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BRIEFING

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California's continued electric vehicle market development

This briefing provides an update on the growth in electric vehicle sales in California through 2017. It quantifies electric vehicle market growth across California local markets, provides broader U.S. market comparisons, and describes these developments in the context of California's 2025–2030 goals.

INTRODUCTION

California has continued to see much faster uptake of electric vehicles than elsewhere in the United States and most other places around the world. This briefing updates our analysis of the 2016 California market[1] and quantifies several key developments that occurred during 2017. It includes both metropolitan-area and city-level data, providing greater detail about markets where electric vehicle uptake is the highest. The briefing analyzes uptake of battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) only; conventional gasoline-electric hybrids are excluded.

As shown in Table 1, California continues to play an outsized role in growing the electric vehicle market in the United States. The California market—about 96,000 electric vehicle sales in 2017—accounts for half of the U.S. market, as well as nearly half of cumulative electric vehicle sales through 2017. This compares with California representing about 12% of the U.S. population, 14% of the economy, and 12% of national new light-duty vehicle sales. Electric vehicle sales in California from late 2010, when modern electric vehicles emerged, through the end of 2017 totaled 366,000. Growth in annual sales from 2016 to 2017 was approximately 29% in California versus 28% in the

1 Nic Lutsey, *Update: California's electric vehicle market* (ICCT, 2017); www.theicct.org/publications/update-californias-electric-vehicle-market.

Prepared by Nic Lutsey

U.S. market as a whole. Public charging infrastructure—a key consideration for electric vehicle drivers—also expanded by about 22% in California (and in the United States overall) during 2017, and now represents 31% of all U.S. public charging infrastructure, including one-quarter of all public direct-current fast charging.

Table 1. Electric vehicle and general data for California and the United States.

		U.S.	California	California as percent of U.S.
General	Population	326 million	39.5 million	12%
	Gross domestic product	$19.4 trillion	$2.75 trillion	14%
	Light-duty vehicle sales in 2016	16.2 million	2.0 million	12%
Electric vehicles	New 2017 electric vehicles	193,000	96,000	50%
	Cumulative 2010–2017 electric vehicles	749,000	366,000	49%
Electric vehicle public charging	Level 2 charge points	38,100	12,000	32%
	Fast charge points	6,200	1,600	25%
	Total charge points	44,300	13,600	31%

Population data from U.S. Census; income data from U.S. Bureau of Economic Analysis; vehicle registrations from IHS Automotive; public charging data from Alternative Fuels Data Center.

California further stands out upon closer examination of the local markets. The state includes six of the 50 largest U.S. metropolitan areas by population.[2] These six areas—Los Angeles, San Francisco, Riverside, San Diego, Sacramento, and San Jose, in order of decreasing population—ranked among the top eight markets nationally in 2017 in terms of electric vehicle sales share. Whereas electric vehicles accounted for 1% of the national light-duty vehicle market, sales reached 13% in San Jose, 7% in San Francisco, and 5% in Los Angeles, making these three the largest U.S. electric vehicle markets by sales share and by annual sales volume.

Beyond California, other top electric vehicle share markets among large metropolitan areas include Boston, Denver, Portland, and Seattle. The largest single market by sales volume was Los Angeles, where area residents purchased more than 38,000 new electric vehicles in 2017, constituting more than one-fifth of the entire U.S. electric vehicle market. In terms of cumulative electric vehicle sales, the Los Angeles metropolitan area accounted for more than 143,000 sales from 2010 to 2017; during the same period, electric vehicle sales in the San Francisco and San Jose metropolitan areas exceeded 71,000 and 54,000, respectively.

A combination of policies and promotional activities distinguishes the California market from the rest of the nation. The state's Zero Emission Vehicle regulation, consumer rebates, access to carpool lanes on congested highways, extensive electric vehicle charging infrastructure, progressive electric utility policies, greater model availability and marketing, access to high-occupancy vehicle lanes, and continued growth of local electric vehicle promotions have spurred uptake in California.[3] The following sections summarize the underlying market data to show the details and comparative context for California's electric vehicle market growth.

2 U.S. Office of Management and Budget, OMB Bulletin No. 15-01 (2015); https://obamawhitehouse.archives.gov/sites/default/files/omb/bulletins/2015/15-01.pdf.

3 Peter Slowik, Nic Lutsey, *Expanding the electric vehicle market in U.S. cities* (ICCT, 2017); www.theicct.org/publications/expanding-electric-vehicle-market-us-cities.

LEADING CALIFORNIA MARKETS

The California electric vehicle market grew 29% from 2016 to 2017, reaching approximately 96,000 new registrations. This growth was widespread, with the vast majority of California cities seeing growth in electric vehicle sales. Of the 312 California cities with more than 500 total vehicle sales in 2017, 94% saw electric vehicle sales growth, and 79% (247 cities) saw at least a 20% increase in electric vehicle sales. Two ways to identify the fastest-growing electric vehicle markets are by annual electric vehicle sales and by the proportion of total new vehicle sales that are plug-in electric (i.e., BEVs or PHEVs).

When investigating the largest electric vehicle markets by annual sales at the city level, Los Angeles stands out. Figure 1 shows how the City of Los Angeles, California's most populous city, had new electric vehicle sales of nearly 12,000 during 2017—more than twice the number sold in San Jose. San Diego, San Francisco, Irvine, and Fremont followed, with about 2,000 to 3,500 new electric vehicle sales in 2017. Palo Alto, Oakland, Sunnyvale, Santa Clarita, Pleasanton, Laguna Beach, and Long Beach each had about 1,000 to 1,500 in 2017 sales. All the top-30 electric vehicle sales cities in Figure 1 saw increases in electric vehicle registrations in 2017 versus 2016, with 24 of the cities seeing at least a 20% increase.

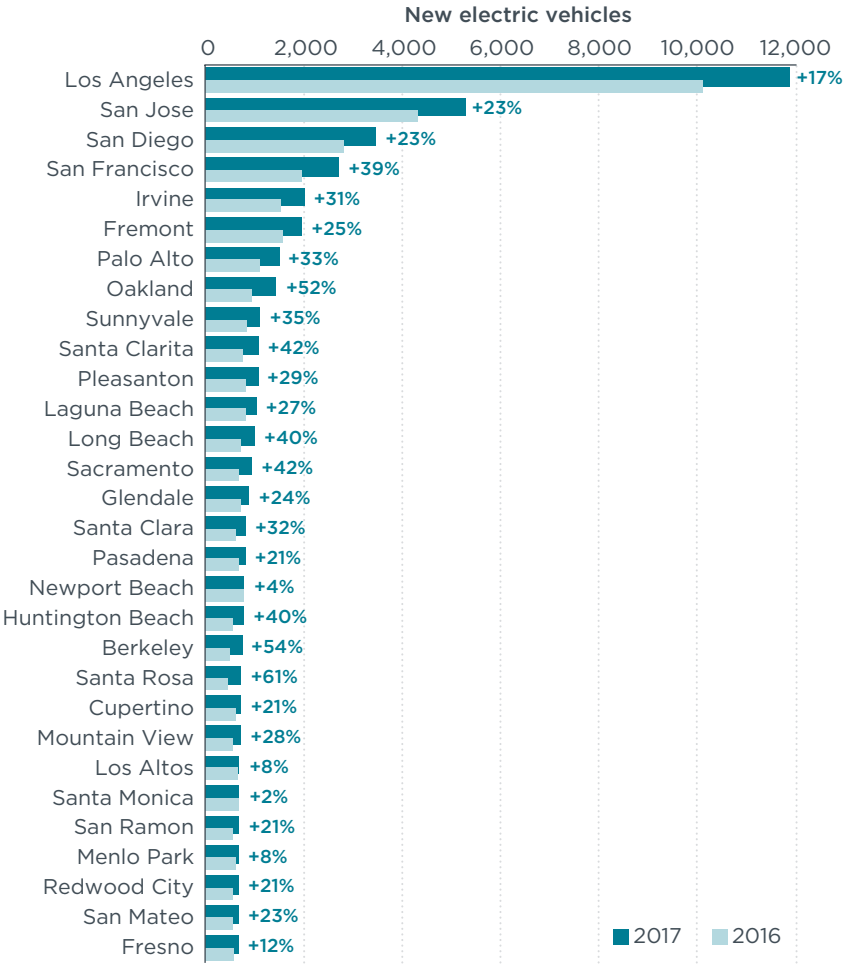

Figure 1. Top 30 cities with the most new electric vehicle sales in 2017, with percent increase from 2016 labeled. *(Vehicle registrations from IHS Automotive)*

The cities had some variation in technology type between BEVs and PHEVs. For 21 of the 30 cities shown in Figure 1, BEVs represented 50 to 70% of electric vehicle sales. Five cities had fewer than 50% BEV sales, with Glendale the lowest at 41%, followed by Sacramento at 45%. Four of the cities had more than 70% BEV sales, including Palo Alto at 82% and Fresno at 73%.

Looking at electric vehicle sales as a proportion of total new vehicle sales, rather than absolute numbers of sales, helps to provide an early indication of which markets are expanding beyond the first pioneering electric vehicle purchasers. Figure 2 analyzes California cities by the share of new vehicles that are plug-in electric vehicles, including a breakdown of BEVs and PHEVs. Among the top 40 California cities by electric vehicle market share in 2017, Palo Alto led with 29%, followed by Saratoga at 24% and Los Altos at 22%. In total, nine cities had electric vehicle market shares of more than 15%, up from six such cities in 2016. Thirty California cities had electric vehicle shares above 10% in 2017, up from 19 such cities in 2016. Beyond those listed in Figure 2, there were 109 California cities with a greater than 5% share of electric vehicles in 2017, up from just 64 in 2016.

The cities with higher electric vehicle shares tended to have a much higher proportion of BEVs. The PHEV share of total vehicle sales was 3% to 7% for 37 of the 40 cities shown in Figure 3, making BEV share a key differentiating element. PHEVs constituted the majority of 2017 electric vehicle sales in only three of the 40 cities. Almost all of the cities with the highest market shares were in the metropolitan areas of San Francisco (18 cities), San Jose (12), and Los Angeles (9). Many of the cities at the top of the list are in the Silicon Valley region.

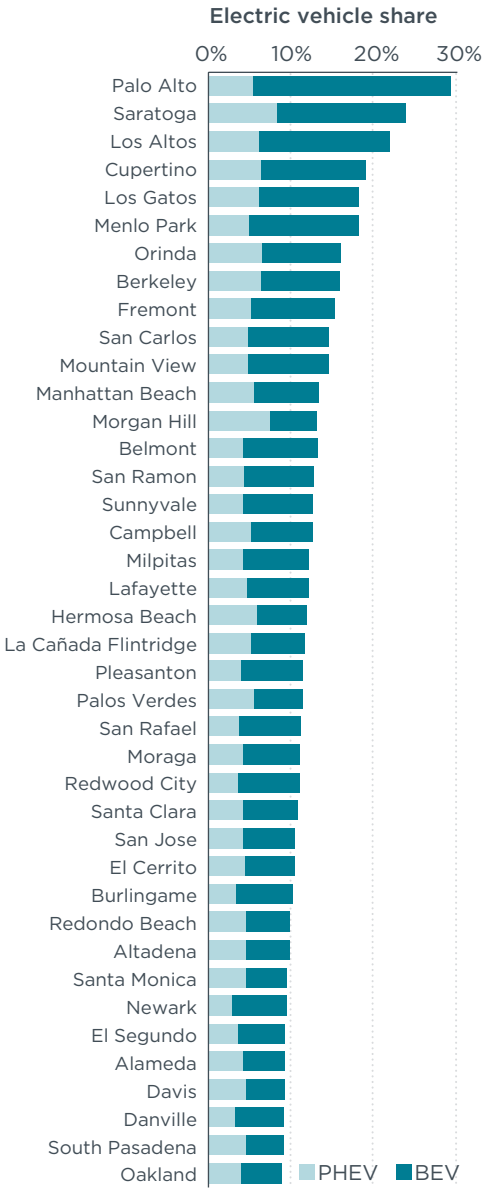

Figure 2. New electric vehicle market share in 2017. *(Vehicle registrations from IHS Automotive)*

ELECTRIC VEHICLE SALES BY AUTOMAKER

To better understand the industry dynamics in the California market, we analyzed which companies had the highest electric vehicle sales and shares, and investigated where in California the electric vehicle market was more concentrated among particular automaker models.

Figure 3 shows both the electric vehicle sales and sales share leaders among automaker groups[4] in California in 2017. The automaker groups with the most electric vehicle sales are General Motors (about 25,000 new vehicles) and Tesla (more than 19,000). These companies are followed by three companies with more than 9,000 sales (Toyota, Ford, BMW) and two companies around 6,000 (Volkswagen, Fiat Chrysler). Overall in the state, about 5% of new vehicles are electric, but, as shown, several automaker groups have greater or lesser shares of their own vehicle sales that are plug-ins. Tesla only sells BEVs. BMW and General Motors have more than double the state average electric vehicle share, with 11% of their California sales being plug-ins. Volvo also has well above the state average share with 9%. Volkswagen and Ford are about at the average, and all others are below the average California electric vehicle share.

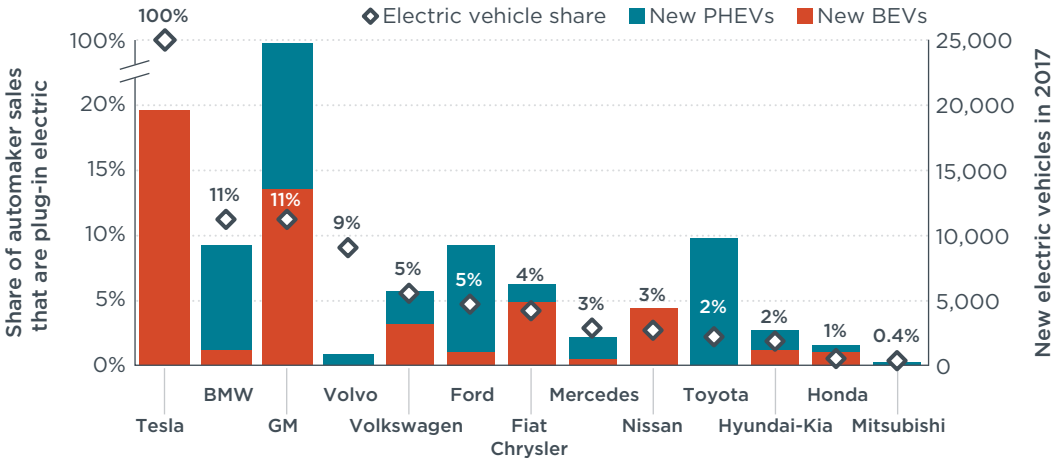

Figure 3. Electric vehicle registrations and shares by automaker group in California in 2017. *(Vehicle registrations from IHS Automotive)*

Also shown in Figure 3 are breakdowns of California electric vehicle sales by technology type for each automaker. Tesla and Nissan sales are exclusively BEVs; Toyota and Volvo sales are all PHEVs. The remaining automaker groups each have some combination of the two technology types. General Motors is approximately split between the categories, with the highest PHEV model sales (the Volt) and the second-highest BEV model sales (the Bolt). Although the data are shown by automaker group, many automaker brands within each group do not offer any electric models. Brands without BEV or PHEV registrations in California in 2017 include Acura, Alfa Romeo, Buick, Dodge, Genesis, GMC, Infiniti, Jaguar, Jeep, Land Rover, Lexus, Lincoln, Maserati, Mazda, Ram, and Subaru.

4 Manufacturer groups are based on vehicle ownership and subsidiary relationships of the companies. For example, BMW includes Mini; General Motors includes Buick, Cadillac, Chevrolet, and GMC. See manufacturers and makes in U.S. Environmental Protection Agency, "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2017" (2018); www.epa.gov/fuel-economy-trends/download-report-co2-and-fuel-economy-trends#Full%20Report.

Considering the relatively limited production of electric vehicles to date, we also wanted to better understand how automakers are deploying their electric vehicles in California relative to the rest of the United States. In Figure 4, we compare each major automaker group's share of its own 2017 vehicle sales in California that were plug-ins (left panel) with its comparable electric vehicle share in the rest of the United States (center panel). As shown, other than Tesla, all automakers have a much higher electric vehicle share in California than elsewhere. The electric vehicle sales proportion for BMW, Volvo, and Nissan in California is about 3 to 5 times each company's electric vehicle sales proportion in the rest of the United States. General Motors, Volkswagen, and Ford each have California electric vehicle shares 11 to 16 times those outside of California. The three companies with the highest California/non-California electric vehicle sales ratios are Honda (18), Fiat Chrysler (26), and Mercedes (61).

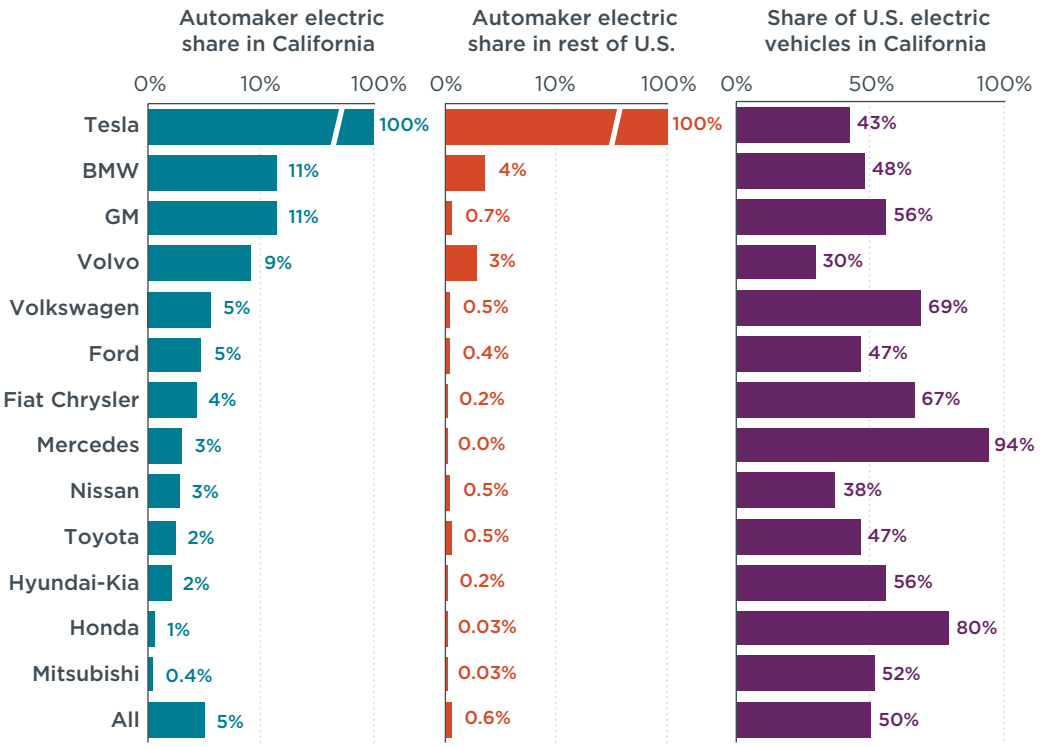

Figure 4. Automaker group electric vehicle share in California and the United States, and share of U.S. electric vehicles deployed in California. (*Vehicle registrations from IHS Automotive*)

The right panel of Figure 4 shows the proportion of each company's U.S. electric vehicles that were sold in California. As already mentioned, half of all U.S. electric vehicle sales in 2017 were in California, but there is wide variation among automakers' concentrations of electric vehicle sales in the state. For example, Volvo at 30%, Nissan at 38%, and Tesla at 43% have deployed and marketed their electric vehicles more broadly across the United States. Other automakers such as Mercedes (84%), Honda (80%), Volkswagen (69%), and Fiat Chrysler (67%) sell a much higher proportion of their electric vehicles in California. These data on comparative electric vehicle uptake in California versus elsewhere indicate how greatly the level of effort to deploy and market electric vehicles across the United States varies by major auto company.

Figure 5 shows a breakdown of electric vehicle sales in selected markets across California, as compared with the overall California breakdown in the top row. These cities were selected specifically because they have the highest shares of electric vehicles sold by one automaker; therefore, they deviate the most from the California state average. The majority of electric vehicle sales in California (88%) were under the eight brands shown in the figure. The subsequent rows of the figure show the breakdown of automaker brands in selected city markets, with labels (percentages) for the leading electric vehicle brand in each to point out where different companies have shown especially high concentrations of electric vehicle sales. As illustrated, Chevrolet made up 26% of the California market overall but accounted for 38 to 40% of the Campbell and Tracy markets. Tesla made up 62% of electric vehicle sales in Palo Alto and 46% in Beverly Hills, as compared to 20% overall in California.

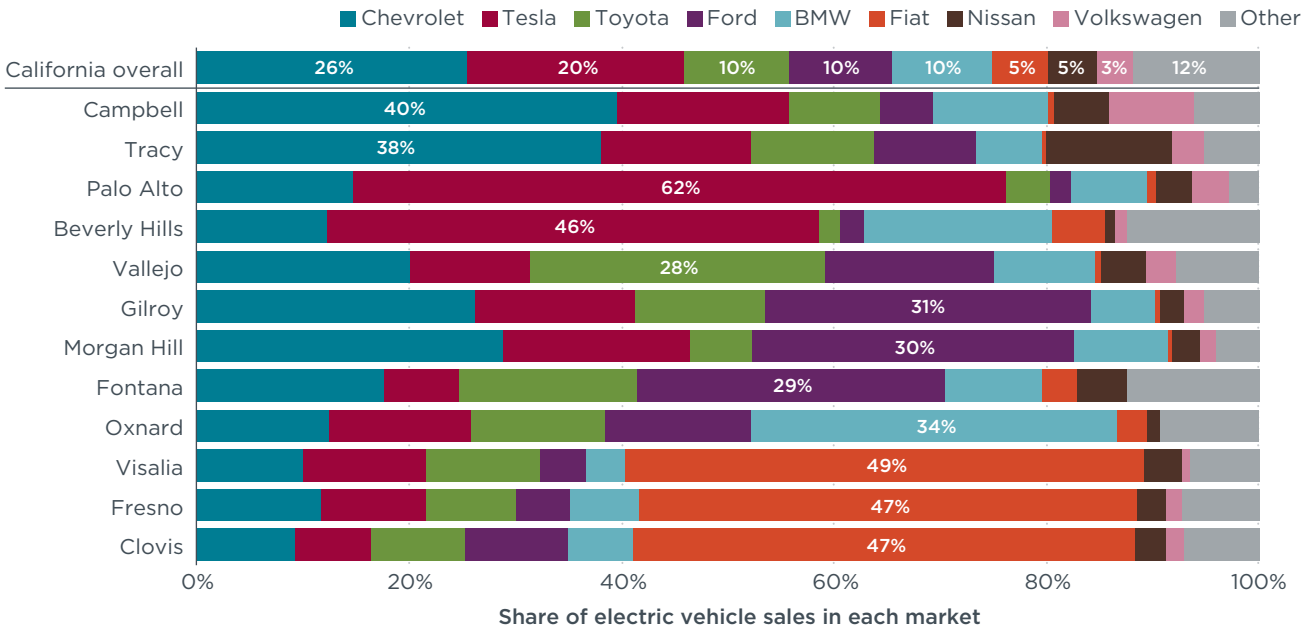

Figure 5. Share of electric vehicles sold in selected California markets by automaker brand. (*Based on vehicle registrations from IHS Automotive*)

Even automaker brands with just 10% of the overall California electric vehicle market led in particular markets in several cities. Toyota, with 28% of electric vehicle sales in Vallejo, had the largest share there. Ford led in Gilroy, Morgan Hill, and Fontana with approximately 30% of electric vehicle sales. BMW led in Oxnard with more than one-third of that market's electric vehicle sales. What perhaps stands out most in Figure 5 is how the electric vehicle markets of Visalia, Fresno, and Clovis are nearly half Fiat (i.e., the Fiat 500e BEV). Although not shown in Figure 5, the largest electric vehicle sales markets (e.g., Los Angeles, San Jose, San Diego, San Francisco, Oakland) tended to have shares by brand that were closer to the California state average, as these markets are much larger and tend to have more dealers and advertising across the various automakers.

CHARGING INFRASTRUCTURE

Figure 6 compares electric vehicle charging infrastructure in California metropolitan areas and elsewhere in the United States. Our previous related analysis of U.S. and international markets showed a clear link between public charging infrastructure and electric vehicle uptake at the metropolitan-area level.[5,6] Here, as elsewhere, charging infrastructure is analyzed at the metropolitan-area level because typical travel patterns extend beyond city boundaries. The horizontal axis in the figure shows the number of public Level 2 and direct current fast charge points per million residents;[7] the vertical axis shows the percentage of new electric vehicle sales in 2017. The size of each circle represents the number of new 2017 registrations by metropolitan area. The 15 labeled metropolitan areas are those with the highest electric vehicle sales in California, representing 98% of the state's electric vehicle market. At the end of 2017, there were about 344 public charge points per million residents across California with an electric vehicle market share of 5%—close to the Los Angeles data point. For the rest of the United States, there were 107 charge points per million people with an electric vehicle share of 0.7%.

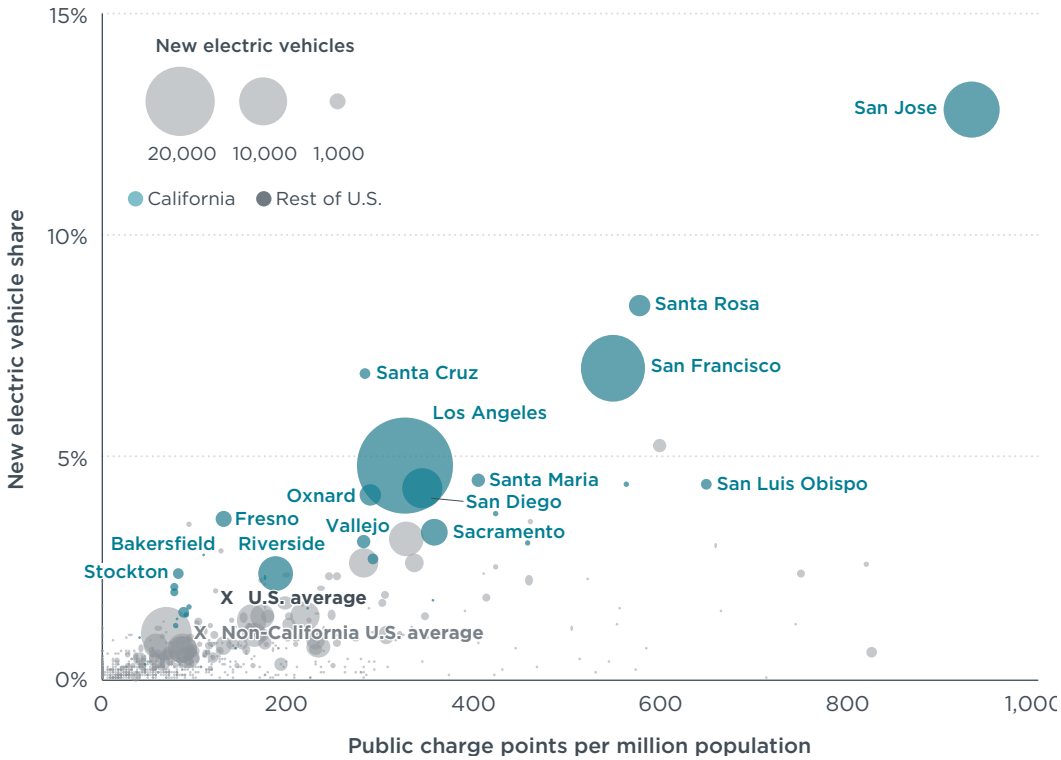

Figure 6. Electric vehicle market share and public charging infrastructure per capita for California and other U.S. metropolitan areas. *(Vehicle registrations from IHS Automotive; charging data from Alternative Fuels Data Center)*

5 Dale Hall, Nic Lutsey, *Emerging electric vehicle charging infrastructure best practices* (ICCT, 2017); www.theicct.org/publications/emerging-best-practices-electric-vehicle-charging-infrastructure.

6 Peter Slowik, Nic Lutsey, *Expanding the electric vehicle market in U.S. cities* (ICCT, 2017); www.theicct.org/publications/expanding-electric-vehicle-market-us-cities.

7 U.S. Department of Energy Alternative Fuels Data Center, "Alternative Fuel Station Locator"; www.afdc.energy.gov/locator/stations/.

As illustrated in the figure, metropolitan areas with the most extensive public charging networks tend to have the highest electric vehicle market share. This point can be seen through the three largest electric vehicle markets in California. San Jose, with a 13% electric vehicle share, has about 6 times the U.S. average number of public charging stations per capita; San Francisco, with a 7% share, has about 4 times the U.S. average; and Los Angeles, with a 5% share, has more than twice the U.S. average. The Northern California markets of San Jose, San Francisco, and Santa Rosa have more extensive public charging networks than Southern California or the Central Valley markets such as Bakersfield, Stockton, and Fresno.

CONSUMER INCENTIVES

Most electric vehicle buyers in California and elsewhere in the United States are eligible for federal tax credits of $2,500 to $7,500. The exact value of the federal tax credits depends on the capacity of the electric vehicle battery pack. California's government, like those of many other states, also offers rebates to further encourage electric vehicle sales. These incentives for electric vehicles lower the costs to be closer to those of conventional vehicles while technology costs fall.[8] For households with low and moderate incomes, California's rebates are typically $2,500 for BEVs and $1,500 for PHEVs. High-income buyers are not eligible; incentives are increased by $2,000 for those with lower incomes.

Figure 7 shows the percentage of electric vehicle purchases for which the state paid rebates by quarter in 2015 through 2017, based on IHS Automotive and Center for Sustainable Energy data on the Clean Vehicle Rebate Program.[9] As shown, rebate activity has fallen substantially since 2015. The rebate program was suspended for parts of the second and third quarters of 2016 and was then restored with more eligibility restrictions, specifically an income cap that made high-income consumers ineligible.[10] Considering how the California electric vehicle sales share rose by about 18% from 2015 to 2016, and then by 32% from 2016 to 2017 while rebate use dropped, it appears that the restrictions on rebate use for high-income buyers have had only a small impact on growth of electric vehicle sales.

8 Peter Slowik, Nic Lutsey, *Evolution of incentives to sustain the transition to a global electric vehicle fleet* (ICCT, 2016); www.theicct.org/publications/evolution-incentives-sustain-transition-global-electric-vehicle-fleet.

9 California Air Resources Board Clean Vehicle Rebate Project, "Rebate Statistics," Center for Sustainable Energy; https://cleanvehiclerebate.org/eng/rebate-statistics.

10 California Air Resources Board Clean Vehicle Rebate Project, "Eligibility Guidelines"; https://cleanvehiclerebate.org/eng/eligibility-guidelines.

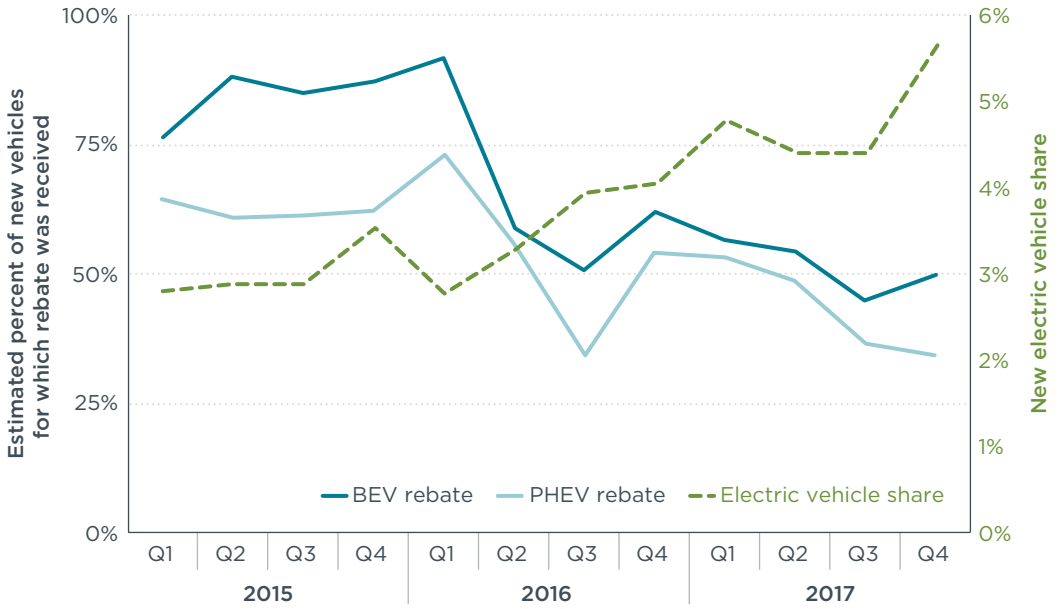

Figure 7. Estimated 2015–2017 use of California rebates for BEVs and PHEVs by quarter.
(Vehicle registrations from IHS Automotive; rebate data from Center for Sustainable Energy)

Figure 8 shows new electric vehicle registrations and average use of California rebates by automaker brand for 2017. The automaker brands across the horizontal axis are sorted by whether they are luxury brands (to the left) or nonluxury brands (to the right) and then according to sales. The use of rebates varied greatly according to automaker brands, and also (to a lesser degree) according to electric vehicle type. Overall, luxury-brand electric vehicle consumers received rebates 27% of the time, versus 59% of the time for nonluxury brands. By technology type, rebate use was about 54% for BEVs versus 40% for PHEVs. Sales of Fiat electric vehicles (all Fiat 500e BEVs) were associated with rebates 92% of the time, whereas sales of Porsche electric vehicles (all PHEVs) never involved rebates.

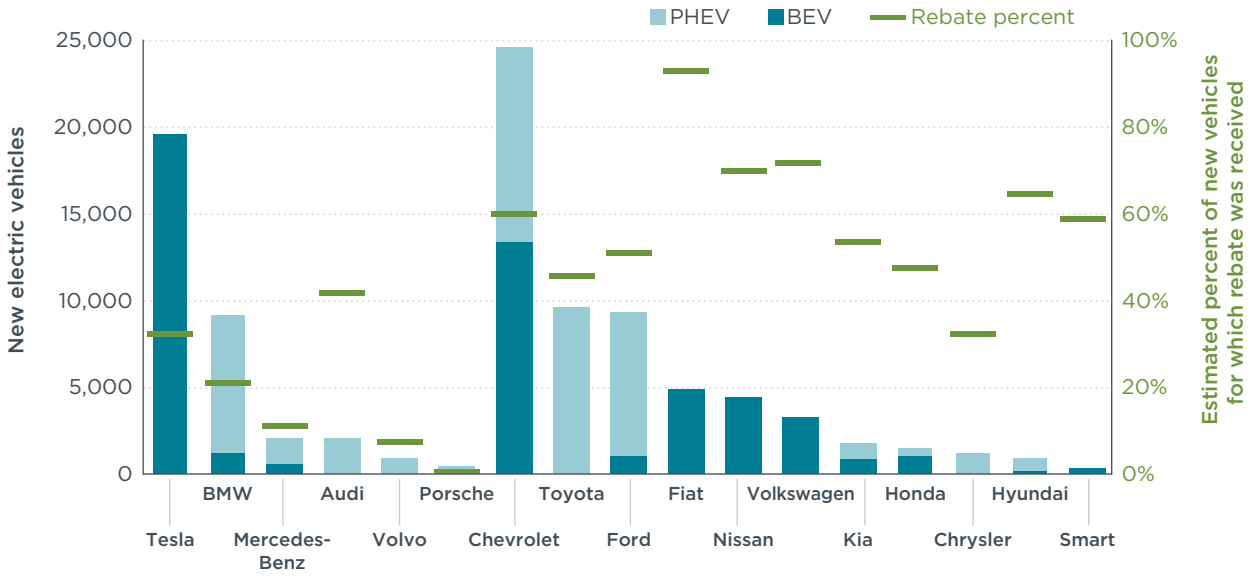

Figure 8. Estimated 2017 use of California electric vehicle rebates by automaker brand.
(Vehicle registrations from IHS Automotive; rebate data from Center for Sustainable Energy)

Also, because of the availability of higher-value rebates for lower-income consumers, the amount of the incentives by automaker varied somewhat. Overall, the average rebate for BEVs was about $2,675 (compared to the maximum of $2,500 for middle incomes), and $1,700 for PHEVs (compared to the maximum of $1,500 for middle incomes). Across the automakers with high electric vehicle sales, Fiat had especially high rebate levels, with an average of $2,900 per BEV rebate. Putting this together with the result in Figure 8, it is clear that the Fiat 500e is more successfully marketed toward lower-income consumers to take advantage of the higher-value rebate. A closer examination of the rebate data by location shows that the Fiat 500e averaged more than $3,000 per BEV rebate, with relatively high sales in Fresno, Los Angeles, and Riverside counties. This suggests that there might be much greater potential across automakers to market the rebate program, including to lower-income car shoppers.

ELECTRIC VEHICLES AND INCOME

To provide further context to the markets in California where electric vehicles are being purchased, Figure 9 shows new electric vehicle shares and the average household income of each city. The income data reflect 5-year city median household income averages for each city from the U.S. Census.[11] As shown, the cities where electric vehicles account for 15% or more of the market tend to be the wealthiest. Many of the cities with the highest electric vehicle market shares, such as Palo Alto, Los Altos, and Saratoga in Silicon Valley, are among the wealthiest in the state. The city with the highest electric vehicle sales, however, was Los Angeles, where the median household income was about $51,000, below the statewide median of $64,000. Data linking specific electric vehicle sales to the household income of individual electric vehicle purchasers were not available. For context, new car buyers across the United States are relatively wealthy relative to the population at large: The median household incomes of 2017 buyers of new compact cars, midsize cars, and crossovers were $74,000, $87,000, and $90,000, respectively.[12]

11 U.S. Census Bureau, "2012–2016 American Community Survey (5-year estimates). Income, Poverty, and Employment Status" (2018); www.dof.ca.gov/Reports/Demographic_Reports/American_Community_Survey/index.html#ACS2016x5.

12 Christian Wardlaw, "PowerSteering: 2017 Honda Civic Review," J.D. Power, September 27, 2017. www.jdpower.com/cars/articles/new-car-reviews/powersteering-2017-honda-civic-review; Christian Wardlaw, "PowerSteering: 2017 Honda Accord Review," J.D. Power, October 10, 2016. www.jdpower.com/cars/articles/new-car-reviews/powersteering-2017-honda-accord-review; and Liz Kim, "PowerSteering: 2017 Honda CR-V Review," J.D. Power, March 6, 2017. www.jdpower.com/cars/articles/new-car-reviews/powersteering-2017-honda-cr-v-review.

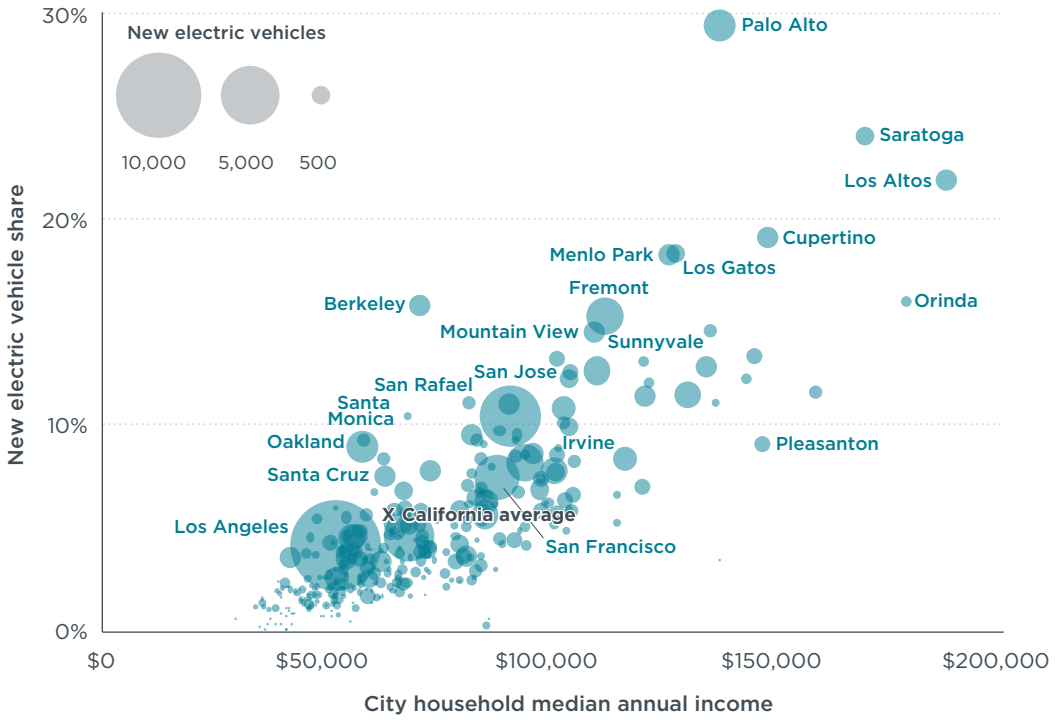

Figure 9. Share of California new vehicle sales that are electric by city median household income. *(Vehicle registrations from IHS Automotive; income data from U.S. Census)*

The underlying data in Figure 9 indicate that the most concentrated electric vehicle markets are affluent cities, and fewer electric vehicles are being sold in cities that are below California's state median income. This indirectly indicates that many electric vehicles are, to some degree, being sold in more socioeconomically diverse cities. However, the data also reflect the challenge the state faces. The cities with below-average median incomes represent 51% of the population and just 33% of electric vehicles. This supports the increasing interest by the state of California to better ensure that its policies are more broadly deployed and experienced across the state. Equity-focused policies have been adopted, including incentive restrictions for high-income buyers, increased rebate levels for low-income buyers, linking of higher electric vehicle rebates to vehicle scrappage, placement of electric vehicles in car-sharing and ride-hailing fleets to broaden access, and deployment of charging infrastructure in disadvantaged communities. These policies are only in their early stages, and they seem key to expanding the market, especially as low-cost electric vehicle models enter the fleet.

THE ZEV REGULATION

It is important to acknowledge the role of California's special policy driver, the Zero Emission Vehicle (ZEV) regulation. The ZEV regulation, first instituted in 1990, requires that an increasing share of electric vehicles be sold annually through 2025. The last major modifications to the rules were adopted in 2012, and the standards become incrementally more stringent through model year 2025.

The ZEV standards have been adopted by nine other states, Oregon plus eight across the Northeast. Including California, the standards now apply to 29% of the U.S. auto market. The ZEV regulation in 2017 differed functionally across the ZEV states. For

example, automakers have been able to focus early electric vehicle deployment in California and delay efforts in other ZEV states. This flexibility ends in 2018, when manufacturers will henceforth be required to offer increasing numbers of electric vehicles in ZEV states outside of California.

Figure 10 shows the growth since 2010 in new electric vehicle sales in California, the other ZEV-adopting states, and the rest of the United States. Electric vehicle sales in California grew by 20% in 2016, followed by 29% growth in 2017. Electric vehicle sales in the other ZEV states grew even faster, by 62% in 2016 and 46% in 2017, as the availability of new electric vehicle models increased. Late 2016 model launches included the Chevrolet Bolt and Chrysler Pacifica. New electric model launches in 2017 included the BMW 530e, Tesla Model 3, second-generation Nissan Leaf, Honda Clarity, Volvo XC60, Hyundai Ioniq, Mini Countryman, and Mitsubishi Outlander. The California and ZEV states together accounted for two-thirds of 2017 U.S. electric vehicle sales.

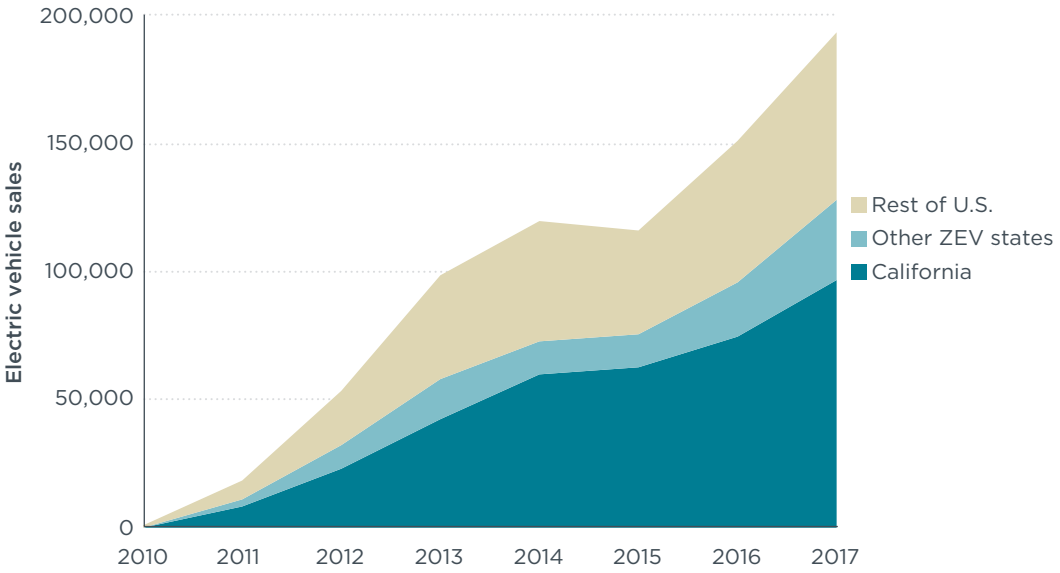

Figure 10. Electric vehicle sales in California, other ZEV states, and the rest of the United States. *(Based on vehicle registrations from IHS Automotive)*

BROADER POLICY GOALS

Along with the ZEV regulation that is set to increase electric vehicle sales through 2025, California also has a more ambitious state goal that would go much further by 2030. In February 2018, Governor Brown announced California's goal to reach 5 million cumulative zero-emission vehicles on California roads by 2030 as part of an Executive Order to deploy much more infrastructure to accelerate the technology.[13] Under the ZEV regulation and the subsequent state goal, electric vehicle deployment would increase dramatically from 2018 through 2030. Over the longer

13 "Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments," Office of Governor Edmund G. Brown, January 26, 2018; www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

term, California has committed to steer its entire new vehicle fleet to zero emissions by no later than 2050.[14]

Figure 11 shows the 2017 California market developments in context with California's 2025–2030 goals. The impact of the California ZEV program is shown, with electric-drive vehicles increasing to 8% of new vehicle sales by 2025.[15] In order to minimally comply with the standards, industry would need to increase shares in electric vehicle sales by a compounded 6% per year over eight model years between 2017 and 2025, which is a much slower growth rate than previous years. The electric vehicle shares through 2017 in the leading metropolitan areas of San Francisco (up to 7%) and San Jose (up to 13%) are shown for context. The figure also shows two scenarios that achieve the goal of 5 million total electric vehicles on California roads by 2030. The scenarios are illustrative cases, simply based on electric vehicle growth rates, including basic assumptions for California's overall vehicle market.[16] One scenario has a constant annual growth rate (in green) that reaches 15% electric vehicles in 2025, and then up to a 36% share in 2030. The second scenario (in purple) results in a 13% electric vehicle share in 2025 before increasing to 50% in 2030, based on the growth rate increasing over time.

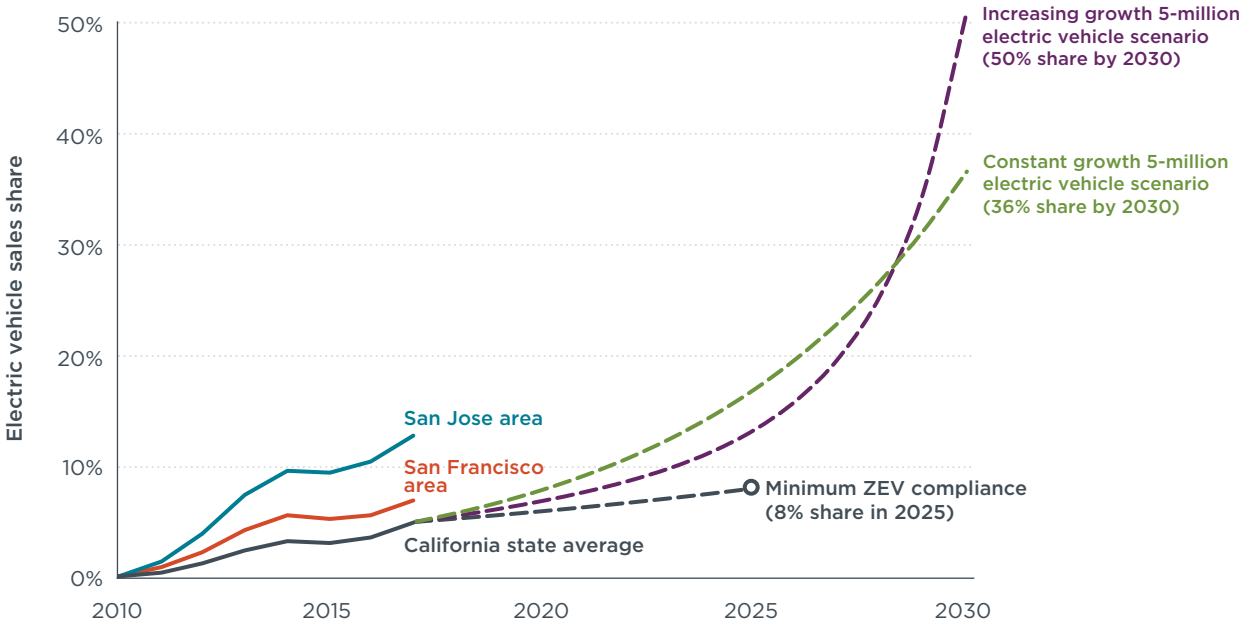

Figure 11. Electric vehicle sales share in California through 2017, minimum compliance for 2025 ZEV regulation, and two scenarios leading to 5 million electric vehicles in California by 2030.

The two scenarios in Figure 11 illustrate how fast electric vehicle shares would need to increase to meet the goal of 5 million electric vehicles in California. The constant-growth (19% per year) scenario is more incremental, as compared with the scenario

14 "International ZEV Alliance Announcement," International Zero Emission Vehicle Alliance, December 3, 2015; www.zevalliance.org/international-zev-alliance-announcement/.

15 This includes BEV, PHEV, and hydrogen fuel cell vehicles. See California Air Resources Board, "California's Advanced Clean Cars Midterm Review: Summary Report for the Technical Analysis of the Light Duty Vehicle Standards" (January 18, 2017); www.arb.ca.gov/msprog/acc/mtr/acc_mtr_summaryreport.pdf.

16 These scenarios include 2% per year growth in overall light-duty vehicle sales (up from 2 million in 2017) and assume that new vehicles after 4 years are retired from the fleet at 5% per year (median vehicle life 16–17 years).

of increasing annual growth (increasing from 14% in 2018 to 62% in 2025), reflecting a later breakthrough to a mainstream electric vehicle market that occurs after 2025.

CONCLUDING THOUGHTS

California's electric vehicle market in 2017 shows continued growth. Here are several high-level concluding thoughts.

California remains home to several of the world's electric vehicle capitals. The San Jose, San Francisco, and Los Angeles metropolitan area markets have some of the highest electric vehicle sales and market shares in the world. These three markets together, through 2017, already had more than a quarter-million electric vehicles on their roads. Along with other world electric vehicle capitals in Europe and China, California's leading markets are implementing comprehensive policies to overcome barriers and spur the market.[17] Within the three leading California metropolitan areas, 30 cities had electric vehicle shares of more than 10%; nine, more than 15%; and three, more than 20%.

Uneven progress reveals great potential for more marketing, increased local action, and incentives to grow the electric vehicle market. The ZEV regulation and rebates expand the market, yet there is great variation in electric vehicle shares across major auto markets. Whereas many cities in the San Francisco Bay area have sales shares above 10%, other major cities such as Bakersfield, Riverside, and Sacramento have electric vehicle shares that are approximately half the state average. Lagging cities could implement more leading-city actions; examples include electric vehicle–ready building codes, expanded public parking for electric vehicles, more extensive charging infrastructure, and greater electric deployment in ride-hailing and car-sharing applications.[18] Broader automaker marketing, public education campaigns, and promotion of existing incentives appear to be needed to expand electric vehicle success across the state. Continued use of the consumer incentives, targeting lower-cost electric vehicles for the mainstream market, will also remain important.

Several industry leaders are greatly outperforming policy goals. The auto industry has over-complied with the ZEV regulation requirements, with several times more ZEV credits than required through 2016.[19] Leading companies such as BMW, General Motors, and Volvo have already transitioned their fleets to greater electric vehicle shares (9 to 11%) than what is required for the fleet to meet California's 2025 regulation (8%). This suggests that many auto companies could greatly surpass the minimum 2025 requirements. This also suggests the California regulators in 2012 greatly underestimated the potential for the growth in electric vehicle sales that California has experienced through 2017. However, many companies have much lower electric vehicle shares in California, and most of the companies have not yet begun to make similar electric vehicle deployment efforts outside of California.

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17 Dale Hall, Hongyang Cui, Nic Lutsey, *Electric vehicle capitals of the world: What markets are leading the transition to electric?* (ICCT, 2017); www.theicct.org/publications/EV-capitals-of-the-world-2017.

18 Peter Slowik, Nic Lutsey, *Expanding the electric vehicle market in U.S. cities* (ICCT, 2017); www.theicct.org/publications/expanding-electric-vehicle-market-us-cities.

19 California Air Resources Board, "California's Advanced Clean Cars Midterm Review" (March 24, 2017). www.arb.ca.gov/board/books/2017/032317/17-3-8pres.pdf.

More aggressive policy will be needed to achieve California's long-term goals. California has set ambitious goals for 5 million electric vehicles by 2030 and all zero-emission vehicle sales by no later than 2050 to meet its air quality and climate objectives. This will require sales of electric vehicles to rise substantially over the next decade, perhaps to half of all new vehicle sales by 2030. Although many automakers are announcing how the industry's future is electric, most automakers are nowhere near a path toward all zero-emission vehicles. California's goals mean that there will have to be a mainstream electric vehicle market across California communities, with electric vehicles becoming cost-competitive with conventional vehicles. The clearest way to ensure this outcome is with stronger regulations requiring that a much greater share of new vehicles have zero emissions by 2030. Electric vehicle costs appear to be rapidly dropping in time to make these goals feasible. Sustained purchasing incentives, consumer awareness, campaigns, and infrastructure deployment appear to be headed in the right direction. It will be important to sustain and adapt these policies as the market continues to develop through the long-term transition to an electric vehicle fleet.