and DCFCs by census tract, county, and air district. Staff assessed charger density (chargers per square mile) by population density (persons per square mile) and plug-in electric vehicle (PEV) density (PEVs registered per square mile). Staff defined and identified low-, middle-, and high-income communities statewide using census tract median household income (MHI), county area MHI, and state median income to assess charger distribution by population income level. The sections below provide summaries of the analysis and results.

Geographical Distribution: Public Chargers are Unevenly Distributed Across State Air Districts and Counties but are Collocated with Populations and Plug-In Electric Vehicles

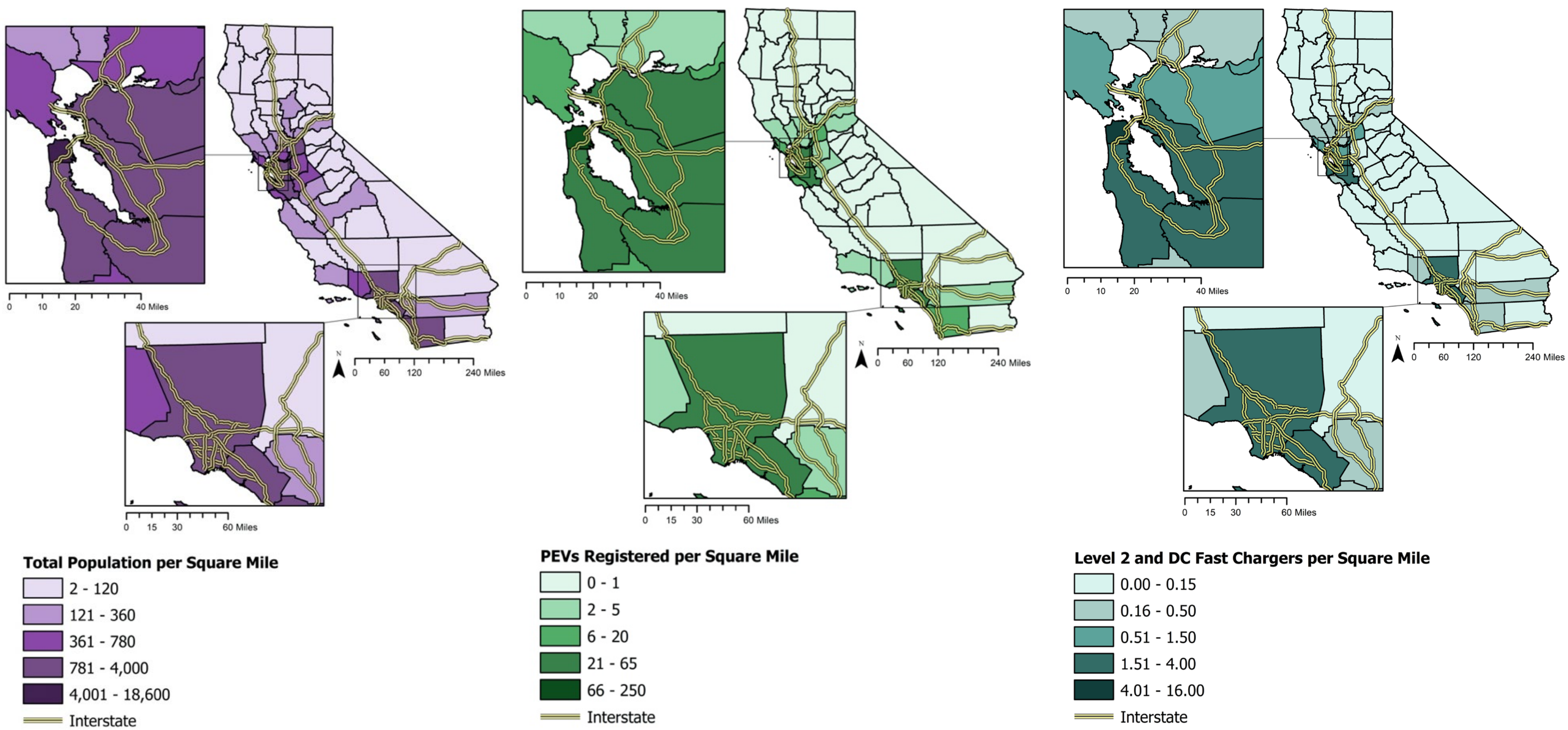
The South Coast Air Quality Management District and Bay Area Air Quality Management District together comprise nearly three-quarters of public Level 2 chargers and more than half of public DCFCs statewide (Figure ES.1). At the county level, Los Angeles County holds the largest percentages of statewide public Level 2 chargers (26 percent) and DCFCs (16 percent). But on a per-square-mile basis, San Francisco County leads in charger counts. San Francisco County has the highest charger density, population density, and PEV density in the state. Analysis shows that chargers are generally deployed in counties where there are high concentrations of people and PEVs, as shown by Figure ES.2.

Figure ES.1: Public Level 2 and DC Fast Charging Stations by Air District



Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Figure ES.2: Population Density, Plug-In Electric Vehicle Density, and Public Level 2 and DC Fast Charger Density by County



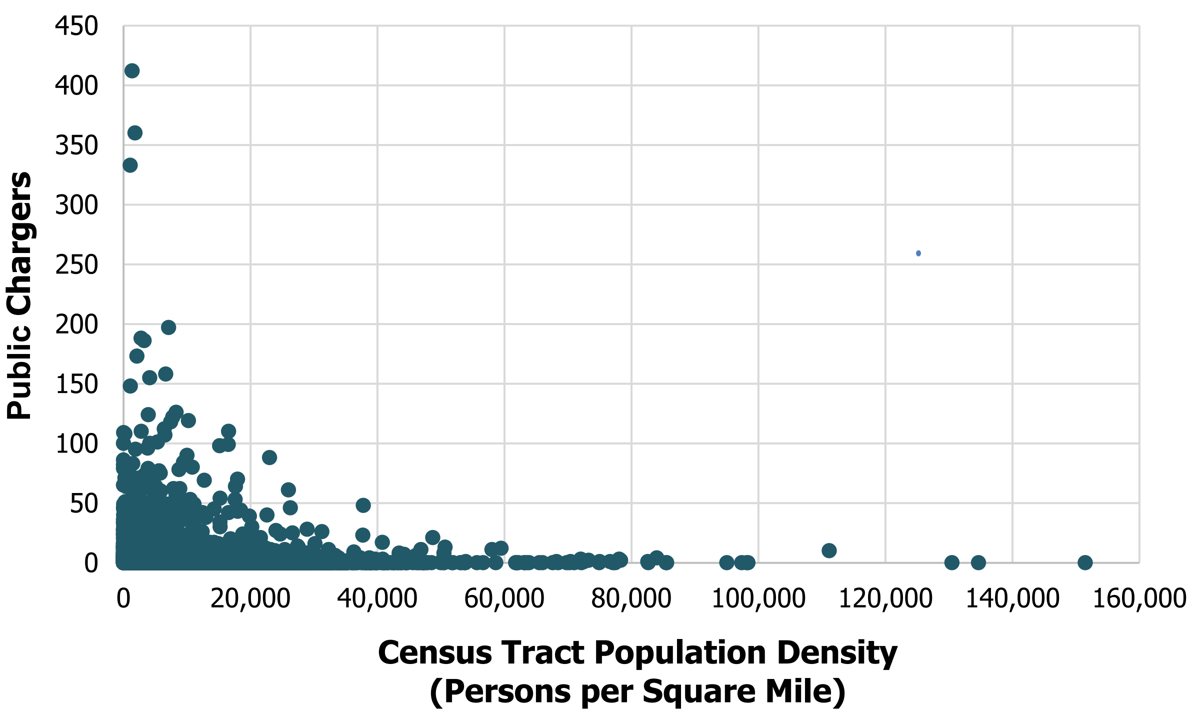
Source: California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates, California Department of Motor Vehicles registration statistics as of October 2018, and U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Population Distribution: Fewer Public Chargers in High Population Density Census Tracts

At a finer scale, factors other than population density and PEV density appear to play a larger role in charger numbers. Staff evaluated charger distribution by census tract population density. Figure ES.3 shows total public Level 2 and DCFCs and population density for each census tract in California. As shown, relatively more chargers appear in census tracts with low population density and fewer appear in tracts with high population density.

Staff investigated whether, and if so, how, land use influences charger distribution. Generally, census tracts with high population density cover less surface area and are predominantly residential. Public chargers are mostly absent or low in these dense urban residential census tracts. The census tracts neighboring these, with large commercial areas and more roads traversing, generally contain more public chargers. Census tracts with low population density and high number of chargers are generally larger tracts that contain land uses like large commercial areas and airports.

Figure ES.3: Public Level 2 and DC Fast Chargers by Census Tract Population Density



Source: California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Income Distribution: Fewer Public Chargers in Low-Income Communities

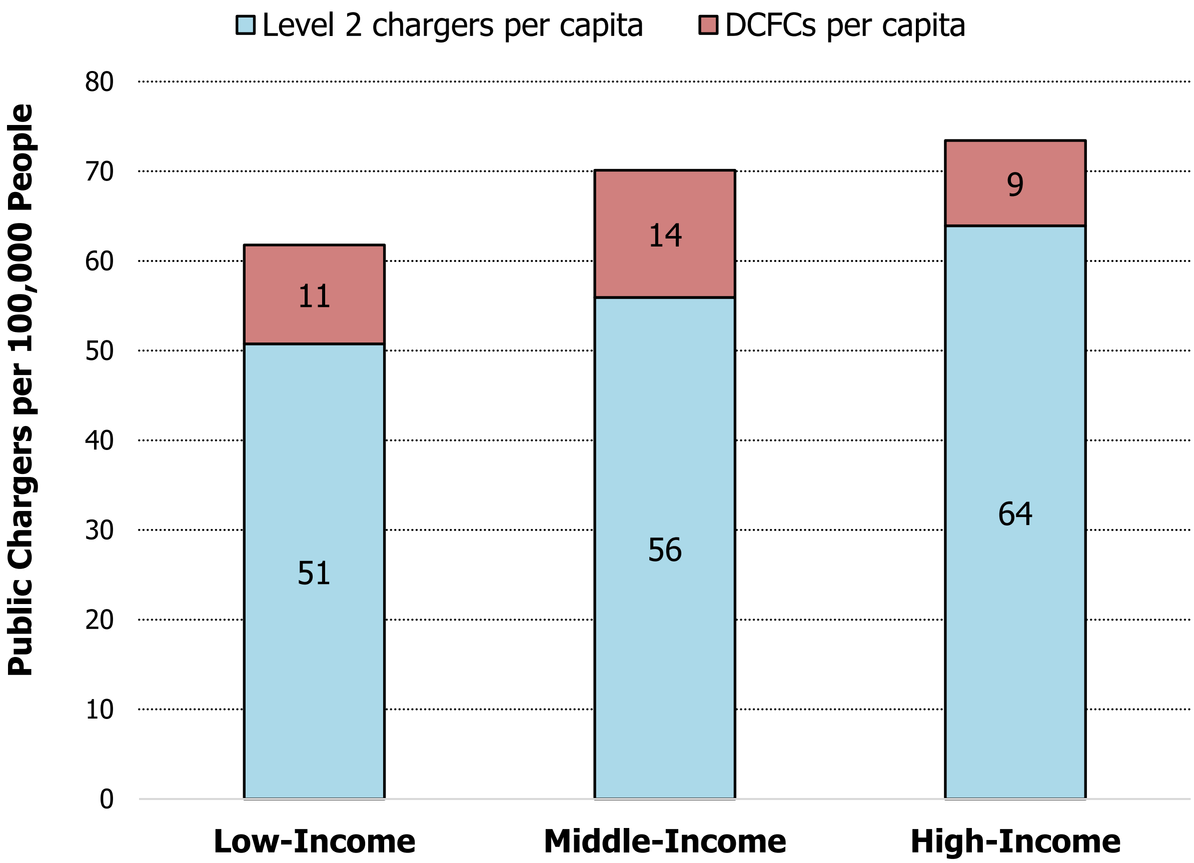
Staff identified low-, middle-, and high-income communities statewide to assess charger distribution by population income level. Staff defined low-income communities as census tracts with median household incomes (MHI) at or below 80 percent of the statewide median income or at or below the low-income threshold determined by the Department of Housing and Community Development. Staff defined middle-income communities as census tracts with MHIs between 80 to 120 percent of the statewide median income or between the low- and moderate-income threshold. Staff defined high-income communities as census tracts with MHIs at or above 120 percent of the statewide median income or at or above the moderate-income threshold. About 55 percent of Californians live in low-income communities, 23 percent of Californians live in middle-income communities, and 21 percent of Californians live in high-income communities.

About 50 and 57 percent of public Level 2 and DCFCs, respectively, are in low-income communities. About 22 and 24 percent of public Level 2 and DCFCs, respectively, are in middle-income communities. About 24 and 18 percent of public Level 2 and DCFCs, respectively, are in high-income communities. The remaining 4 and 1 percent of public Level 2 and DCFCs, respectively, are in census tracts where the Census Bureau does not report median household income.

Consequently, low-income communities on average have the fewest public Level 2 and total chargers per capita, and high-income communities have the most. Middle-income communities on average have the most DCFCs per capita, and high-income communities have the least (Figure ES.4).

Taken as a whole, preliminary distribution analysis indicates that more public EV infrastructure investments and deployments may need to be targeted in low-income communities and high-population-density neighborhoods to enable more proportionate infrastructure deployment throughout the state. A distribution analysis alone, however, does not present a full picture. Further analysis is required to better understand access to chargers by drivers traveling within and outside geographical areas and neighborhoods. Further analysis is also required to identify whether land use or other factors explain the distribution of chargers observed across geographical areas, low- and high-population-density neighborhoods, and communities that are low-, middle-, and high-income. Conservation areas or residential neighborhoods, for example, may limit deployment of public chargers. The road network within and between areas also influences deployment of public chargers. Additional analysis is needed to better understand how current and future drivers use charging stations so that infrastructure investments and deployments occur in a way that supports current and expected charging demand.

Figure ES.4: Public Level 2 and DC Fast Chargers Per Capita by Community Income Level



Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Median Household Income 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator charger data as of July 23, 2020

Future Work

This assessment uses the best available data to estimate public charger distribution. However, public chargers are only one part of charging infrastructure. To the best of staff's knowledge, uniform and comprehensive data on home and workplace charging locations statewide are not available.

For future assessments, staff will use updated data as it becomes available and plan to evaluate components of charging access.

Staff plans to evaluate public charger distribution across urban and rural communities statewide. Using the identified income categories, staff plans to also evaluate charger distribution across low-income-urban, middle-income-urban, high-income-urban, low-income-rural, middle-income-rural, and high-income-rural communities.

Staff will continue to work with land use and neighborhood-level data to analyze charger distribution and charging access for communities and unique environments. Staff plans to conduct more granular land use analysis to assess whether drivers from high population density census tracts and low-income communities that have absent or few public chargers are able to charge conveniently from public chargers in neighboring tracts.

Staff plans to perform additional analyses by housing type and size, and tenure, to better characterize charging access for multi-unit dwelling residents, renters, and others. Staff plans to evaluate distances between public chargers and clusters of housing, by housing type, and by demographics.

Staff plans to evaluate registered plug-in hybrid electric vehicles (PHEVs) and battery-electric vehicles (BEVs) to assess whether the mix of PEVs in a county contributes to the types of chargers deployed. Staff also plans to analyze public charger power capacity to assess distribution of chargers by charging speed.

PEV adoption, though growing, continues to face several challenges. These include relatively higher upfront vehicle purchase costs and barriers to charging. Federal, state, and local regulations and incentives aim to close charging gaps and expand PEV access for all. California's clean energy programs may, however, be disproportionately benefitting high-income communities according to a recent study published by researchers from the University of California, Los Angeles (UCLA). These researchers concluded that the PEV ownership gap between disadvantaged communities and more affluent ones in Los Angeles County will continue to grow under a business as usual scenario. SB 1000 assessments will look at where, and to which communities, public chargers are deployed to prevent inadvertent inequities in program outcomes. Results have the potential to inform public charging investments to increase access to EV infrastructure for all.

CHAPTER 1: Introduction

Electrifying California's transportation sector is crucial to meeting climate, air quality, and public health goals. More greenhouse gas emissions and air pollutants are emitted from the transportation sector than any other sector in California. In 2017, 40 percent of total statewide greenhouse gas emissions came directly from mobile sources.[1] Of that, nearly 70 percent came from passenger vehicle tailpipes.

Rising transportation emissions in California add to the burdens faced by communities. Community exposure to local air pollution is disproportionately high in low-income and minority communities. A study published in 2019 by the Union of Concerned Scientists states that the lowest-income households in California live in areas where particulate matter 2.5 (PM2.5) pollution from vehicles is 10 percent higher than the state average, while those with the highest incomes live where PM2.5 pollution is 13 percent below average.[2] African-American, Latino, and Asian Californians are, on average, exposed to 43, 39, and 21 percent, respectively, higher PM2.5 pollution from vehicles than white Californians. Because of higher exposure, low-income and minority communities experience more pollution-induced illnesses and deaths.[3]

A long history of discriminatory transportation planning and land use policies in the United States contributes to these disparities.[4] Redlining, exclusionary zoning, and urban renewal projects placed more low-income and minority households in polluted areas and further from economic opportunities.[5] Limited access to convenient, reliable, and affordable transportation

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1 California Air Resources Board staff. 2019. *California Greenhouse Gas 2000-2017 Emissions Trends and Indicators Report.* Available at https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

2 Union of Concerned Scientists staff. 2019. *Inequitable Exposure to Air Pollution from Vehicles in California.* Available at https://www.ucsusa.org/sites/default/files/attach/2019/02/cv-air-pollution-CA-web.pdf.

3 American Lung Association staff. 2020. *Disparities in the Impact of Air Pollution.* Available at https://www.lung.org/clean-air/outdoors/who-is-at-risk/disparities.

4 Creger, Hana, Joel Espino, and Alvaro S. Sanchez (The Greenlining Institute). 2018. *Mobility Equity Framework: How to Make Transit Work for People.* Available at https://greenlining.org/wp-content/uploads/2018/03/Mobility-Equity-Framework-Final.pdf.

5 Epanty, Efon (Virginia Tech Institute for Policy and Governance). 2018. *Rethinking the Challenge of Transportation Equity.* Available at https://ipg.vt.edu/DirectorsCorner/re--reflections-and-explorations/Reflections103018.html.

creates added hardships on these communities.[6] Providing clean mobility options with electric vehicles (EVs) can partially address these problems – if the vehicles and supporting charging infrastructure are conveniently available to these communities.

PEV adoption still faces several challenges, including high upfront vehicle purchase costs, barriers to home charging, and range anxiety due to gaps in public charging infrastructure. These challenges are often felt by low-income households that spend, on average, about a third of take-home income on transportation costs.[7] About 27 percent of Californians live in an apartment.[8] Of that, approximately 72 percent are within low-income communities.[9] Researchers from the University of California, Davis and the International Council on Clean Transportation conducted a survey in 2017 to assess home charging access by dwelling type and vehicle type.[10] Survey results from 2,831 EV drivers in California illustrate the lack of home chargers at apartments. Fewer than half (18 to 48 percent depending on vehicle type) of the survey respondents in apartments reported charging from home.[11] In contrast, 84 to 94 percent of drivers in detached single-family homes and 66 to 83 percent of drivers in attached

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Sanchez, Thomas W., Rich Stolz, Jacinta S. Ma. 2003. *Moving to Equity: Addressing Inequitable Effects of Transportation Policies on Minorities.* Cambridge, MA: The Civil Rights Project at Harvard University. Available at https://www.civilrightsproject.ucla.edu/research/metro-and-regional-inequalities/transportation/moving-to-equity-addressing-inequitable-effects-of-transportation-policies-on-minorities.

6 Ibid.

7 Rice, Lorien (Public Policy Institute of California). 2004. *Transportation Spending by Low-Income California Households: Lessons for the San Francisco Bay Area.* Available at https://www.ppic.org/content/pubs/report/R_704LRR.pdf.

U.S. Department of Housing and Urban Development (HUD) staff. 2019. *Location Affordability Index.* Available at https://www.hudexchange.info/programs/location-affordability-index/.

8 U.S. Census Bureau 2014 – 2018 American Community Survey Total Population in Occupied Housing Units by Tenure by Units in Structure 5-Year Estimates.

9 California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Estimates. Low-income communities are defined as census tracts with median household incomes at or below 80 percent of the statewide median income or with median household incomes at or below the threshold designated as low income by the Department of Housing and Community Development's list of state income limits adopted pursuant to Section 50093.

10 Tal, Gil, Jae Hyun Lee, and Michael A. Nicholas. 2018. *Observed Charging Rates in California*. Available at https://itspubs.ucdavis.edu/publication_detail.php?id=2993.

11 Nicholas, Michael, Dale Hall, and Nic Lutsey. 2019. *Quantifying the Electric Vehicle Charging Infrastructure Gap Across U.S. Markets*. Available at: https://theicct.org/sites/default/files/publications/US_charging_Gap_20190124.pdf.

single-family homes reported charging from home.[12] The ranges in responses are due to variations among owners of vehicles in 4 categories: low range PHEVs, high range PHEVs, low range BEVs, and high range BEVs.[13] Of all the EV drivers surveyed, 83 percent reported using a home charger in the past 30 days.[14] Given that most charging occurs at home, lack of home charging is a major barrier to PEV adoption. As the PEV market grows, it is important to respond to these barriers to enable PEV benefits, including lower operating costs than internal combustion engine vehicles, that are realized and shared by all.

California has enacted bills that focus on equity and access to clean transportation. Senate Bill 535 (De León, Chapter 830, Statutes of 2012) requires identification of disadvantaged communities and allocation of funding to projects benefiting these communities. Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016) defines low-income communities and requires additional funding for projects benefiting disadvantaged and low-income communities. Senate Bill 350 (De León, Chapter 547, Statutes of 2015) directs state agencies to assess barriers that underserved communities face to clean energy technologies, including to zero-emission vehicles (ZEVs), and make recommendations. Senate Bill 862 (Committee on Budget and Fiscal Review, Chapter 36, Statutes of 2014) authorizes the appropriation of Greenhouse Gas Reduction Fund (GGRF) funding to agencies administering programs that reduce emissions. From these bills emerged programs such as the Clean Vehicle Assistance Program and Clean Cars 4 All Program, which provide funding and incentives to advance electric mobility in low-income and disadvantaged communities.[15]

The enactment of Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018) shows the state's continued efforts to enhance transportation equity. SB 1000 directs the CEC, in consultation with CARB, to "assess whether charging station infrastructure is disproportionately deployed by population density, geographical area, or population income level, including low-, middle-, or high-income levels. This includes whether direct current fast charging stations are disproportionately distributed and whether access to these charging stations is disproportionately available."[16] The statute defines charging station as "the removable equipment that provides alternating or direct current to the battery electric vehicle or plug-in

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12 Ibid.

[13] Researchers classified PHEVs with less than 30 miles of electric range as low range PHEVs and BEVs with less than 150 miles of range as low range BEVs. Low range PHEVs include the first-generation Prius Plug-in, Ford C-Max Energi, Ford Fusion, and Prius Prime. High range PHEVs include the first- and second-generation Volt. Low range BEVs include the first- and second-generation Leaf. High range BEVs include the Chevrolet Bolt.

[14] Ibid.

15 Clean Vehicle Assistance Program. https://cleanvehiclegrants.org/.

Clean Cars 4 All Program. https://cleanvehiclegrants.org/.

16 Senate Bill 1000 (Lara, Chapter 368, Statutes of 2018).

hybrid electric vehicle, but does not include the supporting charging infrastructure, such as wiring, conduit, and electric panels."[17] Staff will conduct SB 1000 assessments until CEC Clean Transportation Program funding ends. Results will inform CEC Clean Transportation Program (also known as Alternative and Renewable Fuel and Vehicle Technology Program) investments.

This report is the first assessment conducted by CEC staff on public EV infrastructure distribution by geographical area, population density, and population income level. The first part of this report describes metrics for evaluating charging infrastructure. Subsequent sections illustrate geographic distribution (air district and county level), population distribution (persons and PEVs per square mile), and income distribution (low-, middle-, and high-income) of public chargers. The report concludes with discussion on data gaps and future analyses.

17 Ibid.

CHAPTER 2: Analysis and Results

This report analyzes EV infrastructure deployment in California by geographical area, population density, and population income level. CEC staff counted chargers, the device that controls the power supply to a single PEV in a single session, broken out by power level, across geographical areas and communities. Staff collected public Level 2 and direct current fast charger (DCFC) counts from the U.S. Department of Energy Alternative Fuels Data Center (AFDC) Alternative Fueling Station Locator (as of July 23, 2020). Appendix A describes the charging infrastructure data used in this assessment. The sections below describe the analysis and results.

Geographical Distribution: Public Chargers are Unevenly Distributed Across State Air Districts and Counties but are Collocated with Populations and Plug-In Electric Vehicles

This report analyzes the geographic distribution of public Level 2 and DCFCs by air district and county (see Appendices B – D). Staff tabulated:

- Total chargers by air district broken out by power level.
- Chargers per square mile by air district broken out by power level.
- Total chargers by county broken out by power level.
- Chargers per square mile by county broken out by power level.

Air district distributions of public Level 2 and DCFC stations is shown in Figure 2.1.[18] Generally, public Level 2 and DCFC stations are clustered where interstate highways cross. These clusters occur in the Bay Area Air Quality Management District (AQMD), Sacramento Metro AQMD, South Coast AQMD, and San Diego Air Pollution Control District (APCD).

Public Level 2 and DCFC counts by air district are shown in Figures 2.2., 2.3, and 2.4. Percentage distributions are shown in Figures 2.5, 2.6, and 2.7 and are grouped by the air districts with the highest percent distribution of chargers statewide. Together, South Coast AQMD and Bay Area AQMD comprise nearly 75 percent of public Level 2 chargers and more than half of public DCFCs statewide. San Diego APCD and San Joaquin Valley APCD have the third and fourth highest distribution of chargers statewide, but the difference in chargers between these air districts and South Coast and Bay Area is large. Together, San Diego APCD and San Joaquin Valley APCD comprise only about 11 and 13 percent of public Level 2 and DCFCs, respectively, statewide. Other air districts, independently, make up less than 3 percent of statewide public Level 2 chargers and less than 4 percent of statewide public DCFCs.

18 Appendix E provides a map labeling California air districts.

While more public chargers total are distributed in South Coast AQMD, more public chargers per square mile are distributed in Bay Area AQMD. San Joaquin Valley APCD has more public chargers total, but fewer per square mile compared to other air districts. Figure 2.8 shows the distribution of chargers per square mile by air district.

County distributions of public Level 2 and DCFC stations is shown in Figure 2.9.[19] Stations are generally clustered in Bay Area counties and in Southern California counties where interstate highways meet.

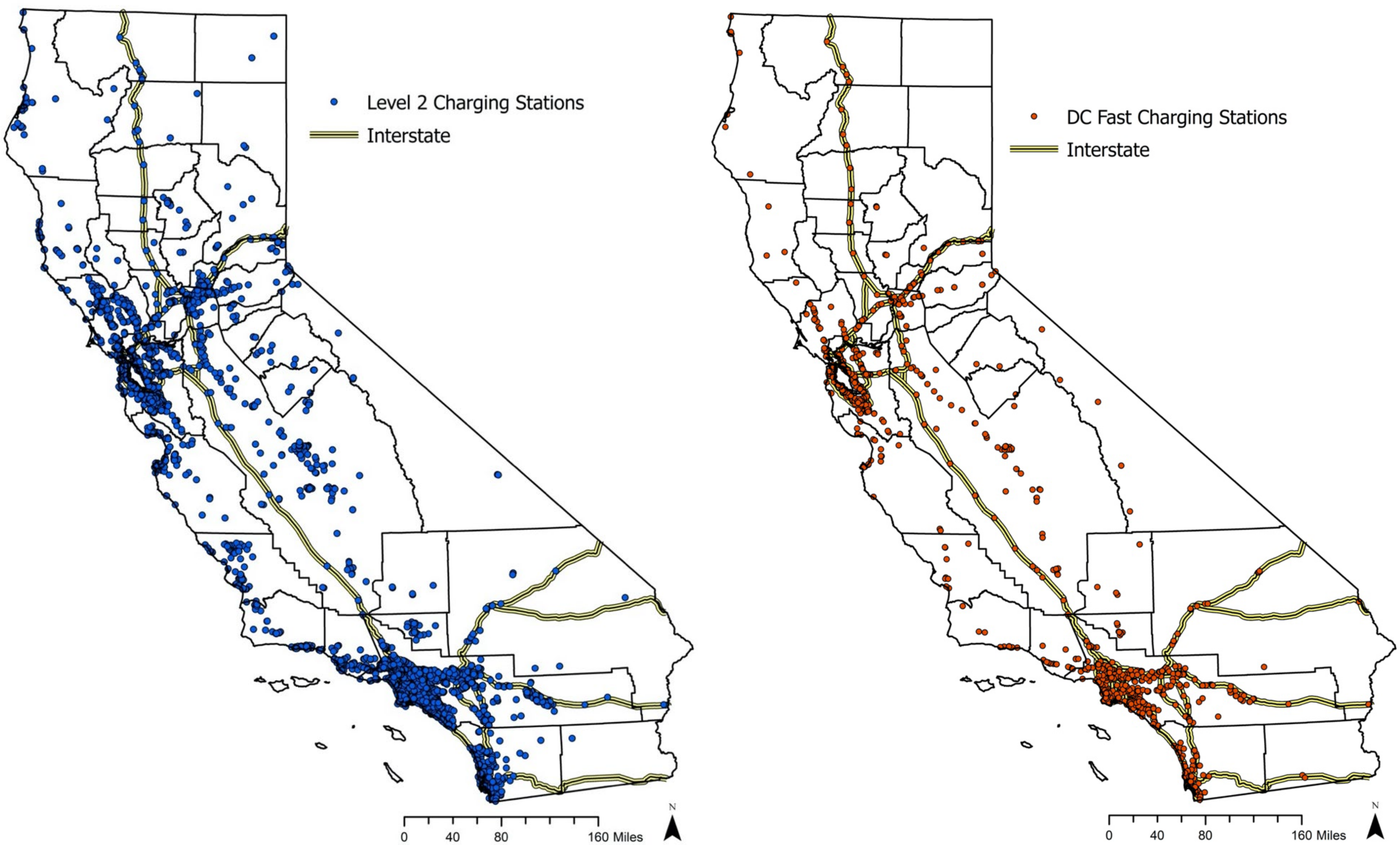
County distributions of public Level 2 and DCFC counts are shown in Figures 2.10, 2.11, and 2.12. Percentage distributions are shown in Figures 2.13, 2.14, and 2.15 and are grouped by the counties with the highest percentage distribution of chargers statewide. Other counties, independently, make up less than 6 percent of statewide public Level 2 chargers and DCFCs. Los Angeles County comprises about 25 percent of statewide public Level 2 chargers but only about 16 percent of statewide DCFCs. Although Santa Clara County has the second highest number of public Level 2 chargers, it has less than half of the number in Los Angeles County. Orange County has the second highest number of public DCFCs but only slightly more than half the number of Los Angeles County. Overall, differences in charger distribution across counties with the highest percentage of chargers are relatively larger for public Level 2 charger counts than DCFCs.

While more public chargers total are distributed in Los Angeles County, more public chargers per square mile are distributed in San Francisco County. Figure 2.16 shows the geographic distribution of chargers per square mile by county.

Overall, public Level 2 and DCFCs, total and per square mile, are unevenly dispersed across state air districts and counties. Population and PEVs appear to play a role. Staff tabulated population density (persons per square mile), PEV density (PEVs registered per square mile), and charger density (chargers per square mile) by county to assess whether population and PEVs drive infrastructure distribution. (See Appendix G for full method.) Analysis shows that chargers are generally deployed in counties with high concentrations of people and PEVs, as evident by Figures 2.17 and 2.18. San Francisco County has the highest population density, PEV density, and charger density in the state. Lassen County has the seventh lowest population density, second to lowest PEV density (after Modoc County), and the lowest charger density in the state.

19 Appendix F provides a map labeling California counties.

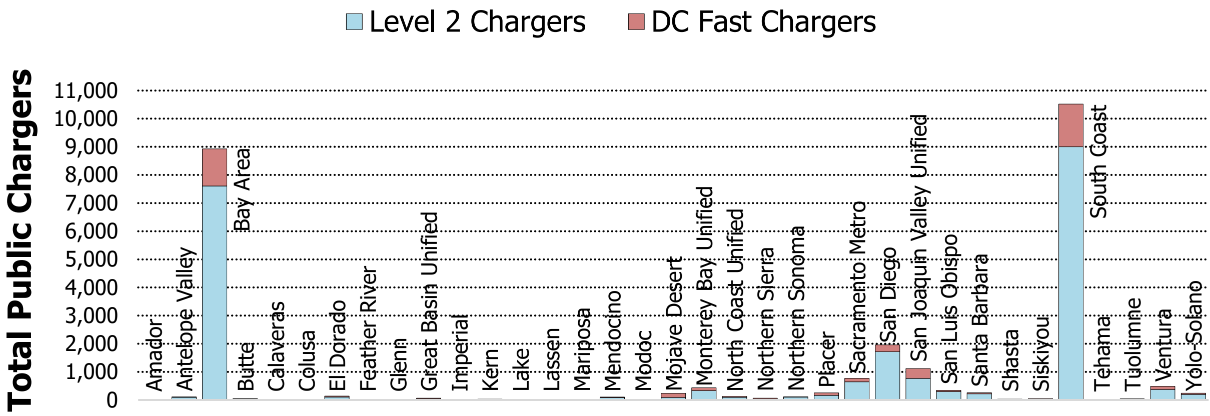
Figure 2.1: Public Level 2 and DC Fast Charging Stations by Air District



See Appendix E for map of California Air Districts

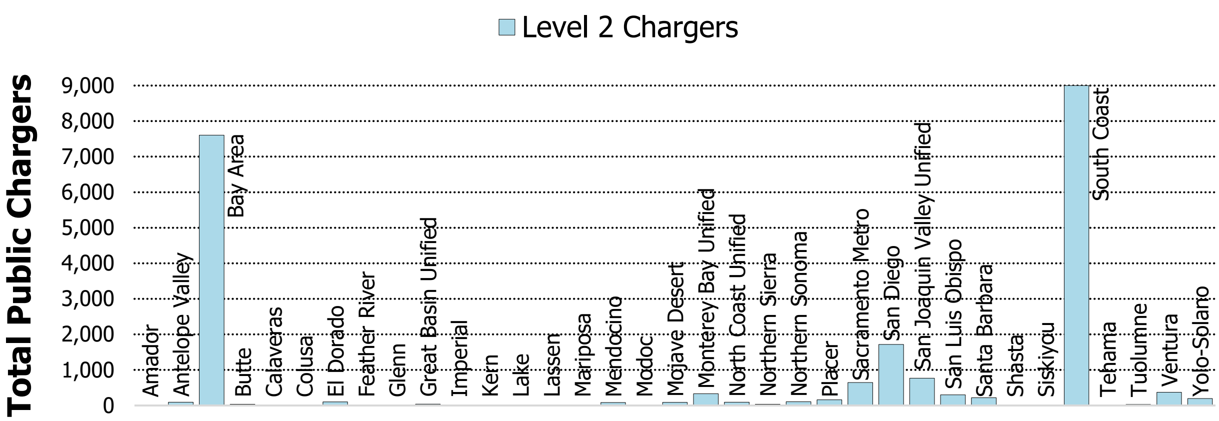
Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Figure 2.2: Public Level 2 and DC Fast Charger Counts by Air District



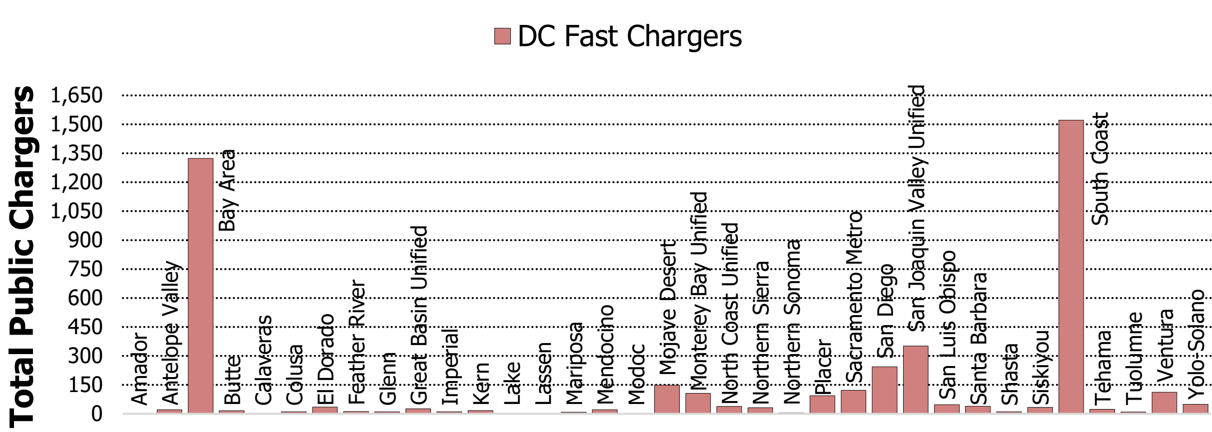
Source: California Energy Commission Staff Analysis

Figure 2.3: Public Level 2 Charger Counts by Air District



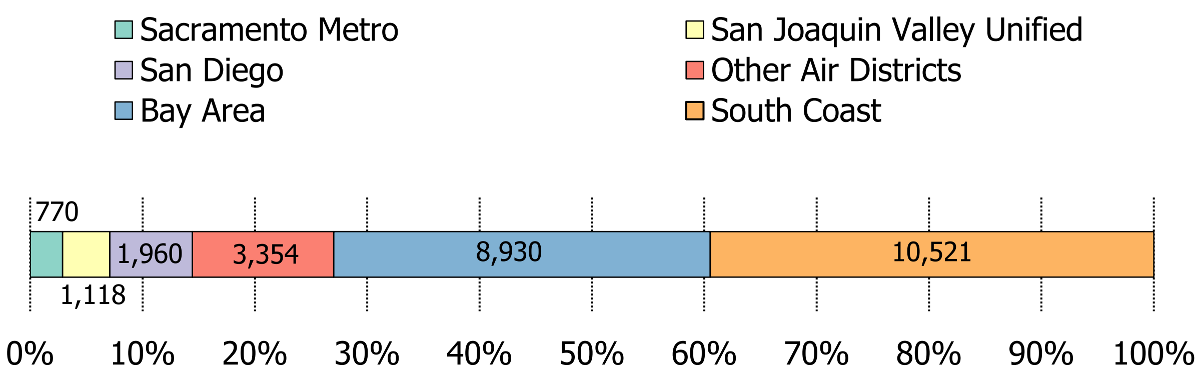
Source: California Energy Commission Staff Analysis

Figure 2.4: Public DC Fast Charger Counts by Air District



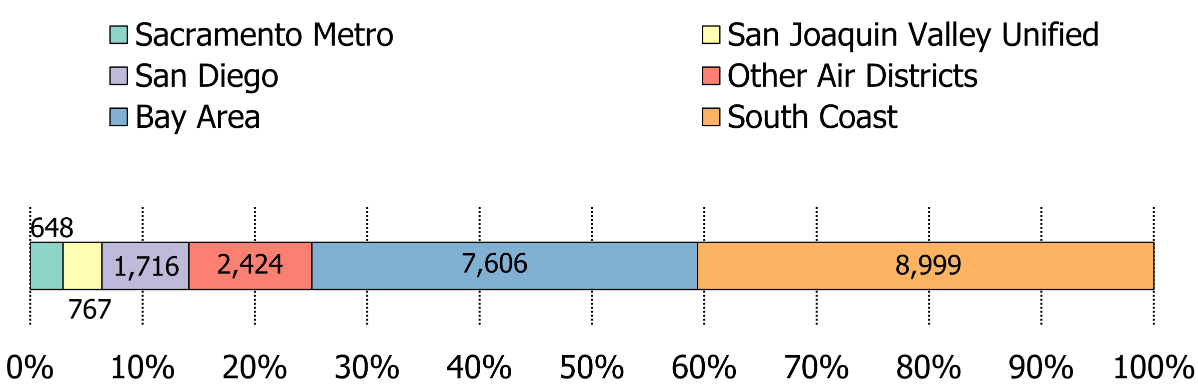
Source: California Energy Commission Staff Analysis

Figure 2.5: Distribution of Public Level 2 and DC Fast Chargers by Air District



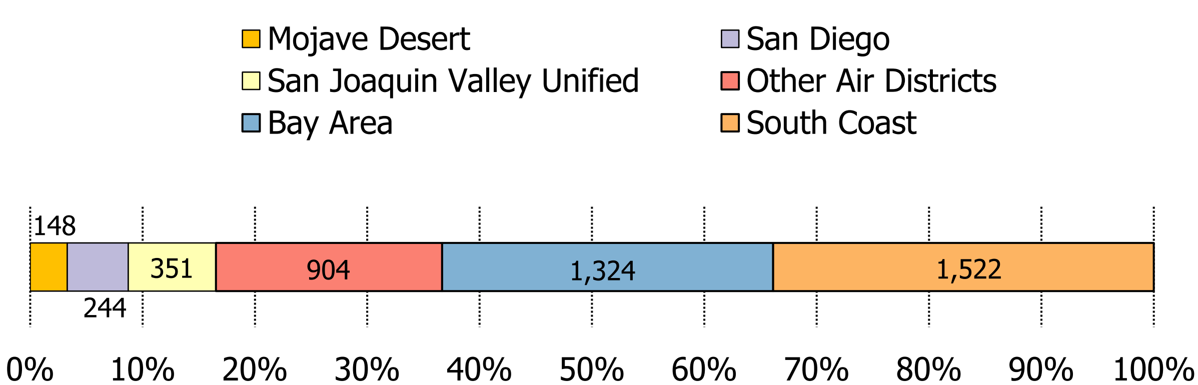
Source: California Energy Commission Staff Analysis

Figure 2.6: Distribution of Public Level 2 Chargers by Air District



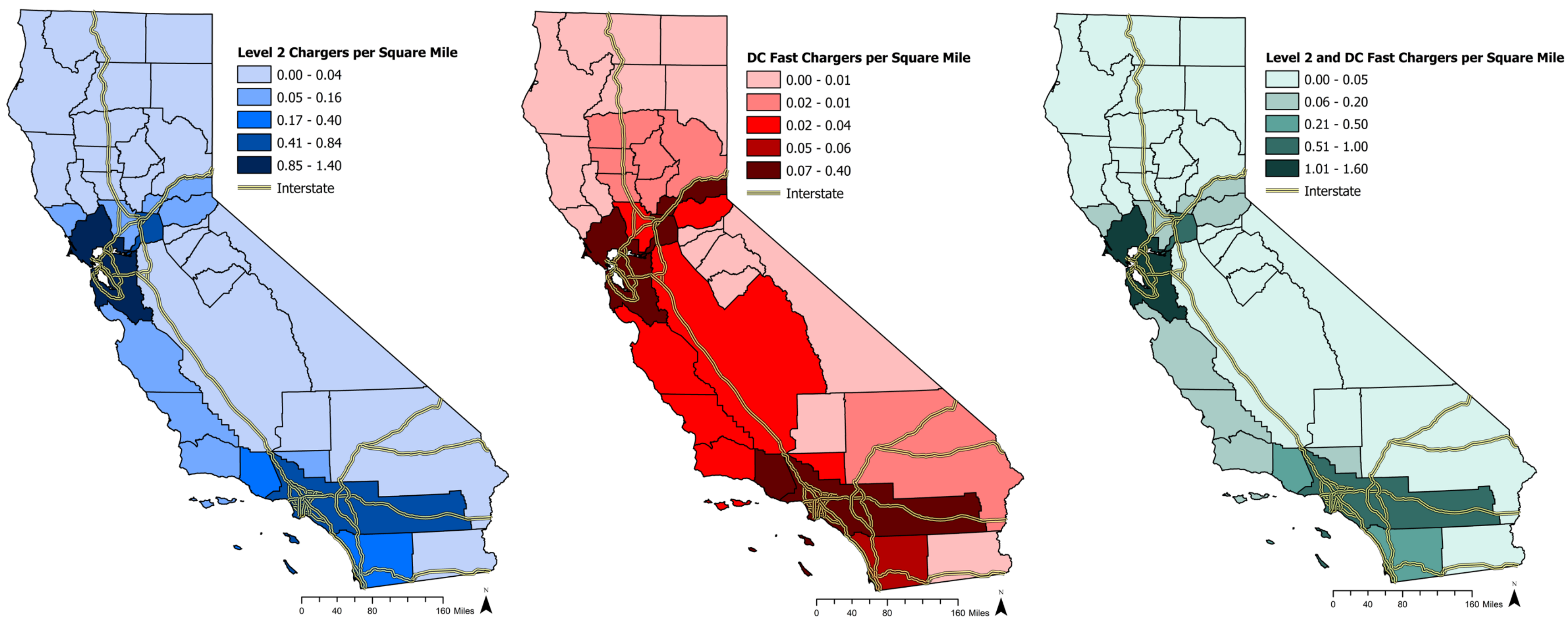
Source: California Energy Commission Staff Analysis

Figure 2.7: Distribution of Public DC Fast Chargers by Air District



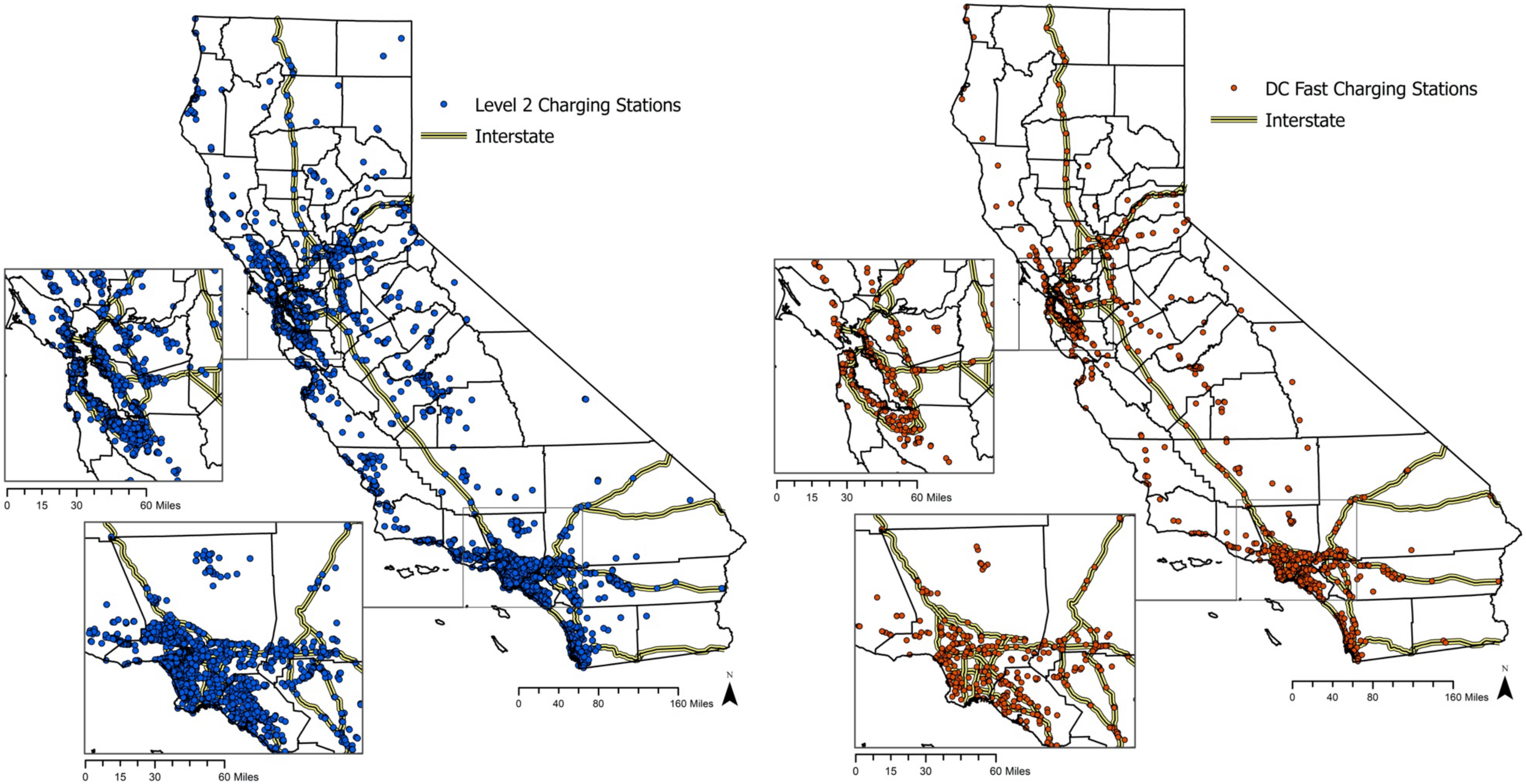
Source: California Energy Commission Staff Analysis

Figure 2.8: Public Level 2 and DC Fast Charger Density by Air District



Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

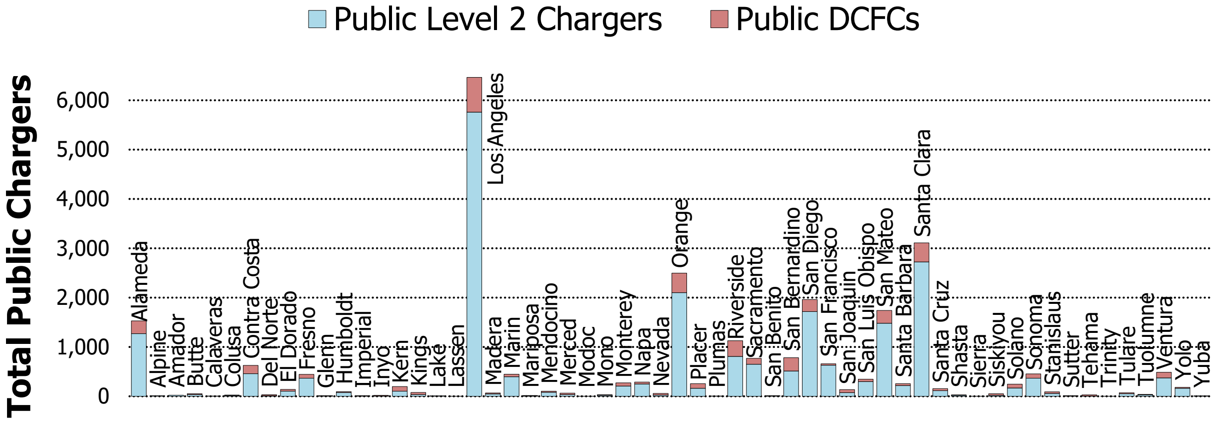
Figure 2.9: Public Level 2 and DC Fast Charging Stations by County



See Appendix F for map of California Counties

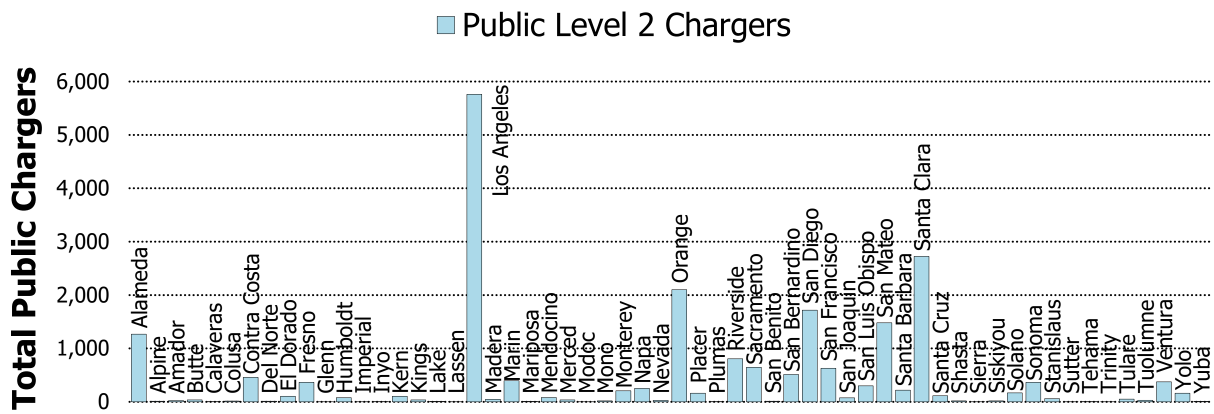
Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Figure 2.10: Public Level 2 and DC Fast Charger Counts by County



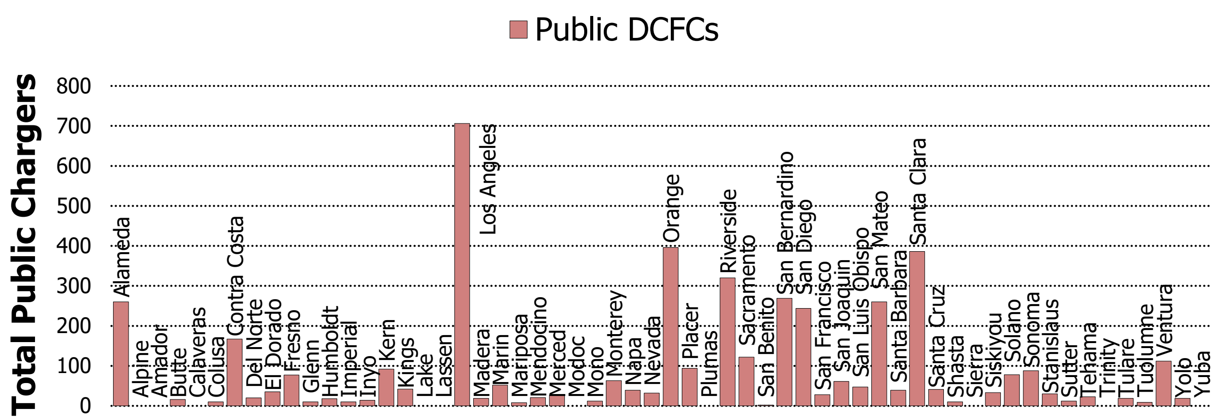
Source: California Energy Commission Staff Analysis

Figure 2.11: Public Level 2 Charger Counts by County



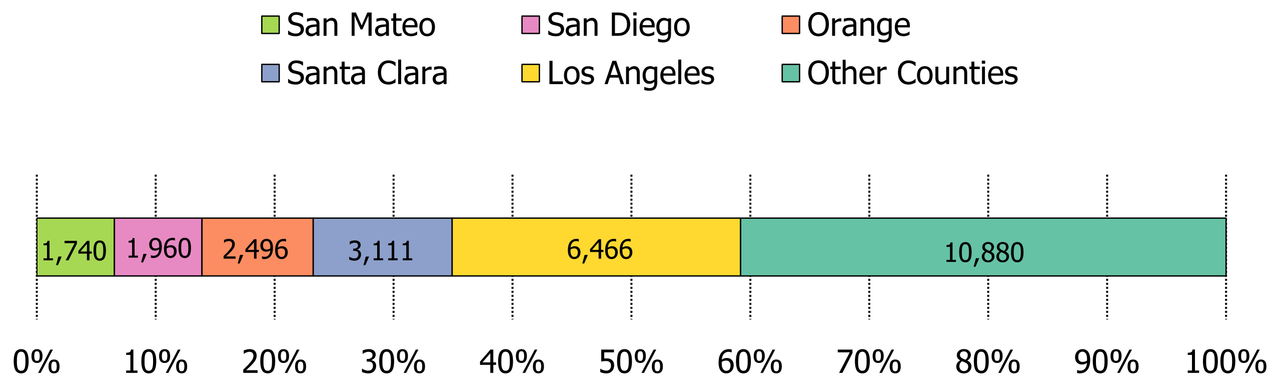
Source: California Energy Commission Staff Analysis

Figure 2.12: Public DC Fast Charger Counts by County



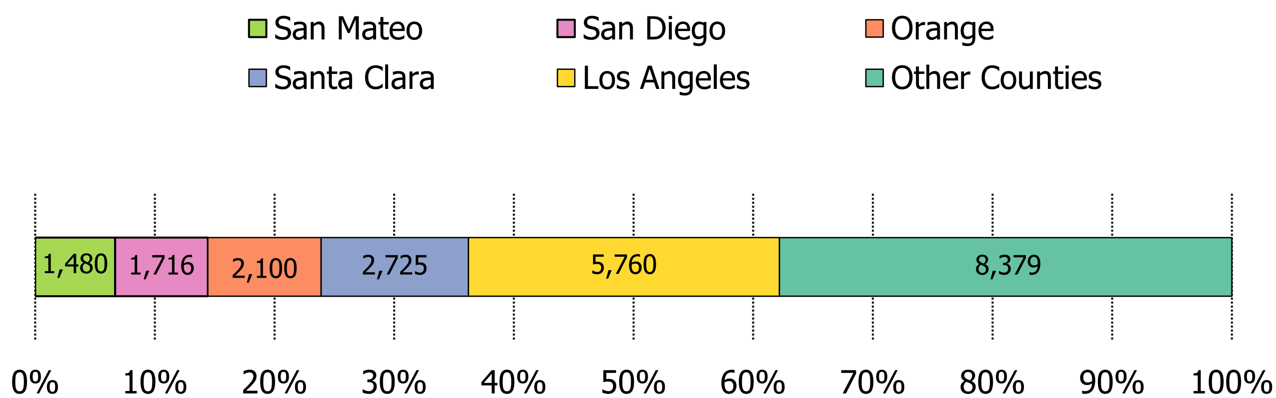
Source: California Energy Commission Staff Analysis

Figure 2.13: Distribution of Public Level 2 and DC Fast Chargers by County



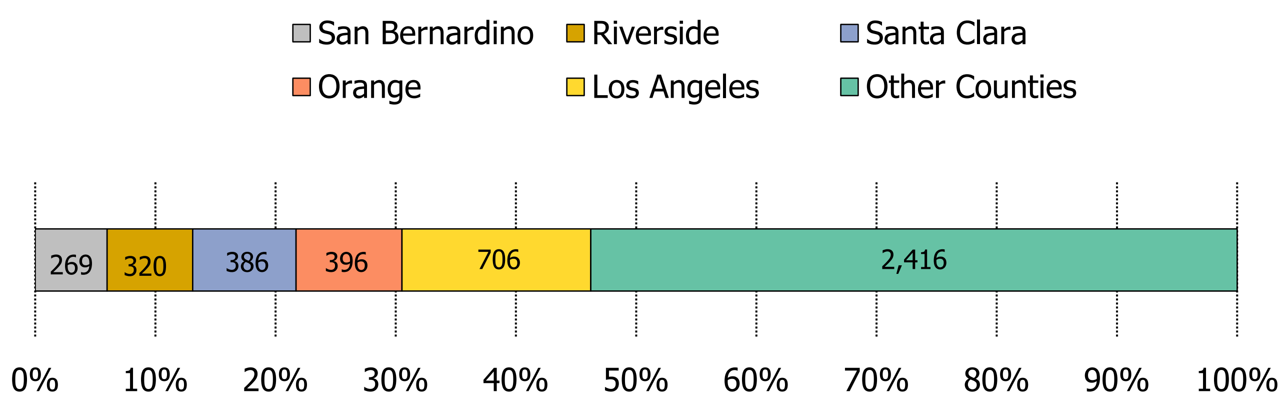
Source: California Energy Commission Staff Analysis

Figure 2.14: Distribution of Public Level 2 Chargers by County



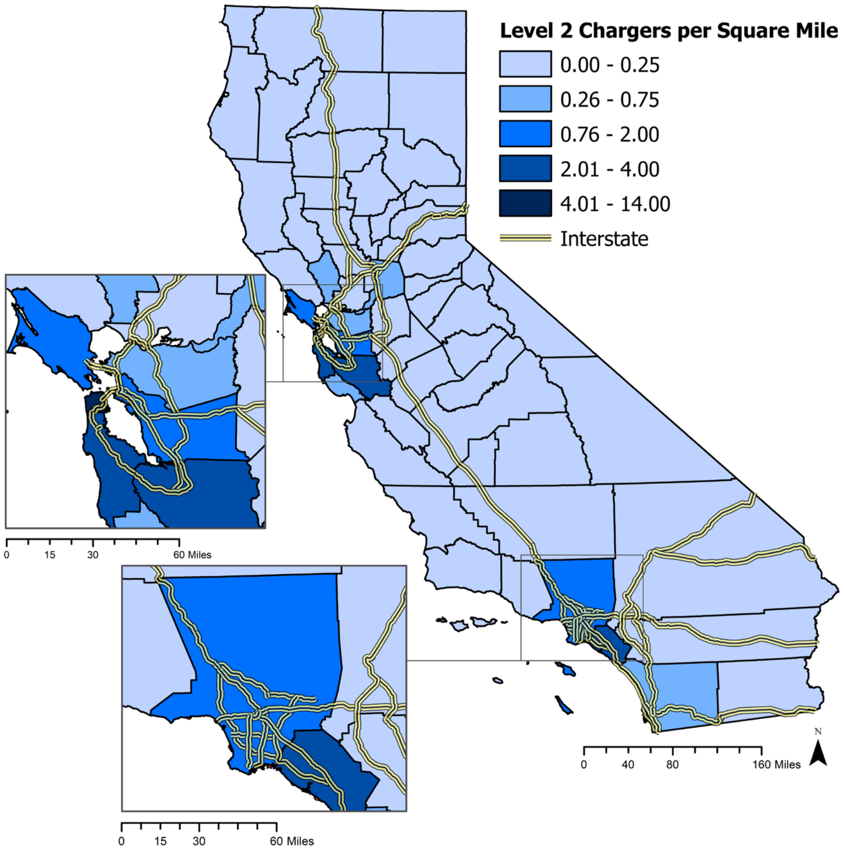
Source: California Energy Commission Staff Analysis

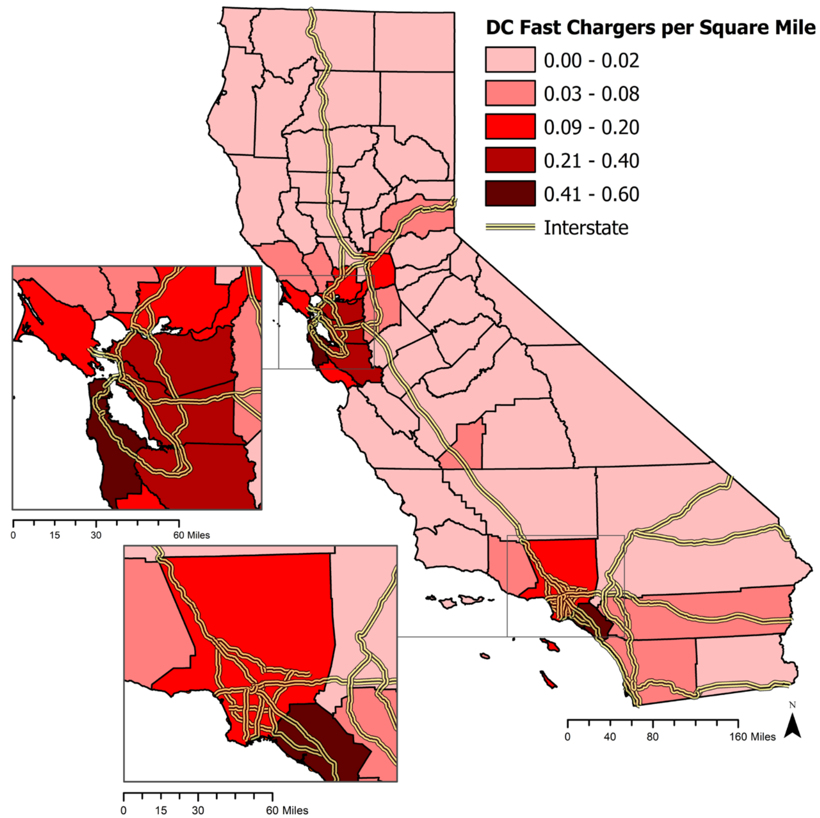
Figure 2.15: Distribution of Public DC Fast Chargers by County



Source: California Energy Commission Staff Analysis

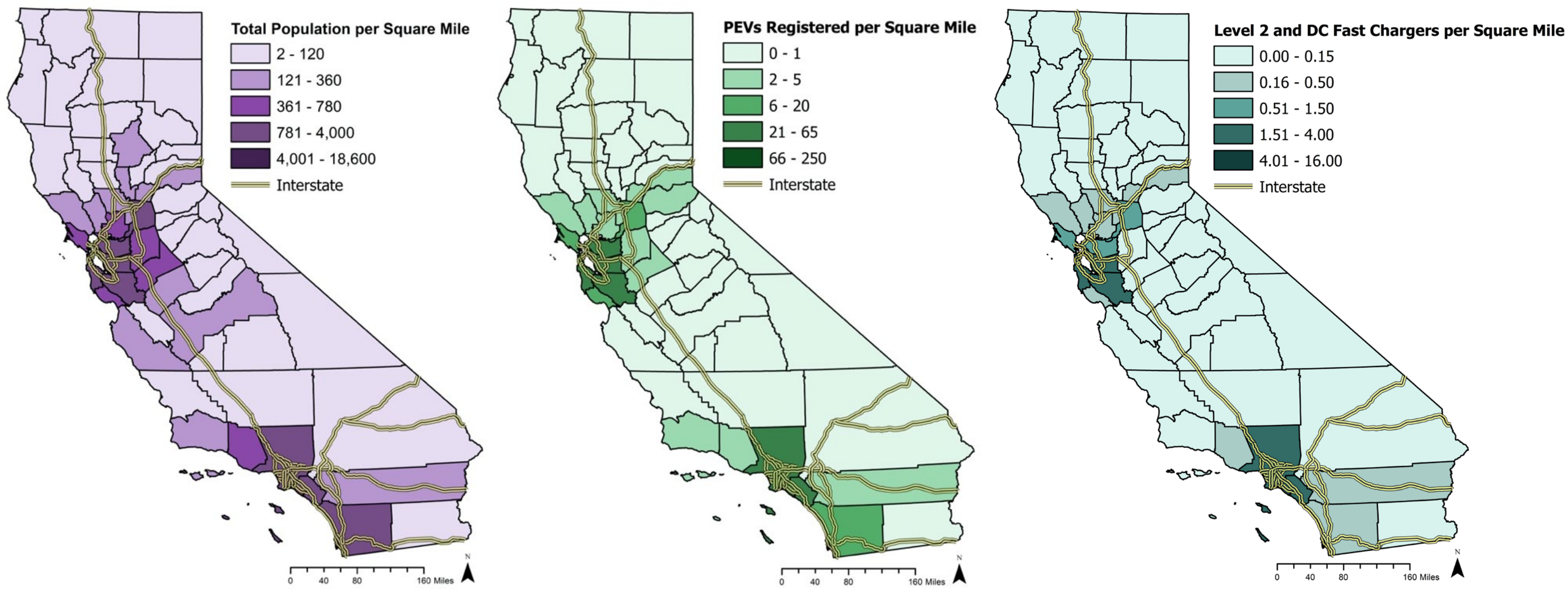
Figure 2.16: Public Level 2 and DC Fast Charger Density by County





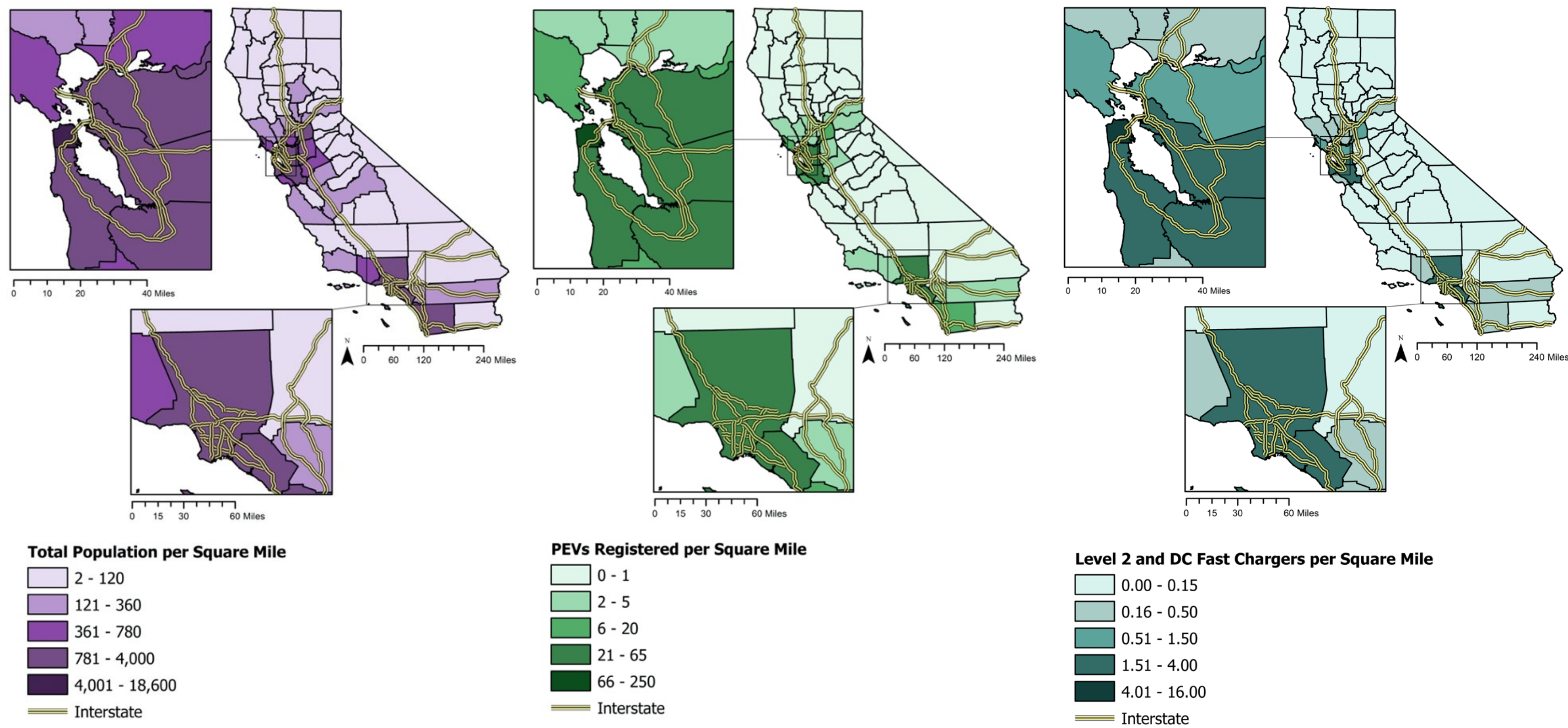
Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Figure 2.17: Population Density, Plug-In Electric Vehicle Density, and Public Level 2 and DC Fast Charger Density by County



Source: California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates, California Department of Motor Vehicles registration statistics as of October 2018, and U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Figure 2.18: Population Density, Plug-In Electric Vehicle Density, and Public Level 2 and DC Fast Charger Density by County (Close Up)



Source: California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates, California Department of Motor Vehicles registration statistics as of October 2018, and U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Population Distribution: Fewer Public Chargers in High Population Density Census Tracts

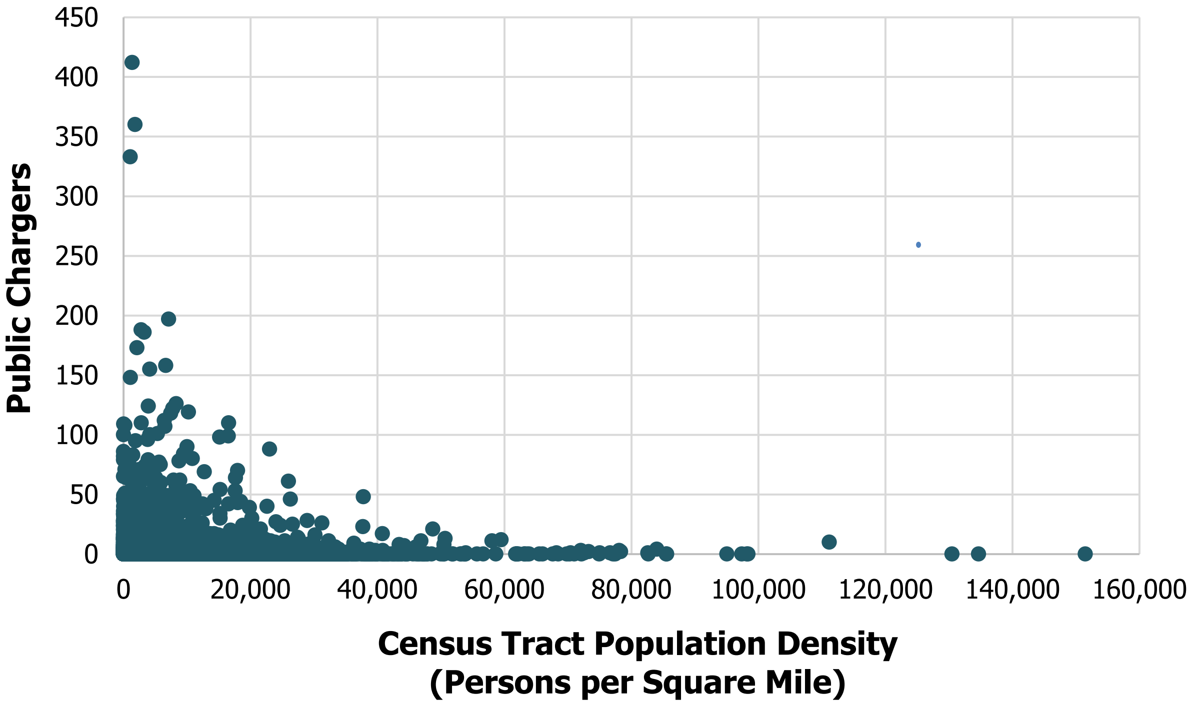
While chargers are collocated with population at the county level, at a finer scale, other factors appear to play a larger role. Staff evaluated total public Level 2 and DCFCs by census tract population density for neighborhood-level analysis. Figure 2.19 shows total chargers by population density for each census tract in California. The analysis shows that there are fewer total chargers within census tracts that have high population density.

Land use and surface area contribute to this observation. Staff analyzed land use data compiled and constructed by researchers from Conservation Science Partners, Inc. and the Department of Fish, Wildlife, and Conservation Biology at Colorado State University.[20] Using these data, staff located residential (dense urban, urban, suburban, rural), commercial (office, retail, entertainment), institutional (schools, medical, churches, government), production (agricultural), recreation (parks), and conservation areas statewide.

Generally, staff found that census tracts with high population density, and smaller area, are tracts of mainly dense residential use. For example, the point at the far right of Figure 2.19, with a population density of 151,487 and 0 chargers, represents a dense residential census tract in San Francisco County. The analysis shows that public chargers are absent or low in census tracts with the highest population densities statewide. However, census tracts neighboring these with more commercial use and roads traversing generally have more public chargers deployed. An example of this is illustrated by Figure 2.20. Census tracts with some of the highest population densities in the state are shown in red. Although there are fewer public Level 2 and DCFC stations within those census tracts, there are generally stations nearby. Census tracts with the lowest population densities statewide have more chargers deployed overall. Land use analysis shows that these large census tracts generally contain land uses like retail, office spaces, and airports.

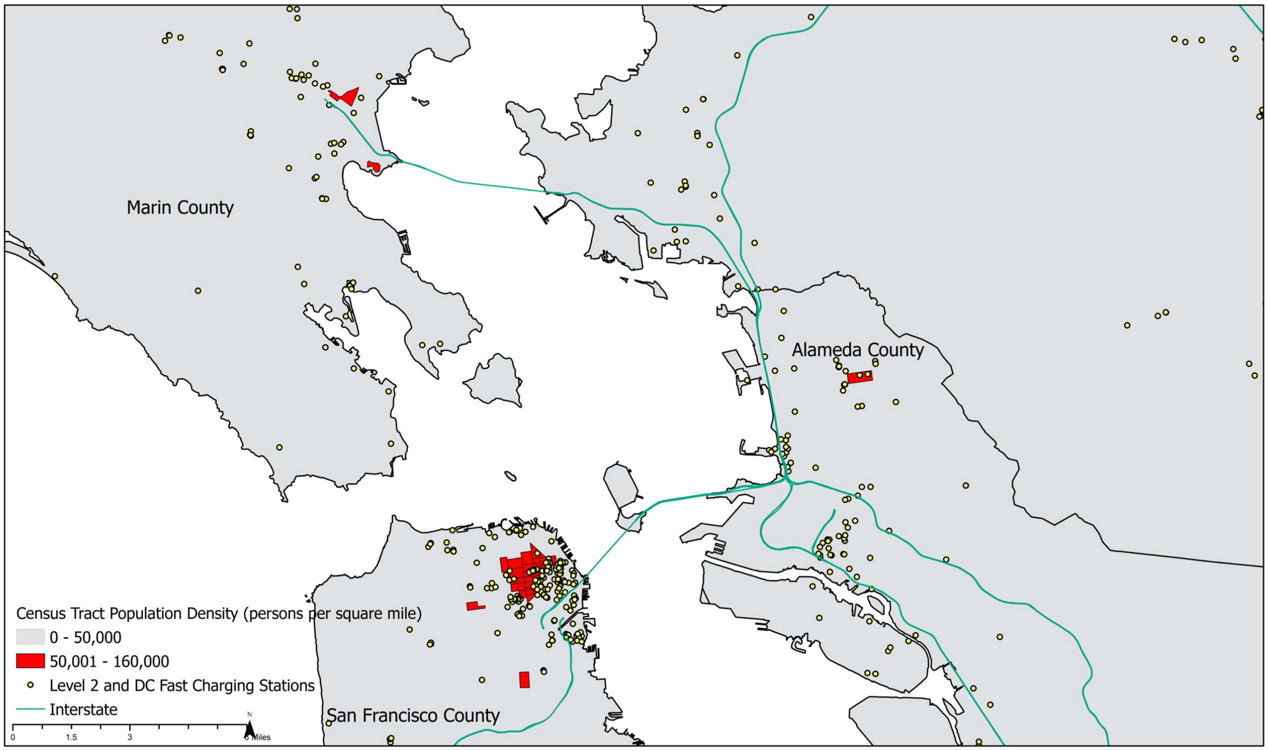
20 Theobald, David M. 2014. *Development and Applications of a Comprehensive Land Use Classification and Map for the U.S.* PLoS One 9(4): e94628. Available at https://doi.org/10.1371/journal.pone.0094628.

Figure 2.19: Public Level 2 and DC Fast Chargers by Census Tract Population Density



Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator charger data as of July 23, 2020

Figure 2.20: Distribution of Public Level 2 and DC Fast Chargers in Parts of the Bay Area

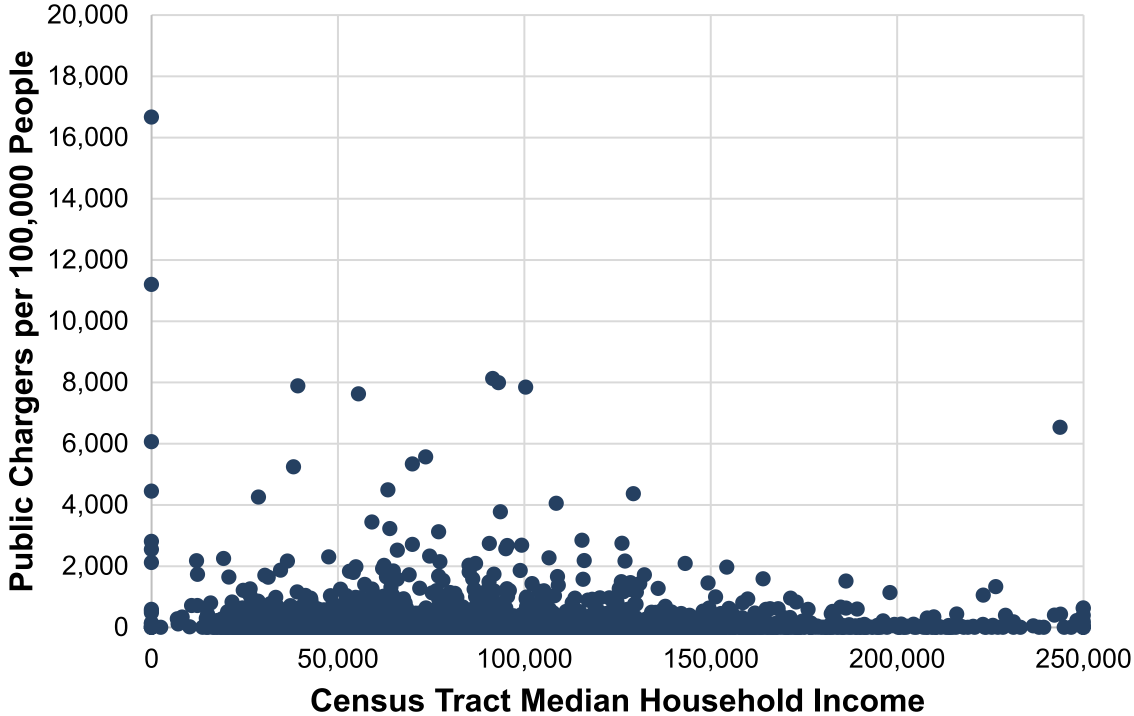


Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator charger data as of July 23, 2020

Income Distribution: Fewer Public Chargers in Low-Income Communities

This assessment uses census tract median household income (MHI) to evaluate charger distribution by population income level. Staff plotted total public Level 2 and DCFCs by census tract MHI and per-capita public Level 2 and DCFCs by census tract MHI, the latter of which is shown by Figure 2.21. Results from both plots show a lot of scatter. Staff also separately plotted public Level 2 chargers and DCFCs by census tract MHI, with similar results. While a correlation between total chargers or per-capita chargers and census tract MHI does not seem to exist, when communities are binned into three income categories, differences in per-capita charger numbers appear.

Figure 2.21: Per-Capita Public Level 2 and DC Fast Chargers by Census Tract Median Household Income



Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator charger data as of July 23, 2020

SB 1000 directs the CEC to assess charger deployment by population income level, *including* low-, middle-, and high-income levels. Staff identified the categories of low-, middle-, and high-income communities as the following:

> *Low-income communities* are "census tracts with median household incomes at or below 80 percent of the statewide median income or with median household incomes at or below the threshold designated as low income by the Department of Housing and Community Development's list of state income limits adopted pursuant to Section 50093."[21]
>
> *Middle-income communities* are census tract with median household incomes between 80 to 120 percent of the statewide median income, or with median household incomes between the threshold designated as low- and moderate-income by the

21 Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016).

Department of Housing and Community Development's list of state income limits adopted pursuant to Section 50093.[22]

High-income communities are census tracts with median household incomes at or above 120 percent of the statewide median income or with median household incomes at or above the threshold designated as moderate-income by the Department of Housing and Community Development's list of state income limits adopted under Section 50093.

Appendix H provides the full method by which staff identified low-, middle-, and high-income communities for the SB 1000 assessment along with a state map of the communities.

Staff assessed the percentage of statewide public Level 2 and DCFCs deployed within low-income, middle-income, and high-income communities, averaged. The results are shown in Table 2.2.

About 55 percent of Californians live in low-income communities. About 50 and 57 percent of public Level 2 and DCFCs in the state, respectively, are deployed in low-income communities. This deployment results in fewer Level 2 chargers per capita in low-income communities statewide.

About 23 percent of Californians live in middle-income communities where 22 and 24 percent of the state's public Level 2 and DCFCs reside, respectively. As a result, middle-income communities statewide have more Level 2 chargers per capita than low-income communities and more DCFCs per capita than low- and high-income communities.

About 21 percent of Californians live in high-income communities.[23] About 24 and 18 percent of the state's public Level 2 and DCFCs are in high-income communities, respectively. Consequently, high-income communities statewide have more Level 2 chargers but fewer DCFCs per capita than low- and middle-income communities.

Figure 2.22 shows the modest correlation. High-income communities statewide have the most public Level 2 and DCFCs, total and per capita, followed by middle-income communities — public chargers per capita is lowest in low-income communities statewide.

22 Section 50093(b) of the California Health and Safety Code defines "middle-income families" as "persons and families of moderate income or middle-income families." The California Department of Housing and Community Development defines "moderate-income households" as "those with incomes between 80 to 120 percent of the area median income." This definition is also used by the Federal Financial Institution Examination Council to identify "middle-income census tracts."

23 The remaining percentage of Californians live in census tracts with no reported MHI.

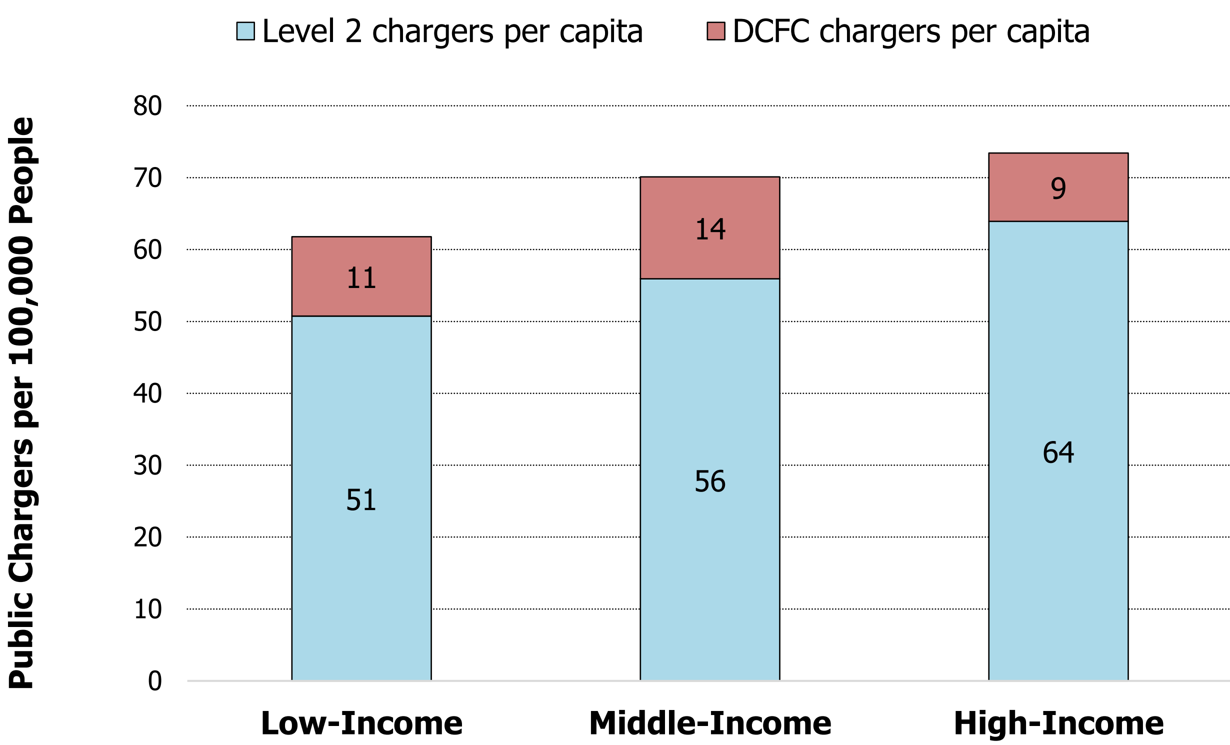
Table 2.1: Percentage of Statewide Public Level 2 and DC Fast Chargers Deployed by Income

Public Chargers	Low-Income	Middle-Income	High-Income
Level 2	50%	22%	24%
DC Fast	57%	24%	18%

About 4 percent of public Level 2 chargers and 1 percent of public DCFCs are deployed in census tracts where the Census Bureau does not report median household income.

Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Median Household Income 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator charger data as of July 23, 2020

Figure 2.22: Public Level 2 and DC Fast Chargers Per Capita by Community Income Level



Source: California Energy Commission staff analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Median Household Income 5-Year Estimates and U.S. Department of Energy's Alternative Fuels Data Center Station Locator data as of July 23, 2020

Data Gaps and Limitations

The information and analysis in this report provide a high overview of charging availability statewide. However, data gaps and limitations exist. This assessment does not include Level 1, shared-private, or private chargers. Level 1 chargers need only a standard 120-volt outlet to charge a PEV. The ability to charge from any standard household outlet makes counting and locating Level 1 chargers statewide more difficult. The AFDC Alternative Fueling Station Locator provides some information on public Level 1 chargers. However, because there is no requirement for electric vehicle supply providers (EVSPs) to report public Level 1 chargers, gaps may occur. These gaps would make it impossible to assess, on an ongoing basis, whether Level 1 chargers are disproportionately deployed across regions and communities. The Electric Vehicle Supply Equipment (EVSE) Standards Regulation requires all EVSPs operating public Level 2 or DCFCs to report EVSE information to CARB and the National Renewable Energy Laboratory (NREL).[24] This reporting enables staff to continue to assess whether public Level 2 and DCFCs statewide are disproportionately deployed.

Private chargers of any type are privately owned and operated and often reserved for a specific person or household. The AFDC Station Locator does not include private chargers. There are very limited data available on private chargers. Shared-private chargers include workplace chargers shared among employees and visitors, multi-unit dwelling (MUD) chargers shared among tenants and visitors, and fleet chargers shared among vehicles in a fleet. A lack of uniform and quality spatial data makes it impossible to assess whether private chargers are disproportionately deployed. The AFDC Station Locator includes spatial information on some shared-private chargers, but those represent a small portion statewide: shared-private Level 2 and DCFCs, total, represent only about a tenth of all Level 2 and DCFCs reported in the Station Locator for California. The CEC reports shared-private charger numbers, by county, quarterly.[25] As of the second quarter of 2020, there are more than 35,000 shared-private chargers in the state.

Several variables limited evaluation of charging access. For example, charger utilization data could hypothetically be used to understand how often a given charger is used by low-income community members versus by middle- or high-income community members by tracing charging sessions back to the user. Utilization data may also indicate community preference and demand for DCFCs over Level 2 chargers, or vice versa. However, the CEC does not have access to this kind of data, let alone with the resources needed to measure access by charger utilization statewide.

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24 CARB staff. 2020. *Electric Vehicle Supply Equipment (EVSE) Standards Final Regulation Order.* Available at https://ww2.arb.ca.gov/our-work/programs/electric-vehicle-supply-equipment-evse-standards.

25 California Energy Commission. Zero Emission Vehicle and Charger Statistics. Available at energy.ca.gov/zevstats.

The cost of charging is an important equity issue and component of charging access. However, pricing structures for chargers are not uniform. Some are charged per kilowatt-hour, others per hour, possibly with variable parking, session, or energy fees. Some charge for use after a certain period of charging for free. There are also chargers reported without any pricing information. A lack in uniform pricing data, in addition to data gaps, makes it difficult to characterize statewide charging access by the cost to charge. Level 1 or Level 2 charging is typically less expensive than DCFC; therefore, unevenness in the ability to charge at home or at work could have equity implications, but CEC staff does not currently have the ability to measure this.

There are multiple ways to define population income level. In this report, staff defined population income level using census tract MHIs. Other hypothetical ways of defining income include assessing the income of PEV adopters and assessing the spatial distribution of used PEVs. However, there are limited available data on the income of PEV adopters statewide. The Clean Vehicle Rebate Project (CVRP), which offers rebates of up to $7,000 for the purchase or lease of new ZEVs, provides some income information but misses those who do not apply.[26] Various income thresholds for what is low-, middle-, or high-income makes consolidating data from multiple sources, like PEV incentive programs, to group PEV adopters or prospective adopters by income difficult. Research indicates that low-income households are more likely to buy used vehicles.[27] Used PEV owners could therefore serve as one proxy for low-income PEV ownership. The California Department of Motor Vehicles (DMV) tracks vehicle registrations statewide. However, the way that vehicle ownership changes appear in the DMV database makes it difficult to track used vehicles. The DMV does not track previous vehicle owners. To identify previous vehicle ownership, staff would need to look through multiyear records to detect changes.

These data gaps create uncertainty and variation in the EV infrastructure deployment assessment. Not accounting for Level 1, private, and shared-private chargers may mask larger differences in charger counts, total, per capita, and per square mile across communities. Deployment of chargers within a community does not guarantee access to chargers by the community. Metrics for charging access are imperfect. Understanding community benefits derived from chargers requires evaluating criteria beyond just the location, or distribution, of chargers. While the analysis in this report is useful for policy makers and can be used to begin to inform public EV infrastructure deployment, future assessments will be aimed at improving analysis of charging access beyond location and charger counts. Work plans are discussed in the following chapter.

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[26] Clean Vehicle Rebate Project. https://cleanvehiclerebate.org/eng.

27 Paszkiewicz, Laura. 2003. "The Cost and Demographics of Vehicle Acquisition." *Consumer Expenditure Survey Anthology*, 61. Available at https://www.bls.gov/cex/anthology/csxanth8.pdf.

CHAPTER 3: Conclusions and Future Work

Conclusions

Staff analyzed chargers by geographical area (air districts and counties), population density, and population income level. The results present an overview of public Level 2 and DCFCs deployed statewide.

Geographical Distribution: Public Chargers are Unevenly Distributed Across State Air Districts and Counties but are Collocated with Populations and Plug-In Electric Vehicles

Public Level 2 and DCFCs are unevenly dispersed across state air districts and counties. Analysis shows that South Coast AQMD and Bay Area AQMD comprise nearly three-quarters of public Level 2 chargers and more than half of DCFCs statewide. At a county level, about a quarter of public Level 2 chargers and 16 percent of public DCFCs are distributed in Los Angeles County, which has more chargers than any other county in the state. However, on a per-square-mile basis, San Francisco County has more chargers than any other county. Staff assessed the distribution of chargers by population and registered PEVs and found that counties with higher population density and higher PEV density generally have more public Level 2 and DCFCs deployed per square mile. Land use (that is, conservation areas, road network, and so forth) may contribute significantly to geographic distribution of public chargers observed statewide. More analysis is needed to identify whether land use or other factors explain unevenness in the geographic distribution of chargers.

Population Distribution: Fewer Chargers in High-Population-Density Census Tracts

Analysis shows that more public Level 2 and DCFCs are deployed in census tracts with low population density. These census tracts are large and often contain land uses like large retail spaces and airports. On the other hand, chargers are absent or low in census tracts with high population density. These tracts are small and predominantly residential. Neighboring census tracts, however, that have more commercial land uses and roads traversing generally contain more chargers. More granular land use analysis is needed to assess whether drivers in high population density census tracts with absent or few public chargers are able to meet their charging needs in neighboring census tracts. Further analysis is needed to identify whether land use or other factors make infrastructure deployment less feasible in certain areas which may explain the deployment observed.

Income Distribution: Fewer Public Chargers in Low-Income Communities

Results show that about half of all public Level 2 and DCFCs in the state are deployed in low-income communities. However, low-income communities have fewer Level 2 chargers per capita. On average, middle-income communities have the most DCFCs per capita. High-income communities statewide have the most Level 2 chargers but fewest DCFCs per capita. The modest correlation between community income level and total chargers per capita captures just a part of the charging picture since the assessment does not include Level 1, shared-private, or private home chargers. Analysis shows no correlation between total chargers and individual census tract MHI or between chargers per capita and tract income. Further analysis is required to evaluate access and whether land use or other factors create barriers for infrastructure deployment across income categories.

Future Analyses and Improvements

For future assessments, staff will use new data as they become available to update analysis of charger distributions and evaluate components of charging access. Staff plans to evaluate public charger distribution across urban and rural communities and conduct additional land use analysis to investigate charging access beyond location within area boundaries (air districts, counties, census tracts). Staff plans to evaluate components of charging access, including housing and tenure, mix of PEVs, and charger power capacity.

Staff plans to evaluate public charger distribution across urban-rural classifications and the mix of income and urban-rural categories (low-income-urban, middle-income-urban, high-income-urban, low-income-rural, middle-income-rural, high-income-rural).

Staff plans to investigate housing density, broken out by housing type and size (for example, low- and high-rise multi-unit dwellings, attached and detached single-family homes), tenure (renter-occupied and owner-occupied units), and other attributes. Staff plans to break these out further by income level (low-, middle-, and high-income) to differentiate communities by housing density and income. This disaggregation would enable staff to evaluate and compare charging access for various housing types and demographics. For example, staff can evaluate charging access for renters that live in high-rise MUDs within low-, middle-, or high-income communities. One way of identifying low-income renter access is to identify MUDs with subsidized affordable housing units then evaluate distance from those MUDs to public chargers. Staff plans to evaluate the distance between housing and public chargers. Distance between chargers and clusters of housing, characterized by housing type and demographics, serves as one proxy for community charging access. The analysis described would enable staff to better characterize public charging access, in terms of distance to charger, for MUD residents and renters. Staff will continue to work with land use and neighborhood-level data to evaluate charging access for unique built environments.

In this assessment, staff examined relationships across total PEVs and public chargers (excluding Level 1) by county. For future assessments, staff plans to evaluate registered plug-in hybrid electric vehicles (PHEVs) and battery-electric vehicles (BEVs) to assess if the mix of PEVs in a county contributes to the types of chargers deployed. Staff will continue to investigate spatial data on used PHEV and BEV ownership.

In this assessment, staff evaluated types of chargers by power level. For future assessments, staff plans to analyze public Level 2 and DCFC power capacities, which include charger voltage, current, and power outputs. The EVSE Standards Regulation, administered by CARB, requires all EVSPs operating public Level 2 or DCFCs to report EVSE/charger information, including power capacity.[28] Staff will work with CARB on data collection to assess deployment of chargers by charging speed.

Need for Ongoing Analysis to Ensure Equitable Investments

This report marks the first in a series of assessments that will be carried out by CEC staff in accordance with SB 1000. Staff will continue to update the analysis to inform how CEC Clean Transportation Program investments can improve charging access through the deployment of public chargers.[29] Results will be joined with other analyses from the CEC to inform EV infrastructure deployment that meets equity and market uptake goals.

The CEC invites stakeholder engagement in ongoing analyses to inform robust data collection and analysis. Data sharing and input from stakeholders will be essential for fully characterizing statewide charger distribution and access to chargers. Sharing of shared-private charger counts and locations, for example, may enable staff to assess whether shared-private chargers are disproportionately deployed across communities statewide. CEC staff is collecting information on shared-private chargers throughout the state and encourage EVSPs, station developers, site hosts, and site owners to participate in surveys issued quarterly by the CEC.[30] Entities may also report charger information directly to NREL.

The CEC recognizes the unique mobility needs and built environments of communities statewide. Staff working on the SB 1000 assessments strive to make equity a practice by including the perspectives of communities impacted and informing implementation of chargers in a way that supports and uplifts communities. Staff encourage community-based organizations (CBOs), local agencies, and other entities to continue to work closely with current and prospective PEV adopters and riders across communities to identify and document charging gaps and needs. This data has the potential to inform SB 1000 assessments of statewide charger deployment. Likewise, qualitative data on vehicle and mobility preferences in communities have the potential to influence results. Examples include whether communities express more interest in PHEVs over BEVs, or vice versa, or have preference for ride-hailing services over vehicle ownership. These factors, amongst others, may explain discrepancies in charger types observed across communities. Or, they may signify the need to investment more in particular types of EV infrastructure to advance electric mobility in a way that best suits community needs, as expressed by communities.

PEV adoption continues to face several challenges, including high upfront vehicle ownership costs and barriers to charging. Various federal, state, and local regulations and incentives aim

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28 California Air Resources Board staff. 2020. *Electric Vehicle Supply Equipment (EVSE) Standards Final Regulation Order.* Available at https://ww2.arb.ca.gov/our-work/programs/electric-vehicle-supply-equipment-evse-standards.

29 CEC staff will conduct ongoing analysis until CEC Clean Transportation Program investments end.

30 California Energy Commission staff. 2020. *Counting Electric Vehicle Chargers in California Docket Log.* Available at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-TRAN-03.

to close charging gaps and expand PEV access. Researchers from the University of California, Los Angeles (UCLA), however, state that regulations and incentives may be misdirected. In a recent study of energy consumption and clean energy technology adoption, including PEV adoption, in Los Angeles County, they state:

> By design, market-based approaches to residential EE [energy efficiency], electrification, and renewable generation capacity expansion programs tend to prioritize volume, measured in units of either estimated energy savings, sales, or installed capacity – over the equitable distribution of program benefits. The tendency of these programs to be over-utilized by the rich and under-utilized by the poor is well-documented. … We believe that, in many cases, program elements which were assumed to ensure equity of access or opportunity, may be inadvertently responsible for unequal rates of program utilization.[31]

The CEC strives to prevent blind spots like these by calling attention to where, and to which communities, access to public chargers may be disproportionate. Results of SB 1000 assessments have the potential to inform where additional investments may need to be targeted for more equitable distribution of program benefits. The CEC's SB 1000 report, Assembly Bill 2127 report (quantifying the infrastructure needed to support five million zero-emission vehicles), and other analyses and reports are valuable tools to ensure that California meets its ZEV, local air quality, and GHG reduction goals in an equitable manner that supports all Californians.

31 Fournier, Eric D., Robert Cudd, Felicia Federico, and Stephanie Pincetl. 2020. *On Energy Sufficiency and the Need for New Policies to Combat Growing Inequalities in the Residential Energy Sector.* Available at https://www.elementascience.org/article/10.1525/elementa.419/.

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ACRONYMS AND ABBREVIATIONS

Original Term	Acronym/Abbreviation
Air pollution control district	APCD
Air quality management district	AQMD
Alternative Fuels Data Center	AFDC
Assembly Bill	AB
Battery-electric vehicle	BEV
California Air Resources Board	CARB
Community-based organization	CBO
California Energy Commission	CEC
Clean Vehicle Rebate Project	CVRP
Disadvantaged Community Advisory Group	DACAG
Department of Motor Vehicles	DMV
Direct-current fast charger	DCFC
Electric vehicle	EV
Electric vehicle supply equipment	EVSE
Electric vehicle supply provider	EVSP
Greenhouse Gas Reduction Fund	GGRF
California Department of Housing and Community Development	HCD
Median household income	MHI
Multi-unit dwelling	MUD
National Renewable Energy Laboratory	NREL
Plug-in electric vehicle	PEV
Plug-in hybrid electric vehicle	PHEV
Particulate matter	PM
Senate Bill	SB
University of California Los Angeles	UCLA
Zero-emission vehicle	ZEV

GLOSSARY

AIR DISTRICT – Air districts issue permits and monitor new and modified sources of air pollutants to ensure compliance with national, state, and local emission standards and to ensure that emissions from such sources will not interfere with the attainment and maintenance of ambient air quality standards adopted by the California Air Resources Board (ARB) and the U.S. Environmental Protection Agency (U.S. EPA).

AIR POLLUTANTS – Amounts of foreign and/or natural substances occurring in the atmosphere that may result in adverse effects to humans, animals, vegetation and/or materials.

ALTERNATIVE AND RENEWABLE FUELS AND VEHICLE TECHNOLOGY PROGRAM (ARFVTP)— Now known as the Clean Transportation Program, created by Assembly Bill 118 (Nunez, Chapter 750, Statutes of 2007), with an annual budget of about $100 million. Supports projects that develop and improve alternative and renewable low-carbon fuels, improve alternative and renewable fuels for existing and developing engine technologies, and expand transit and transportation infrastructures. Also establishes workforce training programs, conducts public education and promotion, and creates technology centers, among other tasks.

CALIFORNIA ELECTRIC VEHICLE INFRASTRUCTURE PROJECT (CALeVIP) – CALeVIP offers rebates for the purchase and installation of public or shared-private electric vehicle charging infrastructure. CALeVIP is implemented by the Center for Sustainable Energy for the California Energy Commission.

CENSUS TRACTS – Land areas defined by the U.S. Census Bureau. Tracts can vary in size but each typically contains about 4,000 residents. Census tracts are usually smaller than 2 square miles in cities, but are much larger in rural areas.

CHARGER – Chargers or Electric Vehicle Supply Equipment (EVSE) are manufactured units that safely deliver electricity to charge the battery of a plug-in electric vehicle.

CHARGER POWER LEVEL – The power level of charging equipment is rated in kilowatts (kW). Power levels associated with the three categories of charging currently used for light-duty vehicles are:

- Level 1 chargers use 110/120 volts and are rated up to 1.9 kW.
- Level 2 chargers use 208/240 volts and are rated up to 19.2 kW.
- Direct current (DC) fast chargers use 200 to 600 volts and convert alternating current to direct current which must be delivered to the battery through a special charging port on the electric vehicle. Power levels range from 50 kW to over 300 kW. The ability to use higher power charging may be limited by the vehicle.

CHARGING STATION – One or more chargers located at a specified address.

CLEAN CARS 4 ALL PROGRAM – Funded by California Climate Investments and implemented by the California Air Resources Board, Clean Cars 4 All provides incentives to lower-income Californians to replace their high-polluting vehicle with a zero- or near-zero emission vehicle.

CLEAN VEHICLE ASSISTANCE PROGRAM – Funded by California Climate Investments and implemented by the California Air Resources Board and Beneficial State Foundation, the Clean Vehicle Assistance Program provides grants and affordable financing to income-qualified Californians for the purchase or lease of a new or used hybrid or electric vehicle.

CLEAN VEHICLE REBATE PROJECT (CVRP) – The Clean Vehicle Rebate Project (CVRP) promotes clean vehicle adoption in California by offering rebates for the purchase or lease of new, eligible zero-emission vehicles, including electric, plug-in hybrid electric and fuel cell vehicles.

CONNECTOR – A specific socket or cable assembly available on the charger for the plug-in electric vehicle. A charger may have multiple connectors.

DISADVANTAGED COMMUNITIES – Communities disproportionately burdened by multiple sources of pollution and with population characteristics that make them more sensitive to pollution.

ELECTRIC VEHICLE (EV)—A broad category that includes all vehicles that are fully powered by electricity or an electric motor.

EXCLUSIONARY ZONING – Zoning ordinances that exclude a specific class of people or type of business from a district by controlling building, structures, and land uses.

GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (NOx), halogenated fluorocarbons (HCFCs), ozone (O3), per fluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

HIGH-INCOME COMMUNITY – Census tracts with median household incomes at or above 120 percent of the statewide median income or with median household incomes at or above the threshold designated as moderate-income by the Department of Housing and Community Development’s list of state income limits adopted under Section 50093.

LAND USE – Land use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction and conservation).

LOW-INCOME COMMUNITY – Census tracts with median household incomes at or below 80 percent of the statewide median income or with median household incomes at or below the threshold designated as low income by the Department of Housing and Community Development’s list of state income limits adopted under Section 50093.

MIDDLE-INCOME COMMUNITY – Census tracts with median household incomes between 80 to 120 percent of the statewide median income, or with median household incomes between the threshold designated as low- and moderate-income by the Department of Housing and Community Development’s list of state income limits adopted pursuant to Section 50093.

PRIVATE CHARGING STATION – A private charging station has parking space(s) that are privately owned and operated, often dedicated for a specific driver or vehicle.

PUBLIC CHARGING STATION – A public charging station has parking space(s) designated by a property owner or lessee to be available to and accessible by the public. Under Section 44268 of Division 26 of the Health and Safety Code, a publicly available parking space shall not include a parking space that is part of, or associated with, a private residence or a parking space that is reserved for the exclusive use of a driver or drivers.

REDLINING – The discriminatory practice of refusing home improvement loans or mortgages to a specific class of people in certain neighborhoods. Redlining refers to the color-coded maps that designated areas that were considered high risk.

SHARED-PRIVATE CHARGING STATION – A shared-private charging station has parking space(s) designed by a property owner or lessee to be available to and accessible by employees, tenants, visitors, and/or residents. Parking spaces are not reserved to individual drivers or vehicles, and include workplaces, multi-family dwellings, and fleets.

URBAN RENEWAL – Redevelopment and rehabilitation of primarily urban areas through methods including government assistance and eminent domain, typically involving the clearance of slums. Historically, these policies disproportionately displaced minorities and lower-income households.

ZERO-EMISSION VEHICLE (ZEV) – Vehicles that produce zero emissions from the on-board source of power. There are three types of zero-emission vehicles:

- Battery-electric vehicles (BEVs), also known as an "All-electric" vehicle (AEV), utilize energy that is stored in rechargeable battery packs. BEVs sustain their power through the batteries and therefore must be plugged into an external electricity source in order to recharge.
- Plug-in hybrid electric vehicles (PHEVs) are powered by an internal combustion engine and an electric motor that uses energy stored in a battery. The vehicle can be plugged in to an electric power source to charge the battery. Some can travel nearly 100 miles on electricity alone, and all can operate solely on gasoline (similar to a conventional hybrid).
- Fuel cell electric vehicles (FCEVs) run on compressed hydrogen fed into a fuel cell "stack" that produces electricity to power the vehicle.

Battery-electric vehicles and plug-in hybrid electric vehicles are collectively known as plug-in electric vehicles, or PEVs

APPENDIX A: Charging Infrastructure Data

Staff collected charging infrastructure data from the U.S. Department of Energy Alternative Fuels Data Center (AFDC) Alternative Fueling Station Locator (as of July 23, 2020). The National Renewable Energy Laboratory (NREL) collects charging infrastructure data from EV charging network companies, original equipment manufacturers (OEMs), industry associations, Clean Cities coalitions, and others and uploads data daily to the station locator.

The station locator provides public and shared-private charging station locations, facility types, availability status, power levels, and counts.[32] Private chargers, including home chargers, are not included in the station locator. Facility types include corridor, commercial, office, institutional, recreational, and some multi-unit dwellings (MUDs). Availability status includes operational status, hours of operation, and access type. Power levels include Level 1, Level 2, and DCFCs (Table A.1). Counts include number of stations, EVSEs/chargers, and connectors (see glossary for definitions).

For this assessment, staff analyzed public Level 2 and DCFCs. Using the number of EVSEs/chargers aligns with the CEC's and NREL's transition on EVSE counting logic per the Open Charge Point Interface (OCPI) protocol.[33] The EVSE Standards Regulation requires that all electric vehicle supply providers (EVSPs) operating public Level 2 or DCFCs report EVSE information to NREL and the California Air Resources Board (CARB), starting August 15, 2020.[34] This requirement leads to more comprehensive data on public Level 2 and DCFCs, which enables staff to assess statewide charger deployment over time for these types of chargers.

32 Shared-private chargers include workplace chargers shared among employees and visitors, MUD chargers shared among tenants and visitors, and fleet chargers shared among vehicle in a fleet.

U.S. Department of Energy Alternative Fuels Data Center. 2020. Alternative Fueling Station Locator (Data). Available at https://afdc.energy.gov/stations/#/find/nearest.

33 California Energy Commission (CEC) staff. 2020. *Counting Electric Vehicle Chargers in California.* Docket Log Number: 20-TRAN-03. Available at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-TRAN-03.

34 CARB staff. 2020. *Electric Vehicle Supply Equipment (EVSE) Standards Final Regulation Order.* Available at https://ww2.arb.ca.gov/our-work/programs/electric-vehicle-supply-equipment-evse-standards.

Table A.1: Types of Chargers

Power Specifications	Level 1	Level 2	DCFC
Voltage	110/20 Volt AC	208/240 Volt AC	220 – 660 Volt DC
Amperage	15 – 20 Amps	Up to 80 Amps	Up to 400 Amps
Power Output	~1.3 – 1.9 kW	~3.3. – 19.2 kW	~24 – 300 kW
Electric Range (per Hour)	~2 – 5 miles	~14 – 25 miles	~90 miles in 30 mins*

*Based on a 55 kW DCFC. DCFCs offer the fastest charging speeds with various power levels. Charging times depend on the vehicle's battery size, charger's power output, and other factors.

Source: California Energy Commission Staff

APPENDIX B:
Public Level 2 and DC Fast Chargers Total and Per Square Mile by Air District

Table B.1: Public Level 2 and DC Fast Chargers Total and Per Square Mile by Air District

Air District	Public Level 2 Chargers	Public Level 2 Chargers per Square Mile	Public DC Fast Chargers	Public DC Fast Chargers per Square Mile	Public Level 2 and DC Fast Chargers	Public Level 2 and DC Fast Chargers per Square Mile
Amador	23	0.038	0	0.000	23	0.038
Antelope Valley	92	0.070	21	0.016	113	0.085
Bay Area	7,606	1.363	1,324	0.237	8,930	1.600
Butte	35	0.021	16	0.010	51	0.030
Calaveras	7	0.007	0	0.000	7	0.007
Colusa	16	0.014	10	0.009	26	0.022
El Dorado	104	0.058	35	0.020	139	0.078
Feather River	11	0.009	12	0.010	23	0.018
Glenn	4	0.003	10	0.008	14	0.011
Great Basin Unified	37	0.003	26	0.002	63	0.004
Imperial	2	0.000	10	0.002	12	0.003
Kern	13	0.003	17	0.004	30	0.008
Lake	10	0.008	0	0.000	10	0.008
Lassen	4	0.001	0	0.000	4	0.001
Mariposa	9	0.006	8	0.005	17	0.012
Mendocino	82	0.023	21	0.006	103	0.029
Modoc	4	0.001	0	0.000	4	0.001
Mojave Desert	88	0.004	148	0.007	236	0.012

Air District	Public Level 2 Chargers	Public Level 2 Chargers per Square Mile	Public DC Fast Chargers	Public DC Fast Chargers per Square Mile	Public Level 2 and DC Fast Chargers	Public Level 2 and DC Fast Chargers per Square Mile
Monterey Bay Unified	332	0.064	106	0.021	438	0.085
North Coast Unified	93	0.012	38	0.005	131	0.017
Northern Sierra	33	0.007	32	0.007	65	0.014
Northern Sonoma	105	0.108	4	0.004	109	0.112
Placer	161	0.107	94	0.063	255	0.170
Sacramento Metro	648	0.661	122	0.124	770	0.785
San Diego	1,716	0.405	244	0.058	1,960	0.462
San Joaquin Valley Unified	767	0.032	351	0.015	1,118	0.047
San Luis Obispo	299	0.090	47	0.014	346	0.104
Santa Barbara	218	0.079	39	0.014	257	0.093
Shasta	19	0.005	10	0.003	29	0.008
Siskiyou	18	0.003	33	0.005	51	0.008
South Coast	8,999	0.838	1,522	0.142	10,521	0.979
Tehama	5	0.002	23	0.008	28	0.009
Tuolumne	30	0.013	9	0.004	39	0.017
Ventura	374	0.200	112	0.060	486	0.260
Yolo-Solano	196	0.131	49	0.033	245	0.164

This table does not include shared-private chargers, chargers reserved for an individual driver or vehicle, or private residential chargers. Data as of July 23, 2020.

Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator Database and U.S. Census Bureau 2018 TIGER/Line Shapefiles for California

APPENDIX C: Public Level 2 and DC Fast Chargers Total by County

Table C.1: Public Level 2 and DC Fast Chargers Total by County

County	Population	PEVs Registered	Public Level 2 Chargers	Public DCFCs	Public Level 2 and DCFCs
Alameda	1,643,700	31,967	1,269	260	1,529
Alpine	1,146	3	12	0	12
Amador	37,829	134	23	0	23
Butte	227,075	615	35	16	51
Calaveras	45,235	191	7	0	7
Colusa	21,464	38	16	10	26
Contra Costa	1,133,247	16,822	459	167	626
Del Norte	27,424	64	12	20	32
El Dorado	186,661	1,753	104	35	139
Fresno	978,130	4,163	366	77	443
Glenn	27,897	42	4	10	14
Humboldt	135,768	1,164	77	18	95
Imperial	180,216	228	2	10	12
Inyo	18,085	64	6	14	20
Kern	883,053	2,249	105	92	197
Kings	150,075	319	37	42	79
Lake	64,148	284	10	0	10
Lassen	31,185	16	4	0	4
Los Angeles	10,098,052	109,739	5,760	706	6,466
Madera	155,013	391	48	19	67
Marin	260,295	6,468	395	52	447
Mariposa	17,540	60	9	8	17
Mendocino	87,422	720	82	21	103

County	Population	PEVs Registered	Public Level 2 Chargers	Public DCFCs	Public Level 2 and DCFCs
Merced	269,075	590	37	28	65
Modoc	8,938	9	4	0	4
Mono	14,174	32	19	12	31
Monterey	433,212	2,163	208	63	271
Napa	140,530	1,607	251	39	290
Nevada	99,092	659	27	32	59
Orange	3,164,182	51,874	2,100	396	2,496
Placer	380,077	4,122	161	94	255
Plumas	18,699	37	5	0	5
Riverside	2,383,286	13,903	807	320	1,127
Sacramento	1,510,023	9,859	648	122	770
San Benito	59,416	452	11	2	13
San Bernardino	2,135,413	10,280	512	269	781
San Diego	3,302,833	33,616	1,716	244	1,960
San Francisco	870,044	10,767	630	28	658
San Joaquin	732,212	3,284	76	61	137
San Luis Obispo	281,455	2,491	299	47	346
San Mateo	765,935	16,383	1,480	260	1,740
Santa Barbara	443,738	3,331	218	39	257
Santa Clara	1,922,200	55,468	2,725	386	3,111
Santa Cruz	273,765	3,856	113	41	154
Shasta	179,085	442	19	10	29
Sierra	2,930	6	1	0	1
Siskiyou	43,540	82	18	33	51
Solano	438,530	3,251	169	78	247
Sonoma	501,317	7,502	366	88	454
Stanislaus	539,301	1,654	59	30	89

County	Population	PEVs Registered	Public Level 2 Chargers	Public DCFCs	Public Level 2 and DCFCs
Sutter	95,872	180	2	12	14
Tehama	63,373	85	5	23	28
Trinity	12,862	24	4	0	4
Tulare	460,477	986	52	19	71
Tuolumne	53,932	155	30	9	39
Ventura	848,112	8,589	374	112	486
Yolo	214,977	1,970	163	19	182
Yuba	75,493	160	9	0	9
TOTAL	**39,148,760**	**427,363**	**22,160**	**4,493**	**26,653**

This table does not include shared-private chargers, chargers reserved for an individual driver or vehicle, or private residential chargers. Charger data as of July 23, 2020. Includes battery electric and plug-in hybrid electric vehicles. Plug-in electric vehicle data as of October 2018.

Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator Database, U.S. Census Bureau 2014-2018 5-Year American Community Survey Total Population Estimates, California Department of Motor Vehicles Statistics, and U.S. Census Bureau 2018 TIGER/Line Shapefiles for California

APPENDIX D:
Public Level 2 and DC Fast Chargers Per Square Mile by County

Table D.1: Public Level 2 and DC Fast Chargers Per Square Mile by County

County	Population per Square Mile	PEVs Registered per Square Mile	Public Level 2 Chargers per Square Miles	Public DCFCs per Square Mile	Public Level 2 and DCFCs per Square Mile
Alameda	2,229.350	43.357	1.721	0.353	2.074
Alpine	1.552	0.004	0.016	0.000	0.016
Amador	63.624	0.225	0.039	0.000	0.039
Butte	138.759	0.376	0.021	0.010	0.031
Calaveras	44.347	0.187	0.007	0.000	0.007
Colusa	18.653	0.033	0.014	0.009	0.023
Contra Costa	1,580.360	23.459	0.640	0.233	0.873
Del Norte	27.254	0.064	0.012	0.020	0.032
El Dorado	109.296	1.026	0.061	0.020	0.081
Fresno	164.168	0.699	0.061	0.013	0.074
Glenn	21.231	0.032	0.003	0.008	0.011
Humboldt	38.050	0.326	0.022	0.005	0.027
Imperial	43.149	0.055	0.000	0.002	0.003
Inyo	1.776	0.006	0.001	0.001	0.002
Kern	108.586	0.277	0.013	0.011	0.024
Kings	107.944	0.229	0.027	0.030	0.057
Lake	51.052	0.226	0.008	0.000	0.008
Lassen	6.867	0.004	0.001	0.000	0.001
Los Angeles	2,488.312	27.041	1.419	0.174	1.593
Madera	72.540	0.183	0.022	0.009	0.031
Marin	500.128	12.428	0.759	0.100	0.859
Mariposa	12.106	0.041	0.006	0.006	0.012

County	Population per Square Mile	PEVs Registered per Square Mile	Public Level 2 Chargers per Square Miles	Public DCFCs per Square Mile	Public Level 2 and DCFCs per Square Mile
Mendocino	24.932	0.205	0.023	0.006	0.029
Merced	139.010	0.305	0.019	0.014	0.034
Modoc	2.283	0.002	0.001	0.000	0.001
Mono	4.649	0.010	0.006	0.004	0.010
Monterey	132.008	0.659	0.063	0.019	0.083
Napa	187.796	2.148	0.335	0.052	0.388
Nevada	103.462	0.688	0.028	0.033	0.062
Orange	3,991.240	65.433	2.649	0.500	3.148
Placer	270.117	2.929	0.114	0.067	0.181
Plumas	7.324	0.014	0.002	0.000	0.002
Riverside	330.711	1.929	0.112	0.044	0.156
Sacramento	1,564.069	10.212	0.671	0.126	0.798
San Benito	42.787	0.325	0.008	0.001	0.009
San Bernardino	106.452	0.512	0.026	0.013	0.039
San Diego	784.751	7.987	0.408	0.058	0.466
San Francisco	18,565.492	229.752	13.443	0.597	14.041
San Joaquin	525.868	2.359	0.055	0.044	0.098
San Luis Obispo	85.273	0.755	0.091	0.014	0.105
San Mateo	1,707.254	36.517	3.299	0.580	3.878
Santa Barbara	162.236	1.218	0.080	0.014	0.094
Santa Clara	1,488.824	42.962	2.111	0.299	2.410
Santa Cruz	615.030	8.663	0.254	0.092	0.346
Shasta	47.435	0.117	0.005	0.003	0.008
Sierra	3.074	0.006	0.001	0.000	0.001

County	Population per Square Mile	PEVs Registered per Square Mile	Public Level 2 Chargers per Square Miles	Public DCFCs per Square Mile	Public Level 2 and DCFCs per Square Mile
Siskiyou	6.934	0.013	0.003	0.005	0.008
Solano	533.653	3.956	0.206	0.095	0.301
Sonoma	318.120	4.761	0.232	0.056	0.288
Stanislaus	360.492	1.106	0.039	0.020	0.059
Sutter	159.116	0.299	0.003	0.020	0.023
Tehama	21.489	0.029	0.002	0.008	0.009
Trinity	4.046	0.008	0.001	0.000	0.001
Tulare	95.448	0.204	0.011	0.004	0.015
Tuolumne	24.284	0.070	0.014	0.004	0.018
Ventura	460.313	4.662	0.203	0.061	0.264
Yolo	211.856	1.941	0.161	0.019	0.179
Yuba	119.448	0.253	0.014	0.000	0.014

This table does not include shared-private chargers, chargers reserved for an individual driver or vehicle, or private residential chargers. Charger data as of July 23, 2020. Includes battery electric and plug-in hybrid electric vehicles. Plug-in electric vehicle data as of October 2018.

Source: California Energy Commission staff analysis using U.S. Department of Energy's Alternative Fuels Data Center Station Locator Database, U.S. Census Bureau 2014 – 2018 American Community Survey Total Population 5-Year Estimates, and California Department of Motor Vehicles Statistics

APPENDIX E: California Air Districts

Figure E.1: California Air Districts

Source: California Energy Commission staff analysis using Geographic Information System (GIS) data from the California Air Resources Board

APPENDIX F: California Counties

Figure F.1: California Counties

Source: California Energy Commission staff analysis using U.S. Census Bureau 2018 GIS data

APPENDIX G: Geographical Area, Population Density, and Plug-In Electric Vehicle Density Definitions

SB 1000 directs the CEC to assess EV infrastructure deployment by geographical area, population density, and population income level. The sections below define geographical area and population density.

Geographical Area

Geographical area refers to the location of chargers and communities. In this report, communities are characterized by population density, population income level, and location. Staff chose census tracts as the unit of analysis for communities. Census tracts are small subdivisions that enable staff to evaluate charger deployment at the neighborhood-level. They follow county lines and natural and built environments. Census tracts typically have between 1,200 to 8,000 people and average about 4,000 people.[35] The range in population across tracts results in tracts that vary widely in size. The U.S. Census Bureau updates census tract delineations every 10 years to account for population growth and decline.[36]

California has 8,057 census tracts that fit wall-to-wall within California's 58 counties.[37] Census tracts in California vary in size and population – the largest census tract, in San Bernardino County, spans nearly 7,000 square miles and has a population of 3,625, whereas the smallest is roughly 0.02 square miles with a population of 1,477, located in the San Francisco County.

Staff also analyzed chargers by county, a better-known geographic reference, and air district to provide regional results. A county-level analysis enables possibility for cross analysis with models at the CEC that project infrastructure needs by county. California has 58 counties and 35 air districts that cover the state. Air districts monitor regional air quality, plan, and are responsible or stationary source and facility permitting.

Population Density

Staff used the total population and land area of a census tract to measure population density (persons per square mile). Total population counts come from the U.S. Census Bureau

35 U.S. Census Bureau. 2019. *Glossary.* Available at https://www.census.gov/glossary/.

36 Ibid

37 Of the 8,057 census tracts in California, 21 are made up of entirely water and have no population.

American Community Survey (ACS) 2014 – 2018 5-Year Estimates.[38] Land area comes from the U.S. Census Bureau 2018 TIGER/Line Shapefiles for California census tracts.[39] Staff calculated county population density using census tract counts since tracts fit wall-to-wall within counties.

Plug-In Electric Vehicle Density

Staff measured PEV density using the number of PEVs (BEVs and PHEVs) registered in a county and the county's land area. PEV registration counts come from the California Department of Motor Vehicles (DMV) as of October 2018. These are used to maintain consistency with total population counts from 2018 five-year estimates. The DMV provides the number of vehicles registered in a county by fuel type.[40] These data are publicly available through the CEC's Zero Emission Vehicle and Charger Statistics dashboard, which also tracks PEV sales and chargers in California.[41]

38 U.S. Census Bureau. 2014 – 2018. Census Tracts, California, B01003 Total Population (Data). *2018 American Community Survey (ACS) 5-Year Estimates*. Available at https://www.census.gov/data.html.

39 U.S. Census Bureau. 2018. 2018 TIGER/Line Shapefiles: Census Tracts (Data). *TIGER/Line Shapefiles.* Available at https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2018.html.

40 California Department of Motor Vehicles (DMV). 2018. Vehicle Statistics (Data). Available at https://www.dmv.ca.gov/portal/.

41 CEC staff. 2020. Zero Emission Vehicle and Charger Statistics (Data). Available at https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics.

APPENDIX H: Low-, Middle-, and High-Income Communities

Staff referred to the California Department of Housing and Community Development (HCD) 2020 state income limits table to identify whether a census tract is a low-, middle-, or high-income community. The HCD publishes annual state income limits for extremely low-, very low-, low-, and moderate-income households; these limits are used to determine eligibility for assistance programs.[42] The HCD establishes state income limits for each county by household size as shown by Table H.1. This assessment refers to only the low- and moderate-income limits. HCD's low-income limit "reflects 160 percent of the very low-income limit" with some exceptions.[43] This is typically 50 percent of the median family income. The HCD's moderate-income limit "reflects 120 percent of the county's area median income" which is determined using a 4-person household.[44]

Table H.1: California Department of Housing and Community Development 2020 State Income Limits for Riverside County

Number of Persons in Household:		1	2	3	4	5	6	7	8
Riverside County Area Median Income: $75,300	Extremely Low	15,850	18,100	21,720	26,200	30,680	35,160	39,640	44,120
	Very Low Income	26,400	30,150	33,900	37,650	40,700	43,700	46,700	49,700
	Low Income	42,200	48,200	54,250	60,250	65,100	69,900	74,750	79,550
	Median Income	52,700	60,250	67,750	75,300	81,300	87,350	93,350	99,400
	Moderate Income	63,250	72,300	81,300	90,350	97,600	104,800	112,050	119,250

Source: California Department of Housing and Community Development

Figure H.1 walks through staff's methodology for identifying low-, middle-, and high-income census tracts for the SB 1000 assessment. Staff used three census tracts in Los Angeles County for this example. First, staff collected census tract MHIs from the U.S. Census Bureau to identify the income level of the tract using HCD's low- and moderate-income limits.[45] HCD

42 Olmstead, Zachary (California Department of Housing and Community Development). 2020. *State Income Limits for 2020.* Available at https://www.hcd.ca.gov/grants-funding/income-limits/state-and-federal-income-limits/docs/Income-Limits-2020.pdf.

43 Ibid.

44 Ibid.

45 U.S. Census Bureau. 2014 – 2018. Census Tracts, California, B19013 Median Household Income (Data). *2018 American Community Survey (ACS) 5-Year Estimates.* Available at https://www.census.gov/data.html.

limits are listed by county and household size. Staff collected census tract average household sizes from the U.S. Census Bureau and rounded to the nearest whole number to cross reference to the HCD's state income limits table.[46] Staff used the average household size of each census tract-county combination to identify which low- and moderate-income limits to use from HCD's table.[47] This process is shown in the first three tables in Figure H.1.

Since the low-, middle-, and high-income community definitions use both the HCD income limits and the statewide MHI, staff identified California's MHI and calculated 80 and 120 percent to meet the full definitions.[48]

The last table in Figure H.1 tests whether the three census tracts in Los Angeles County are low-, middle-, or high-income using the low- and moderate-income limits from the HCD and 80 and 120 percent of the statewide MHI. If the census tract meets either the HCD limit *or* the state MHI limit, indicated by "yes" in the last table and column in Figure H.1, staff identified the census tract as the income level listed in the column header. For example, the MHI for census tract 6037106112 falls in between HCD's low- and moderate-income limit but does not fall in between 80 to 120 percent of the state's MHI. Because it meets one of the requirements for middle-income, the HCD's threshold, and none of the requirements for low-income, staff identified the census tract as middle-income. The MHI for this census tract also meets part of the high-income definition where the MHI is greater than or equal to 120 percent of the state MHI. This makes the census tract appear both middle- and high-income. Because staff used county MHI by household size, per the HCD's income limits, and state median income overlaps sometimes occurred where a census tract could be low- and middle-income, or middle- and high-income. In these cases, staff identified the census tract as first low-, then middle, then high-income, giving more weight to lower income communities. This is done to capture more underrepresented communities while still meeting the income definitions of AB 1550. Identifications of low-, middle-, and high-income communities are found in Figure H.2.

46 U.S. Census Bureau. 2014 – 2018. Census Tracts, California, B25010 Average Household Size of Occupied Housing Units by Tenure (Data). *2018 American Community Survey (ACS) 5-Year Estimates.* Available at https://www.census.gov/data.html.

47 Staff related assigned geographic identifiers (GEIOD) to identify census tract counties.

48 U.S. Census Bureau. 2014 – 2018. Census Tracts, California, B19013 Median Household Income (Data). *2018 American Community Survey (ACS) 5-Year Estimates.* Available at https://www.census.gov/data.html.

Figure H.1: Identifying Low-, Middle-, and High-Income Communities in Los Angeles County

1. Identify census tract MHI, average household size, and county

Census Tract GEOID	Census Tract MHI	Census Tract Average Household Size	County of Census Tract	HCD's Low Income Limit	HCD's Moderate Income Limit
6037101110	$53,007	3	Los Angeles		
6037106112	$90,875	4	Los Angeles		
6037109800	$96,422	4	Los Angeles		

2. Use the average household size of each census tract-county combination to identify which income limits to apply from the HCD state income limits table

Number of Persons in Household		1	2	3	4
Los Angeles County Area median Income: $77,300	Low Income	$63,100	$72,100	$81,100	$90,100
	Moderate Income	$64,900	$74,200	$83,500	$92,750

Census Tract GEOID	Census Tract MHI	Census Tract Average Household Size	County of Census Tract	HCD's Low Income Limit	HCD's Moderate Income Limit
6037101110	$53,007	3	Los Angeles	$81,100	$83,500
6037106112	$90,875	4	Los Angeles	$90,100	$92,750
6037109800	$96,422	4	Los Angeles	$90,100	$92,750

3. Identify and calculate 80 and 120 percent of the statewide MHI

Statewide MHI	80 Percent of Statewide MHI	120 Percent of Statewide MHI
$71,228	$56,982	$85,474

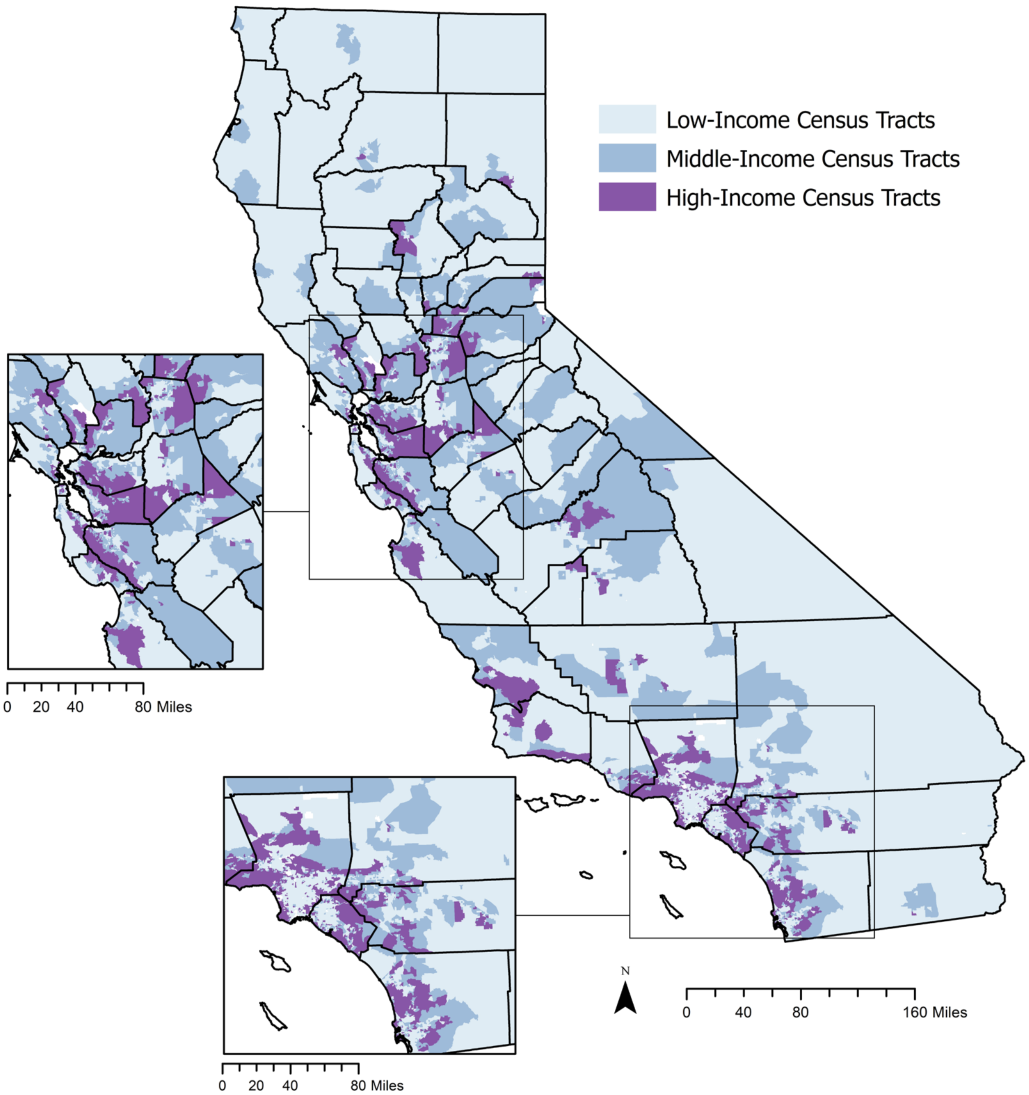
4. Apply limits to identify whether a census tract is a low-, middle-, or high-income

Census Tract GEOID	Low-Income Community?	Middle-Income Community?	High-Income Community?
6037101110	HCD Limit: Yes ($53,077 ≤ $81,100) OR State MHI Limit: Yes ($53,077 ≤ $56,982)	HCD Limits: No ($81,100 < $53,007 < $83,500) OR State MHI Limit: No ($56,982 < $53,007 < $85,474)	HCD Limit: No ($53,007 ≥ $83,500) OR State MHI Limit: No ($53,007 ≥ $85,474)
6037106112	HCD Limit: No ($90,875 ≤ $90,100) OR State MHI Limit: No ($90,875 ≤ $56,982)	HCD Limits: Yes ($90,100 < $90,875 < $92,750) OR State MHI Limit: No ($56,982 < $90,875 < $85,474)	HCD Limit: No ($90,875 ≥$92,750) OR State MHI Limit: Yes* ($90,875 ≥ $85,474)
6037109800	HCD Limit: No ($96,422 ≤ $90,100) OR State MHI Limit: No ($96,422 ≤ $56,982)	HCD Limit: No ($90,100 < $96,422 < $92,750) OR State MHI Limit: No ($56,982 < $96,422 < $85,474)	HCD Limit: Yes ($96,422 ≥ $92,750) OR State MHI Limit: Yes ($96,422 ≥ $92,750)

*In cases where a census tract meets more than one definition, staff gives precedence in the following order: low-, middle-, then high-income

Source: California Energy Commission staff analysis using U.S. Census Bureau 2014-2018 American Community Survey Median Household Income 5-Year Estimates, U.S. Census Bureau 2014 – 2018 American Community Survey Average Household Size 5-Year Estimates, and California Department of Housing and Community Development 2020 State Income Limits

Figure H.2: Low-, Middle-, and High-Income Communities



Source: California Energy Commission Staff Analysis using U.S. Census Bureau 2014 – 2018 American Community Survey Median Household Income 5-Year Estimates and California Department of Housing and Community Development's 2020 State Income Limits