

# ZEV Regional Readiness & Planning

EDUCATION, TRAINING,  
and OUTREACH



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## Education, Training, and Outreach

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The Sacramento region lags other California cities in adopting and using zero-emission vehicles. A 2017 study by the International Council on Clean Technology (ICCT) areas with promotional activities that combined city and regional governments, utilities, businesses, nonprofit advocacy groups, and media had higher EV use.<sup>1</sup>

The goals of this task in the CEC-funded ZEV Readiness project<sup>2</sup> were to identify regional messaging about zero emission vehicles (ZEVs) and to develop a plan for providing education and training that will encourage business and fleet ZEV adoption through the following activities:

- Project ZEV deployment over a 10-year period and needed investment, including transit and freight vehicles
- Identify current and forecasted regional driving patterns
- Identify existing and planned hydrogen stations and DC fast chargers, existing and planned Level 2 public charging, conventional fuel stations that fleets use, and existing gasoline demand patterns
- Identify environmental data based on SMAQMD's air pollution index, Environmental Justice Plan and CalEnviroScreen scores.
- Assess municipal and public properties as future infrastructure locations
- Assess fleet fueling models, including fleet credit cards and third-party operators, to determine opportunities to leverage fleet and public fueling/charging

This project's focus was on infrastructure to support high-mileage drivers, defined as people who drive at least 50 miles or 90 minutes one way to commute to work or drive at least 100 miles during work. When the project started, the region had one hydrogen station in West Sacramento and one DC Fast Charger (DCFC). SMUD planned to build a network of DC fast chargers every three miles along Highway 80 in the SMUD territory.

At the writing of this paper, the Sacramento region had three hydrogen stations open<sup>3</sup> and one more planned to open in mid-2019. SMUD suspended its DCFC network plans and a combination of programs, including from Electrify America, began deploying a network instead. In addition, the Air Resources Board passed two new regulations that require trucks and transit buses to begin the transition to zero emission vehicles.

The activities and findings in this task evolved to include the activities that are underway and meet outreach, training, and education needs of a slightly more-mature technology rollout.

## Organizations Vital to ZEV Success in the Sacramento Region

### **Sacramento PEV Collaborative**

The Sacramento PEV Collaborative is a collaboration of public agencies, non-profits, academia, and business that works together to promote and support the growing demand for electric charging infrastructure. Meeting monthly, the PEV Collaborative is a clearinghouse for information and a central

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<sup>1</sup> [https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices\\_ICCT-white-paper\\_04102017\\_vF.pdf](https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf)

<sup>2</sup> CEC-ARV-16-023

<sup>3</sup> This project included Truckee in the Sacramento region

point for organizing messaging and activities. The PEV Collaborative served as a technical advisory group for this project’s assumptions and recommendations, and this project included fuel cell electric vehicles (FCEVs) into discussions.

### Air Districts

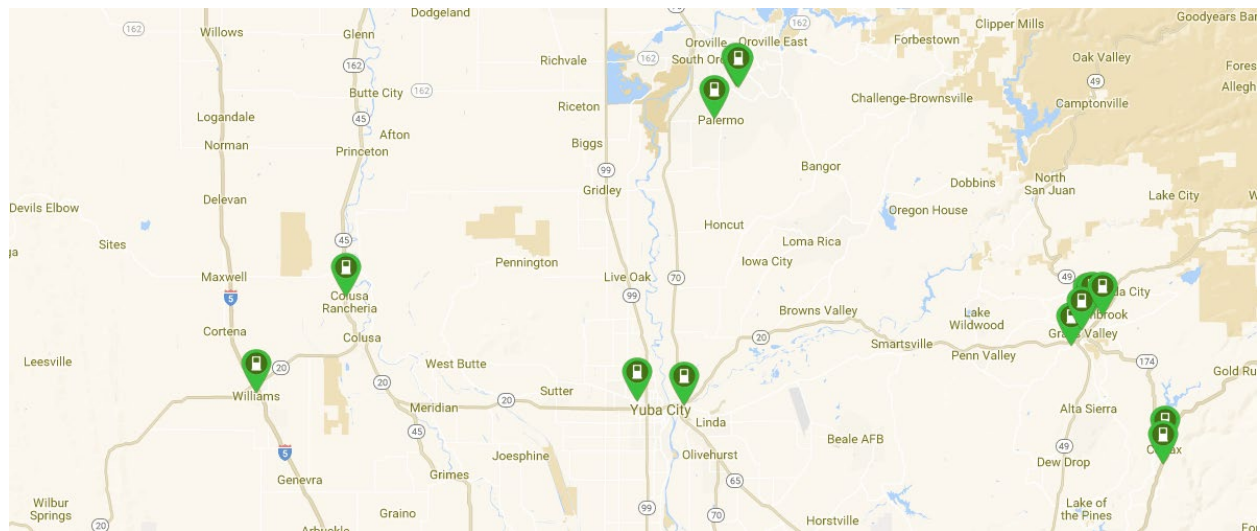
The project team individually contacted the neighboring air districts: Feather River AQMD, Placer County APCI, El Dorado County AQMD, and Yolo/Solano AQMD. The neighboring air districts have fewer resources (people and funding) to devote to ZEV planning than SMAQMD and, therefore, coordination is more important. Sacramento Metro AQMD hosted three quarterly meetings for the air districts and the group continues to coordinate in conjunction with regularly scheduled regional meetings.

A key take-away from the regional meetings was realization that the AQMDs and local governments they serve had different experiences and knowledge of ZEV implementation. Feather River AQMD, which represents the northern-most region in this study, reported that they had zero applicants for a grant for Level 2 charging. Placer County APCD stated that the only applicant was the City of Placerville. Yolo/Solano only offers funding in conjunction with school buses and found that many school yards don’t have enough space for charging.

None of the air districts were aware that the funding they receive from CARB could be used for hydrogen stations. For example, Carl Moyer funding could be used as cost share for a hydrogen station under the California Energy Commission’s grant program instead of rebates for EV stations.

Another key point was that the cities with little access to public charging and no hydrogen stations, as shown in Figure 1, were not optimal locations for outreach events with ZEVs. Additionally, transit agencies in these areas expressed little interest in electrification.<sup>4</sup>

Figure 1: Project areas with limited charging infrastructure



### Transit Agencies

The project team contacted the transit agencies individually, including Yolo County Transportation District (Yolobus), Sutter/Yuba Transit, Unitrans (UC Davis), El Dorado Transit, Placer Transit, e-Tran (Elk Grove), and Roseville Transit to understand their plans to transition to ZEV buses and provide

<sup>4</sup> Before Innovative Clean Transit regulation was passed

information where needed.<sup>5</sup> Most agencies responded to interview requests and expressed some knowledge about BYD and Proterra battery buses but had limited or no knowledge about fuel cell buses.

Area transit agencies frequently meet at the SACOG Transit Coordinating Council (TCC), and the project team participated in the meetings. Initially, the intent was to provide resources about the Zero Emission Bus Resource Alliance (ZEBRA), a transit-agencies-only zero emission bus (ZEB) working group.<sup>6</sup> Few transit agencies have experience with ZEBs and have many questions about maintenance, reliability, and infrastructure needs. Through ZEBRA, transit agencies that include AC Transit and SunLine Transit share their experiences with battery and fuel cell buses and mentor to new agencies.

The purpose of the SACOG TCC shifted as CARB introduced the Innovative Clean Transit Regulation, which requires all transit agencies to purchase ZEBs by 2030. Larger agencies, which includes SacRT and Paratransit, need to submit transition plans by 2020 and smaller agencies by 2023. Smaller agencies have limited ability to track and participate in regulatory affairs and appreciated the opportunity to submit comments before rulemaking started.

### **Utilities**

SMUD and PG&E are the largest electricity providers in the SACOG region. Figure 2 shows the region that each covers and the regions that are covered by Roseville Electric, Liberty Utilities, and Truckee Donner Public Utility District. During this project, Valley Clean Energy<sup>7</sup> was forming as a community choice energy program in Yolo County and was not part of the outreach effort.

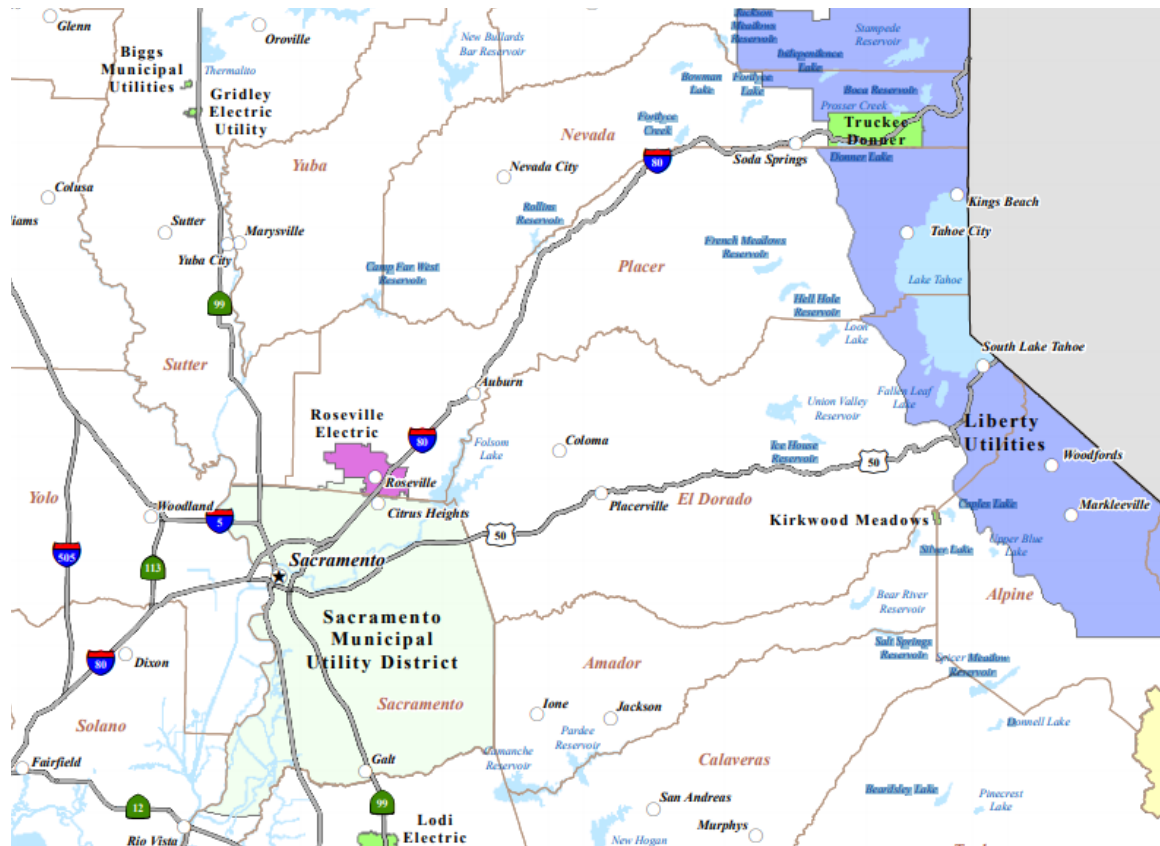
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<sup>5</sup> Other area transit agencies, including Paratransit, Amtrak, and Greyhound were contacted but didn't respond.

<sup>6</sup> <http://www.cte.tv/project/zebra/>

<sup>7</sup> <https://valleycleanenergy.org/>

Figure 2: Regional electricity providers



SMUD, a municipal utility, and PG&E, an investor-owned utility (IOU), are actively involved in funding charging infrastructure for light-duty vehicles, education and outreach, incentives and rebates, and making EVs accessible for disadvantaged communities. Both utilities conducted R&D for hydrogen and operated demonstration stations in the past decade.

Roseville Electric, a municipal, and Liberty Utilities, an IOU,<sup>8</sup> are smaller companies with limited resources. Both participate in the Northern California Power Authorities (NCPA) EV working group in which smaller utilities work together to conduct limited research and understand the impact of EV charging on the grid and other utility infrastructure.

During a meeting with all the utilities, each expressed the same needs:

- Access to data about existing EVs—utilities would like to know the addresses of people who are already charging at home. Although homeowners are required to obtain a permit for Level 2 charging, many do not. The result can be that the demand for electricity on a block outstrips the utility’s supply.
- More notice about public or commercial charging, particularly at businesses that are installing multiple chargers. Utilities requested that they sign off on applications before the building departments accepts a permit application to avoid back-and-forth between the city and the utility to properly site an EVSE.

<sup>8</sup> [https://www.energy.ca.gov/almanac/electricity\\_data/utilities.html](https://www.energy.ca.gov/almanac/electricity_data/utilities.html)

- More engagement by transit agencies and heavy-duty vehicle operators before they acquire battery-powered vehicles. The smaller utilities expressed concern that they will not be able to provide power to battery buses without causing “grid issues.”

The utilities also expressed that they will like to have a regional meeting hosted by CalETC or the Governor’s Office of Planning and Research that also included entities that plan regional ZEV deployments; charger networks, hydrogen stations, and vehicle fleets.

### **Station developers**

DC fast charging (DCFC) and hydrogen stations are in difficult financial positions—high capital and O&M costs and low utilization because not enough vehicles are on the road. More ZEVs using fuel will reduce costs, but customers won’t buy cars and trucks unless they can fill or charge the vehicles. The early network for DCFC and hydrogen serves light-duty cars in metropolitan areas.

Figure 3 is a screenshot from PlugShare<sup>9</sup> that shows the DCFCs in the Sacramento region in April 2019. Grey icons mean the DCFC is unavailable and a small wrench in the icon shows a station under construction or down for maintenance. PlugShare is a crowdsourced map and is not always accurate. DCFCs can charge a battery to 80% capacity in 30-to-40 minutes. In theory, one DCFC can fill 36 cars a day.

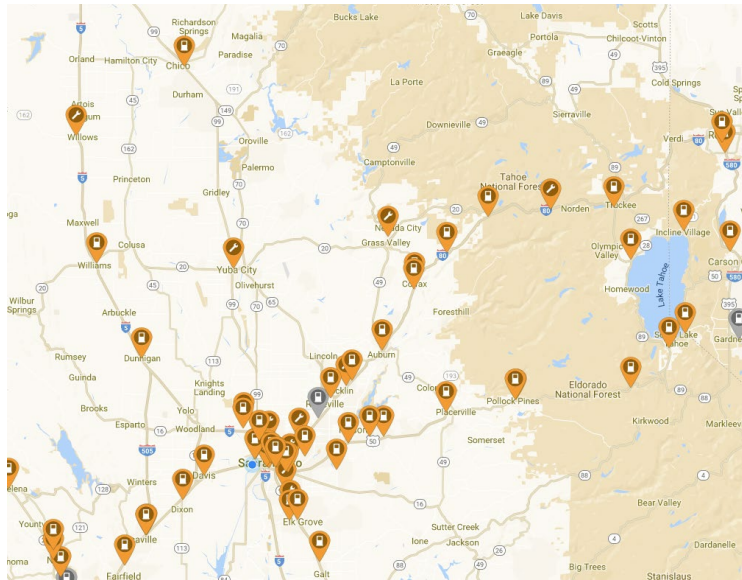
Heavy-duty vehicles, like trucks and buses, use different EVSE than cars. During the project period, no heavy-duty vehicles were deployed although Sacramento RT and Yolobus were planning for electric buses to run between UC Davis in Davis and the UC David Medical Center in Sacramento with charging at each end of the route as well as overnight charging at the bus depots.

EVgo, ChargePoint, Greenlots, and Electrify America reported that they do not engage with SACOG or the air districts when planning locations. Each company has its own mythology for finding locations, and stated that the biggest hurdle is paperwork, including the time to get a permit and coordinating with the utility for an initial location assessment. Companies reported that they prefer to work in SMUD and PG&E territories because the utilities have a standardized (although time-consuming) process.

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<sup>9</sup> <https://www.plugshare.com/>

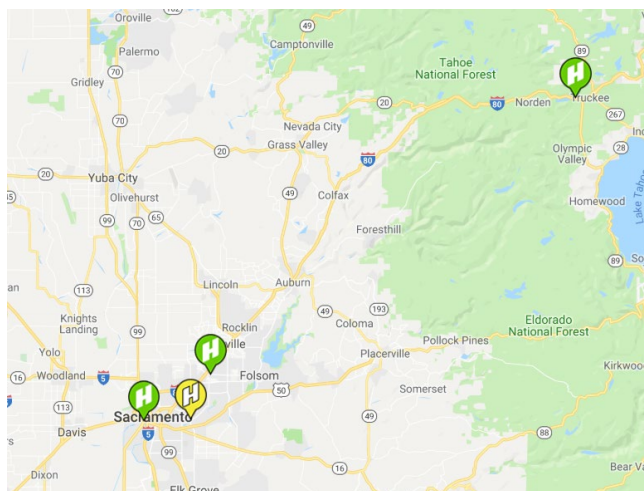
Figure 3: DC Fast Chargers in April 2019



The Sacramento region also has three open hydrogen stations and a fourth that was under construction in April 2019. A green icon means open and a yellow icon indicates under construction. Figure 4 is a screenshot from the California Fuel Cell Partnership station map<sup>10</sup> and each station automatically reports its operational status every few minutes. Fuel cell vehicles fill their tanks in about five minutes and one station can fill 100 or more cars a day. Additional hydrogen stations are planned for buses and freight vehicles in the Sacramento area. Like conventional buses and trucks, heavy-duty fuel cell vehicles will fill at their own stations, and filling takes less than 15 minutes.

Hydrogen station developers engage in a collaborative process with government and automakers to build the initial station network through the California Fuel Cell Partnership.

Figure 4: Hydrogen stations in April 2019



<sup>10</sup> Cafcp.org/stationmap



## Transportation Network Companies

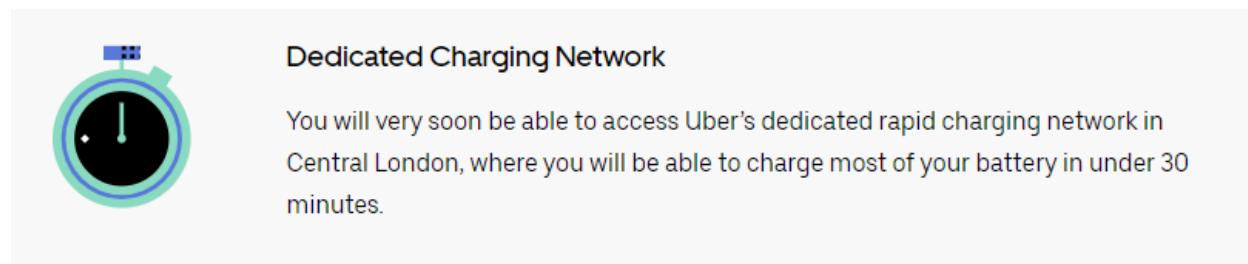
Uber, Lyft, and other transportation network companies (TNCs) have little influence over the cars their drivers use. Drivers are currently independent contractors that use their own vehicles. TNC representatives and drivers interviewed for this project stated that Sacramento is not ideal for a gig economy; it's a small market with long distances between popular destinations. The outlying cities in the Sacramento region have few, if any, drivers. Sacramento is not a target market for new programs, although for a short while Uber offered incentives to about 100 drivers that used EVs for "tens of thousands of miles."

Preliminary learnings from Uber's EV pilots in Sacramento and other cities are:

- Most EV drivers did not have home charging.
- DCFC needs to be convenient; time spend looking for a DCFC is time they are not generating income
  - Close to the street
  - Near large populations
  - Near downtown areas
  - Not at malls or stores
- Charging needs to be fast—40 minutes is too long
- Charging needs to be less expensive; Uber subsidized DCFC during the pilot otherwise the cost would be more than gasoline

In London Uber is building a network of DCFCs for its drivers to support the goal of all London-based Uber vehicles running on electricity by 2025.<sup>11</sup> Figure 5 is a screen capture from Uber's UK website.

Figure 5: Uber dedicated charging network in London.



Maven, a GM-owned company, partnered with EVgo to build a network of DCFCs for Maven drivers. Maven Gig is a weekly rental for ride hailing drivers, and drivers who rent the Bolt can use the DCFC network for free. Maven Gig is exploring Sacramento as a future location.

Before TNC companies will consider introducing or expanding EV services, Uber, Lyft, and Maven each stated that they need to see a Sacramento area-wide strategic plan for DCFCs that included convenient locations near population centers.

It's important to note that neither Uber or Lyft excluded fuel cell vehicles, but neither company believed they needed to act to encourage FCEVs. Uber has about two dozen drivers in San Francisco and Sacramento driving FCEVs. However, FCEV drivers were not included in Uber's pilot program for EVs.

Sacramento's taxi companies and organizations declined to participate in this study.

<sup>11</sup> <https://www.uber.com/en-GB/drive/resources/electric-vehicle-programme/>

## Local Government

The City and County of Sacramento are active participants in the Sacramento PEV Collaborate, and therefore interviews for this project focused on cities and counties that were less engaged. The team interviewed staff at the Cities of West Sacramento, Citrus Heights, Roseville, Dixon, Vacaville, Davis, Rocklin, Placerville, Auburn, Colfax, and Woodland and requested interviews without response from Rancho Cordova, Elk Grove, Galt, Yuba City, Marysville, and Grass Valley.

Other than Sacramento, the cities interviewed do not have strategic plans, road maps, blueprints, or other guidance documents for vehicle electrification and, instead, approach EV charging as a function of building code requirements. Only West Sacramento expressed that a City should be involved in hydrogen station siting.

During the interviews, the project team shared EV and hydrogen station information prepared by the Governor's Office of Business Development (GO-Biz).<sup>12</sup> Most cities were unaware of GO-Biz resources that include checklists, sample codes, and example permit applications or of the AB 1236 tool kits from the California Building Officials (CALBO) website.<sup>13</sup>

Local government officials were largely unaware that heavy-duty vehicles, including delivery vans, trucks, and buses, need different charging or hydrogen stations than passenger vehicles. Most of the communication and outreach materials and efforts focus on infrastructure for light-duty vehicles, which may leave cities unprepared for deploying zero-emission freight.

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<sup>12</sup> <http://www.opr.ca.gov/planning/transportation/zev.html>

<sup>13</sup> <https://www.calbo.org/post/electric-vehicle-charging>

# Identify common ground for messaging

In meetings and interviews, participants talked about need for regional messaging about ZEVs and ZEV infrastructure. A regional message, however, needs a common lexicon.

## Sacramento region

Figure 6 through Figure 8 are maps of the Sacramento region from the U.S. EPA/Sacramento Metro AQMD, SACOG, and Caltrans that each show different counties in the “region.” In addition, tools like the National Renewable Energy Lab’s EVI-Pro and UC Davis’ EV GIS Toolbox use the Sacramento-Arden Arcade-Roseville Metropolitan Area, in Figure 9, as defined by U.S. Census Bureau.

Figure 6: Sacramento region defined by U.S. EPA

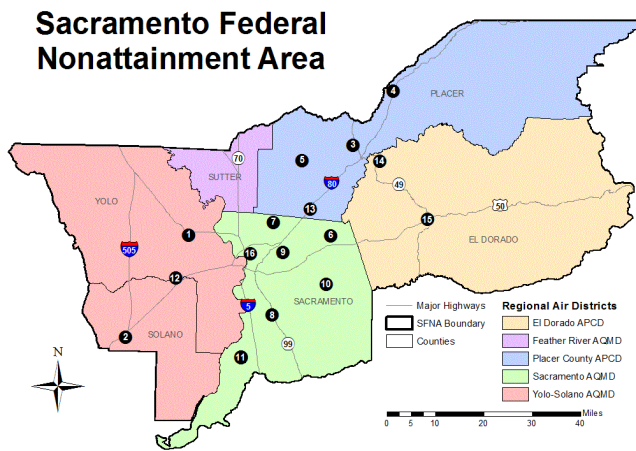


Figure 7: Sacramento region defined by SACOG

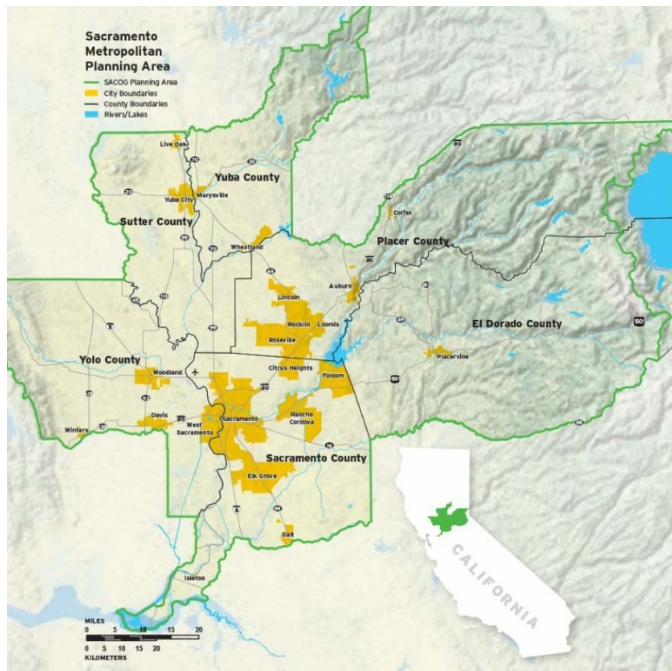


Figure 8: Sacramento region defined by Caltrans

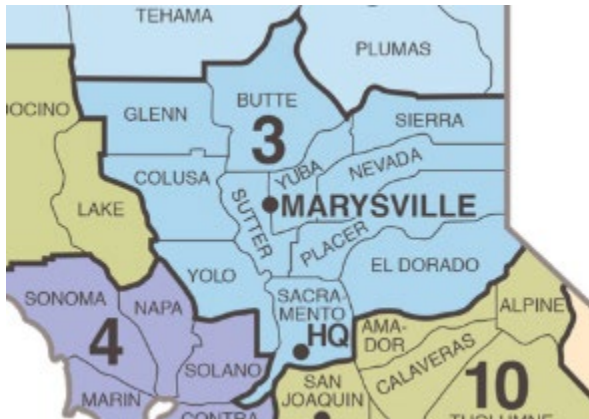
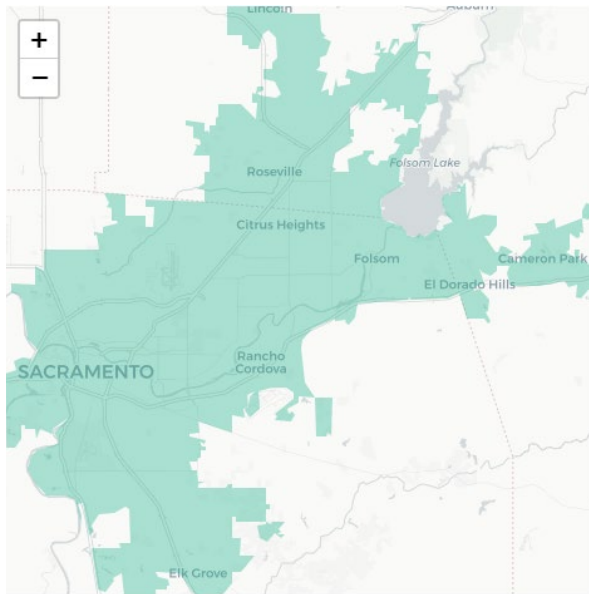
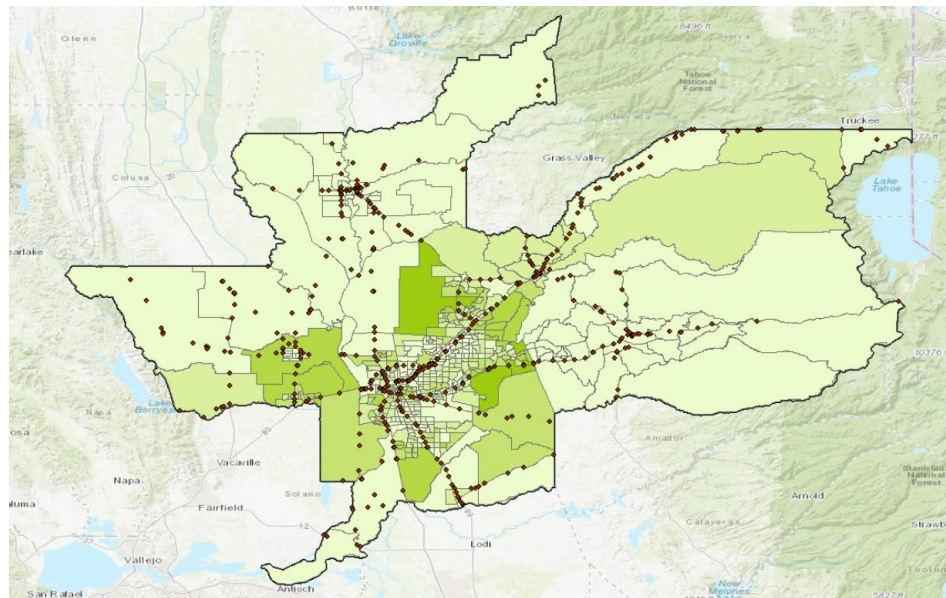


Figure 9: Sacramento Metropolitan Area defined by U.S. Census Bureau



For this project, the “Sacramento region” is a blend of locations, as shown in Figure 10. The region was defined with significant input from the stakeholders listed in the previous section and by analyzing Longitudinal Employer-Household Dynamics<sup>14</sup> from the U.S. Census to consider the travel patterns of long-distance commuters.<sup>15</sup> The dots on the map in Figure 10 show points of high traffic flow.<sup>16</sup>

Figure 10: Sacramento region considered in this project.



### Zero emission vehicle

Stakeholders defined “zero emission vehicles” as:

- Only battery electric vehicles (BEVs)
- BEVs and plug-in hybrids (PHEVs)
- Only BEVs and fuel cell electric vehicles (FCEVs)
- Only light-duty vehicles
- Any combination of the preceding.

Because ZEV is used without a common definition, organizations reported that they were unsure which vehicles and infrastructure were covered by funding opportunities. For example, El Dorado, Feather River, Placer, and Yolo-Solano air districts each reported that they received few to no applications for public charging grants, but didn’t know if they could use State funding to issue the same grant and include hydrogen stations or public charging of medium-duty vehicles.

In another example, stakeholders referenced NREL’s Electric Vehicle Infrastructure Projection Tool (EVI-Pro)<sup>17</sup> tool to project numbers of light-duty ZEVs and needed charging infrastructure but didn’t know that EVI-Pro assumed that 40% of ZEVs are PHEVs. EVI-Pro excludes FCEVs and, therefore, doesn’t allow users to calculate infrastructure needs based on a percentage of ZEVs that would use hydrogen.

<sup>14</sup> <https://lehd.ces.census.gov/data/>

<sup>15</sup> Modeling is discussed in other project reports.

<sup>16</sup> From Caltrans data

<sup>17</sup> <https://maps.nrel.gov/cec/?aL=0&bL=cdark&cE=0&IR=0&mC=38.377192010708846%2C-121.44424438476564&zL=10>

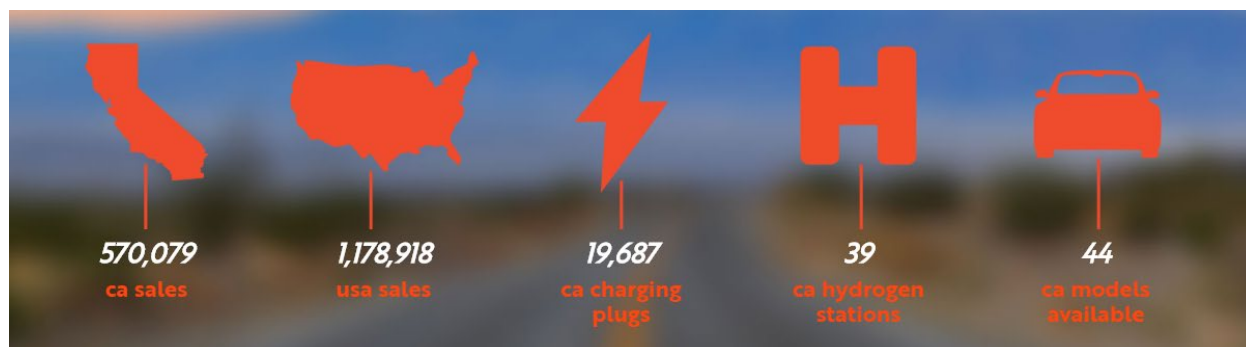
The project team recommended referring to the California Air Resources Board’s definition of ZEV, which is also used in the State of California’s 2018 ZEV Action Plan.<sup>18</sup> ARB defines zero emission vehicles as BEVs, FCEVs, and plug-in hybrids with 20 miles or more of electric range, and light-, medium-, and heavy-duty vehicles. If all air districts, SACOG, and cities use a consistent definition in regulations, funding, and incentives, it will be clear which vehicles and infrastructure are included or excluded.

### Numbers of vehicles and infrastructure

Projecting needs and measuring progress depends on accurate starting numbers, but participants used several sources of information and different calculations.

Veloz<sup>19</sup> updates ZEV deployment statistics its website, shown in Figure 10. Vehicle numbers are cumulative sales of light-duty BEVs, PHEVs, and FCEVs from data that Baum and Associates collects from auto makers. The number of charging connectors or “plugs” (different than EVSE) is from the Alternative Fuel Data Center (AFDC)<sup>20</sup> and the number of hydrogen stations is from the California Fuel Cell Partnership.

Figure 11: ZEV statistics from Veloz in April 2019



The California Clean Vehicle Rebate project reports the number of light-duty ZEVs, including motorcycles, that received rebates from the State of California since the program started in 2010.<sup>21</sup> Detailed data can be downloaded and sorted by county, city, zip code, and census tract. In 2016, CVRP implemented an income cap for BEVs and PHEVs, and in 2017 reduced the rebate amounts for BEVs and PHEVs. In 2018, some dealerships started applying rebates at the point of sale. PEV Collaborative participants estimated that about 30% more ZEVs were leased or sold than was represented by CVRP data. Figure 12 is a snapshot of the CVRP rebates by vehicle type as of March 31, 2019.

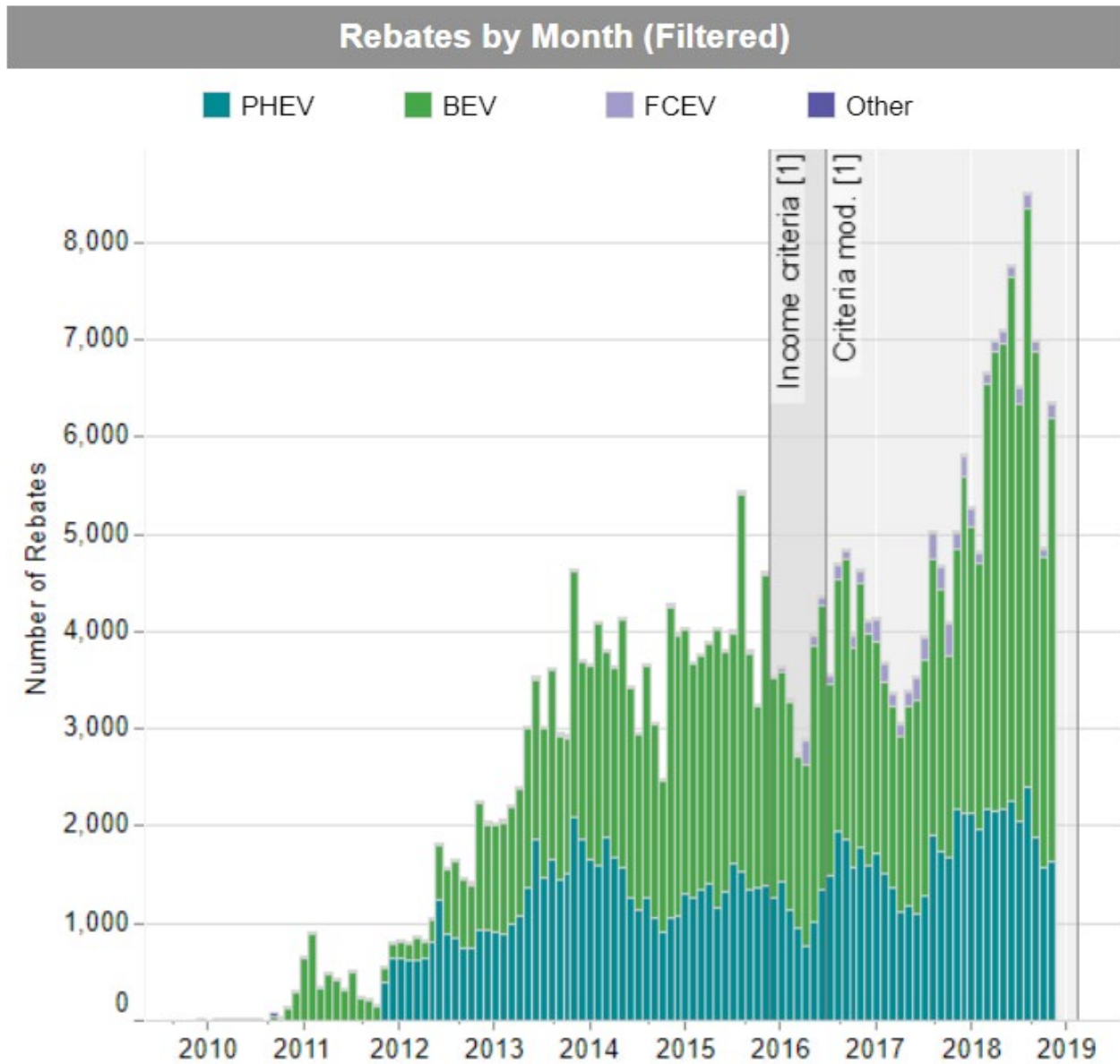
<sup>18</sup> <http://business.ca.gov/Portals/0/ZEV/2018-ZEV-Action-Plan-Priorities-Update.pdf>

<sup>19</sup> [www.veloz.org](http://www.veloz.org)

<sup>20</sup> <https://afdc.energy.gov/stations/states>

<sup>21</sup> <https://cleanvehiclerebate.org/eng/rebate-statistics>

Figure 12: CVRP rebates as of March 31, 2019



In mid-2018, the California Department of Motor Vehicles (DMV) made data available that shows the number of registered vehicles by county, city, and zip code.<sup>22</sup> The initial lists included fuels like methanol and diesel hybrids, and the lists have a large number of diesel vehicles. Although DMV did not confirm, consensus is that the DMV reports include trucks, buses, and low-speed vehicles in addition to passenger cars and motorcycles. It also includes exempt vehicles that are registered to government agencies.

In October 2018, DMV data reflected 21,354 ZEVs in the counties considered in this project, about 5 percent of total registered ZEVs in the state. Table 1 shows each county's ZEV registrations, which may

<sup>22</sup> [https://www.dmv.ca.gov/portal/dmv/detail/pubs/media\\_center/statistics](https://www.dmv.ca.gov/portal/dmv/detail/pubs/media_center/statistics)

include neighborhood electric vehicles, trucks, school buses, and exempt vehicles. Department of General Services staff confirmed that vehicles registered in Sacramento may operate elsewhere.

*Table 1: October 2018 ZEV registration by county*

County	BEV	FC	PHEV
El Dorado	800	11	953
Placer	2,297	35	1,825
Sacramento	4,814	130	5,045
Solano	1,224	6	2,027
Sutter	92	1	88
Yolo	973	36	997
Total	10,200	219	10,935
<b>Grand total</b>	<b>21,354</b>		

Overall, the DMV report shows that California had more than 61 million vehicles registered on October 1, 2018 and ZEVs were .72 percent of the total vehicle population. The six-county region had 4.7 million registered vehicles and ZEVs were .46 percent of the vehicle population.

DMV planned to regularly update the report. Although the data is at least 12 months old and doesn't separate passenger vehicles from commercial vehicles, it is the best and most reliable source of information about vehicles that are in operation.

#### **Station use**

A study by the City of Sacramento about the use of EVSE at public garages indicates that all EVSE are heavily used every work day, but are lightly used on nights and weekends. Data from the California Fuel Cell Partnership shows that hydrogen stations fill cars every few minutes during peak commuting hours (before and after work), and are busy on weekends.

Station utilization is not the same as availability. If a driver cannot fill or charge because a station is in use, offline, or out of order that driver leaves. It is impossible to measure how often a driver wants to use a particular station but can't. Gas stations are designed with multiple dispensers to ensure that the station is available during peaks, even though dispensers may be under-utilized the rest of the day. Tesla charging hubs were designed with multiple EVSE for the same reason.

All hydrogen stations funded by the California Energy Commission are required to use the Station Operational Status System and report their up/down status every few minutes. The data is used to calculate availability, and availability is a consideration for operating and maintenance grants. DCFCs are all networked, but not required to report availability to any funding agency.

The project team recommends that stakeholders evaluate stations in terms of availability rather than utilization to ensure stations are operating and located in response to demand.



### **Range anxiety**

“Range anxiety” is an often-used term to address the fear of running out of fuel, but interviews and first-hand experience show that “time anxiety” is a better phrase. It describes the worry that EVSE or hydrogen won’t be available where and when you need it, and that the driver may need to travel to multiple locations. An ICCT report<sup>23</sup> about DCFC in the U.S. and other countries indicated that drivers value the time saved by fast charging over the added cost.

This is a key finding for messaging, particularly for work-related driving. Messages about ease, convenience, and lower cost of hydrogen or electricity may not resonate with people for whom time absolutely is money. When a station is down or in use, a 30-minute charge or five-minute fill can stretch into an hour—or several hours—of waiting or driving to a second location.

### **Responsibility**

In general, participating organizations believe that local government, utilities, and air districts are responsible for regulations and incentives to deploy charging infrastructure, but not for hydrogen stations. For example, local governments expedite permits, identify locations, waive requirements for curb and property improvements, provide incentives and funding, make exceptions to zoning codes, and engage in public education campaigns about battery EVs and charging infrastructure. For hydrogen stations, cities have required extensive curb and property improvements, traffic studies, used zoning codes to disapprove hydrogen stations, and excluded fuel cell vehicles from outreach events. Permitting, however, has become a smoother process and the two new hydrogen stations in the Sacramento region moved more quickly through the planning and permitting than recent DCFCs.

This belief may be because the California State Building Code requires that new construction and major alterations be made ready to support future installation of EVSE to support light-duty vehicles. Because the State codified EV requirements, local governments have a tool to use for EVSE that they can’t use for hydrogen.

The California Green Building Standards Code<sup>24</sup> (Title 24, Part 11)—called CALGreen—allows a local enforcing agency to determine when EV charging and infrastructure is not feasible based conditions like lack of commercial power supply and costs to the utility. Another jurisdiction-specific exception is:

“Where alternative means of achieving the standards for electric vehicle charging, provided that any the local official based finds that the proposed alternative is satisfactory, complies with the intent of the provisions, and is at least as equivalent as the prescribed requirements.”<sup>8</sup>

An option available to cities is to adopt a local ordinance that allows hydrogen stations and DC fast charging plazas to comply with the intent of CALGreen to provide fuel for zero emission vehicles. This option could be particularly attractive in areas that have existing multifamily properties that would be expensive to retrofit for ZEV fuels. Jurisdictions could also consider requirements that new construction in industrial zones require capability to charge or refuel trucks and buses.

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<sup>23</sup> [https://www.theicct.org/sites/default/files/publications/ZEV\\_fast\\_charging\\_white\\_paper\\_final.pdf](https://www.theicct.org/sites/default/files/publications/ZEV_fast_charging_white_paper_final.pdf)

<sup>24</sup> [https://codes.iccsafe.org/content/document/657?site\\_type=public](https://codes.iccsafe.org/content/document/657?site_type=public)

## Regional outreach campaign

The following organizations (in alphabetical order) have dedicated ZEV outreach and messaging efforts, and actively inform regional infrastructure planners and decision makers:

- California Fuel Cell Partnership
- Cleaner Air Partnership
- Electrify America
- Regional car dealerships
- Sacramento Clean Cities Coalition
- Sacramento Area Plug-in Electric Vehicle Collaborative
- Sacramento EV Owners Association
- SMUD
- Valley Vision
- Veloz

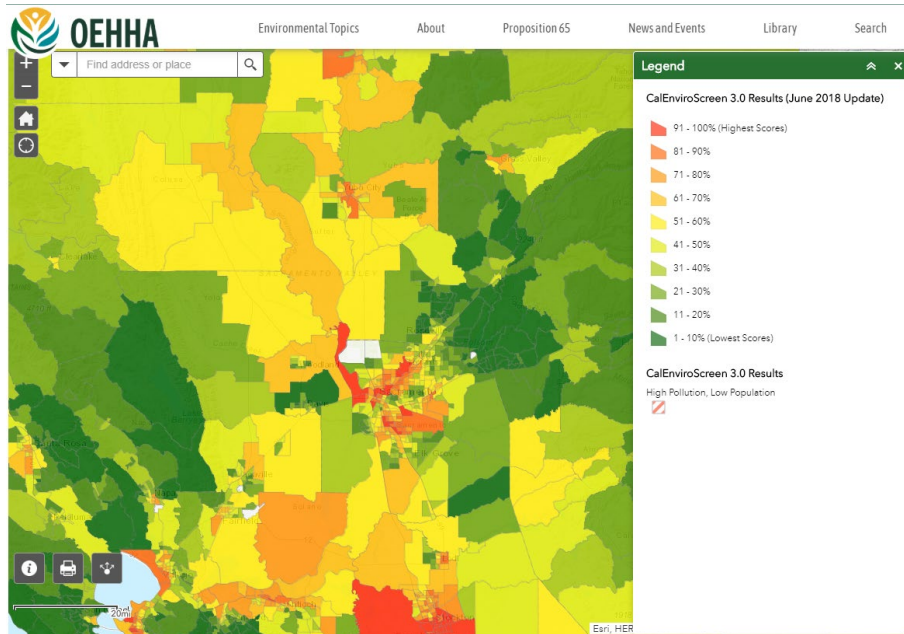
Each organization has a different mission and target audience. For example, Clean Cities targets fleets and heavy-duty vehicles and the Sacramento EV Owners are individuals who encourage other individuals to buy ZEVs.

Assembly Bill (AB) 617 (C. Garcia, Chapter 136, Statutes of 2017) required the California Air Resources Board to establish the Community Air Protection Program to reduce exposure in communities most impacted by air pollution. In October 2018, ARB published the Community Air Protection Blueprint.<sup>25</sup> As a result, local governments and environmental NGOs are focused on projects that bring clean transportation to low-income and disadvantaged communities (DACs); the census tracts that are in the 75<sup>th</sup> percentile and above in CalEnviroScreen 3.0. Red and oranges areas in Figure 13 show the Sacramento region cities that are considered disadvantaged, and are concentrated in Sacramento and West Sacramento, with a small area around Yuba City.

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<sup>25</sup> <https://ww2.arb.ca.gov/index.php/our-work/programs/community-air-protection-program/community-air-protection-blueprint>

Figure 13: Disadvantaged communities from CalEnviroScreen



Without negating the need for ZEV infrastructure in DACs, investing only in these communities will concentrate infrastructure in urban areas and do little to encourage long-distance drivers that may travel from Placerville to Dixon or Galt to Woodland.

ZEV advocates often reference that the average person travels less than 40 miles a day, a national average from the U.S. Bureau of Transportation Statistics.<sup>26</sup> Table 2 is U.S. Census data for one-way trip distance from the census tract of a primary job to the driver's home census tract in 2015 U.S. Census data<sup>27</sup> for the counties in the study area.

<sup>26</sup> <https://www.bts.gov/statistical-products/surveys/national-household-travel-survey-daily-travel-quick-facts>

<sup>27</sup> <https://onthemap.ces.census.gov/>

Table 2: U.S. Census data for one-way commute from work census tract to home census tract

Work to home one-way distance	El Dorado County	Placer County	Sacramento County	Solano County	Sutter County	Yolo County	Total drivers	Percent of total
Total # drivers to primary jobs	45,642	133,360	586,125	133,445	25,740	71,119	995,431	
Less than 10 miles	20,416	61,078	273,259	54,413	14,181	26,050	449,397	45.1%
10 to 24 miles	11,560	34,653	158,594	31,791	3,491	19,749	259,838	57.8%
25 to 50 miles	5,443	12,424	48,619	25,004	4,256	10,755	106,501	10.7%
Greater than 50	8,223	25,205	105,653	22,237	3,812	14,565	179,695	18.1%

This data shows that 28.8% of the workforce—286,000 people—in the Sacramento region commute 50 or more miles a day. Because many commuters also run errands before, after, or during work hours, and that about 5 percent of the population have a second job,<sup>28</sup> it’s probable that more than 30% of drivers travel 50 or more miles a day. In addition, an estimated 20,000 people drive personal vehicles for work-related jobs, including livery drivers (taxi, ride hailing, chauffeur services) and service workers (personal services, repair, outside sales.)<sup>29</sup> Factoring in trucks and delivery vehicles further increases the number of vehicles that do not fall within the “40 miles a day” messaging.

<sup>28</sup> <https://www.bls.gov/cps/cpsaat36.pdf>

<sup>29</sup> Methodology for estimating work-related driving is covered in other reports.

A “there’s a ZEV for that” regional outreach campaign could reach all market segments from car-sharing in DACs to medium-range delivery trucks. Figure 14 shows a rough idea for a campaign that depicts situations that hydrogen stations and DCFC hubs can solve.<sup>30</sup>

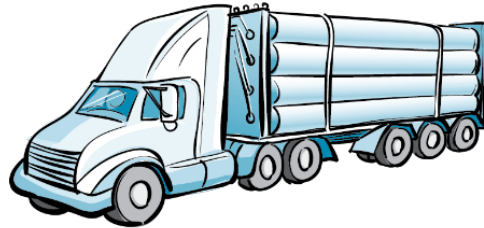
Figure 14: Rough campaign idea

## No time to spare?



There’s a ZEV for that.

## Deliveries to make?



There’s a ZEV for that.

## People to move?



There’s a ZEV for that.

A campaign with a broad scope ensures that each organization can retain its audience focus: DACs, local drivers, heavy-duty vehicle operators. Fuel-neutral images and messaging embrace all types of ZEVs and all types of drivers.

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<sup>30</sup> Illustrations are from other campaigns and are used as a concept only

## Opportunities to create a pool of skilled labor

Most passenger ZEVs are leased from major automakers. Dealerships performs maintenance and dealerships hire technicians that completed automaker-specific training. ZEV bus manufacturers, including Proterra, BYD, Eldorado, and New Flyer, train maintenance staff to perform routine service and have their own service personnel for major service. ZEV trucks are mostly prototypes and the manufacturers service the vehicles.

Car dealerships stated that ZEV servicing is more like data analysis than automotive repair. The Proterra web site shows technicians training in a classroom with laptops to diagnose faults and send data updates. Fuel cell bus manufacturers initially trained technicians at AC Transit and SunLine Transit.

A variety of constituents, from fleet operators to hydrogen station developers, identified journeyman electricians as the largest employment gap in the next five years related to ZEV workforce needs. The International Brotherhood of Electrical Workers Local 340 estimated a current shortage of 1,500 people in its apprentice program.

Another gap in the workforce is people with customer service soft skills. From service writers at automotive repair to insurance estimators to agents answering phone calls about ZEV stations or car-sharing, companies reported difficulty finding people who could answer the phone and care for customers' needs in a professional manner.

### **EV Service Technician**

Service managers at dealerships and independent service centers said that working on ZEVs is a different mindset than mechanical repairs. Mechanics learn to diagnose and repair parts using their senses—what they can see, hear, feel, and smell. With ZEVs, common problems are electrical or with software settings. Technicians need to be able to read data, analyze results, and ask questions.

Currently, high schools, community colleges, and trade schools include ZEV and hybrid information in their auto mechanic classes, but this neither equips students to work on ZEVs nor attracts people who don't want to work on cars. One idea is to integrate ZEV servicing into computer classes at high school, community college, and adult education. Computer and technology classes are often presented as a pathway to a four-year degree and a desk job. Demonstrating the link between data analysis and cars could entice a new segment of people into EV service classes.

For experienced mechanics that want to specialize in battery vehicles, Massachusetts company Automotive Career Development Center's (ACDC) offers EV certification courses. Classes include disassembling cars that the school owns (Leaf, Bolt, Volt, Civic hybrid, Prius, etc.) and hands-on diagnostics and repairs. The seven-day complete class costs \$5,000 plus travel expenses. Online training is video recordings of instructors teaching live classes and cost \$60 per class. ACDC also sells textbooks (one of which is in Spanish), cut-away parts, cars, tools, and equipment. Independent auto service centers said that they do not service enough vehicles to justify the cost of the class and that the 60-minute online classes were too long to be valuable.

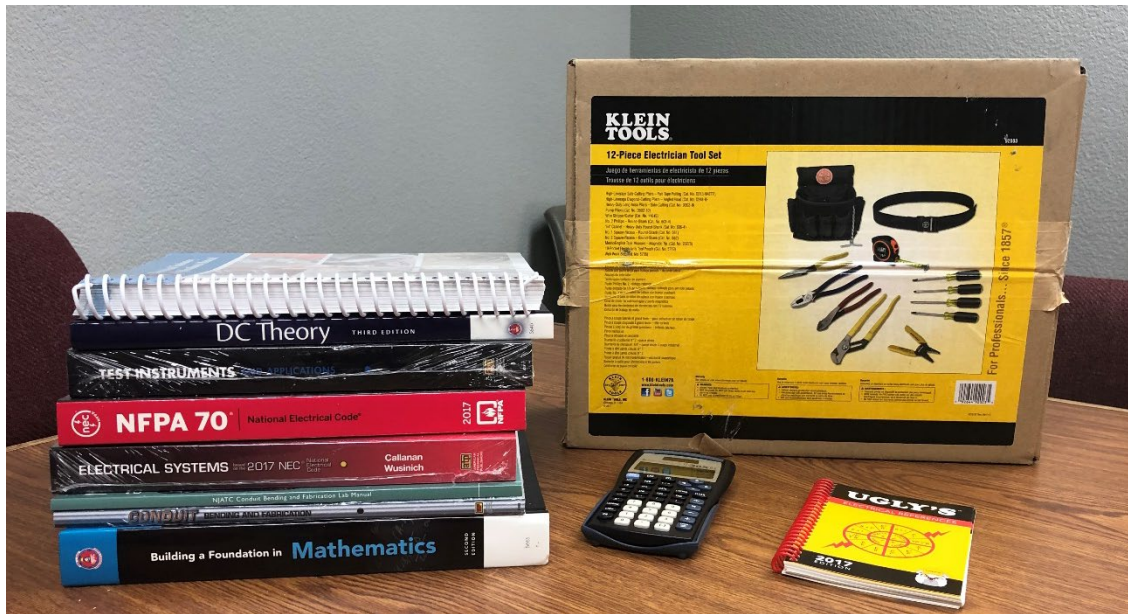
A workforce development effort could potentially fund a Sacramento-area class with ACDC instructors and hands-on materials. Alternatively, a grant could fund licensing the rights to the ACDC curriculum and creating interactive computer-based training modules.

## Electricians

The process of becoming a State of California certified electrician starts with an apprenticeship program that consists of 1,000 hours of classroom training and 8,000 hours (4-to-5 years) of paid, supervised work experience and on-the-job training. After completing training, an apprentice can take the state test to be licensed as a journeyman. After two years of full-time work, which may include supervising apprentices, a journeyman can take the test to become a master electrician. Master electricians can pull permits, design wiring systems, and supervise job sites.

Apprenticeships may be through union or non-union organizations or employers, including private employers, labor unions, the U.S. military, apprenticeship training centers, and community colleges. The largest apprenticeship program is the Electrical Training ALLIANCE, a joint program established under the National Electrical Contractors Association (NECA) and the International Brotherhood of Electrical Workers (IBEW). Apprentices in the NECA/IBEW program do not pay for classes. Sacramento's Local 340 also provides the books and a starter toolkit for free, as pictured Figure 15. Apprentices can also earn an associate degree from American River College by taking a few general education classes to supplement the college credit they receive from apprentice training.

Figure 15: Books and starter toolkit for electrical apprentices



To qualify for the apprenticeship program, applicants must:

- Be 18 or over
- Have a valid driver's license
- Graduated from high school or have equivalency
- Read and write in English
- Pass an aptitude test in math and reading comprehension
- Pass drug test
- Be able to lift 50 pounds

IBEW in Sacramento needs about 1,500 people in the apprentice pipeline to meet growing need. Applicants, however, often don't pass the drug test, which is becoming more common since cannabis legalization, or the aptitude test, another increasingly common issue. A 2017 study by the State of

California Legislative Analyst Office found that 75% of first-time community college students and 40% of university students needed remedial reading, writing, and math skills.<sup>31</sup>

Pioneering programs elsewhere in the U.S. have partnered pre-apprenticeship training with tutoring. For example, Northern California Construction Training<sup>32</sup> is a free program that pairs on-the-job construction training with reading comprehension and math. The free program also includes helping students earn their high-school equivalency, get a driver's license, and proper work habits (time management, problem solving, positive attitude).

IBEW, and non-union electrician training programs,<sup>33</sup> also offer the Electric Vehicle Infrastructure Training Program (EVITP). Experienced volunteer instructors teach the program nationwide to state-certified electricians who pay \$75 per person for the two-day class to cover materials costs. EVITP is integrated into IBEW apprenticeship classes so that every apprentice knows how to calculate load and install EVSE.

### **Data Science**

ZEVs and infrastructure both collect massive amounts of data, and data analysts separate meaningful data from noise. According to American Public Power Association, data collection for EVs and EV charging was one of the top 2018 trends.<sup>34</sup> Utilities want data to understand charging patterns, local government and community-based organizations want data to understand mobility use and needs, automakers collect data to build more-competitive cars, and data is becoming more important with connected roadways and mobility as a service.

Deloitte, the Center for American Mobility, Boston Consulting Group, and other researchers identified data science as an important need in government and industry and will become more important as connected and autonomous vehicles take the road. In April 2019, Uber had 91 job opening with "data scientist" in the job title. The basic duties are to:

- Interpret data to develop analytical insights
- Design experiments and interpret the results to draw actionable conclusions
- Build production grade models on large-scale datasets
- Understand user behavior and predict future performance
- Translate data-driven learnings into actionable insights

In 2017 and 2018, Frontier Energy facilitated workshops with councils of governments and metropolitan planning organizations nationwide to develop action plans for autonomous and connected vehicles. In each workshop, cities and counties identified data science as a workforce gap. At an April 2019 Clean Cities meeting, about half the attendees said that data science was a gap, but of those hand raisers only two worked for private companies.

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<sup>31</sup> <https://lao.ca.gov/handouts/education/2017/Overview-Remedial-Education-State-Public-Higher-Education-Segments-030117.pdf>

<sup>32</sup> <http://www.ncct.ws/>

<sup>33</sup> From American River College, Western Electrical Contractors Association, and Independent Training & Apprenticeship Program. All charge a fee ranging from \$6,000 to \$16,000.

<sup>34</sup> <https://www.publicpower.org/periodical/article/data-collection-charging-patterns-among-top-2018-ev-trends-report>



Local community colleges and universities don't offer degrees or areas of study in data science. UC Davis has a Data Science Initiative<sup>35</sup> and a degree program with a statistical data science track for statistics majors. Sacramento State College of Business Administration's Center for Business Analytics has workshops that are open to the public and cost about \$250 for a one-day class.<sup>36</sup>

It's challenging for colleges to offer coursework and degrees in developing fields of study. As a point of comparison, personal computers were just entering the market in the late 1970s and early 1980s, but few colleges taught PC-related courses. People who established the microcomputer industry, including Bill Gates, Steve Wozniak, Steve Jobs, and Larry Ellison, were self-taught. Colleges started offering coursework and degrees in microcomputer programming, networking, databases, and software applications after PCs were established in business.

College students can, however, be influenced by early movers who give guest lectures, attend mixers, and invite students and teachers to job shadow. It may be years before colleges can invest in ZEV-specific degree programs or major coursework, but it's vital the industry and government demonstrate the future need for this skilled workforce.

At the same time, governments need to prepare themselves for hiring data scientists by reviewing job descriptions and classifications to ensure they can hire the people needed at a competitive salary.

### **Customer Service**

Businesses across the region talk about the difficulty in finding "good" employees; people that show up on time, have a positive attitude, can manage their time, and work as part of a team. Customer service, like every other skill, needs to be taught. Businesses interviewed for this report and other workforce development initiatives emphasized the need for customer service education and many volunteered to participate in a training program.

Soft skills and customer service translate into one often-overlooked EV-related job: insurance appraiser. According to the U.S. Department of Labor, Bureau of Labor Statistics (BLS),<sup>37</sup> the mean income for Sacramento-area insurance appraisers is \$72,000. Training from a school or automaker can teach how to estimate repairs, but not how to interact with anxious customers.

Among the ACDC classes is a series called Shop Management. It includes "Hybrid and EV Service Writer Training" that includes teaching terminology that EV owners know, but service writers often do not. Several of the service centers interviewed liked the idea of a class to teach service writers and customer service agents the terminology, if done in a self-paced, engaging manner.

Multilingual customer service representatives (CSRs) are in particularly high demand. The State of California's emphasis on disadvantage communities increases the need to have people who speak, read, and write in languages other than English and that understand cultural nuances. In April 2019, the Center for Sustainable Energy (CSE) had job postings on its website for rebate processing specialists that speak Tagalog, Russian, Mandarin, Korean, and Hmong. CSE manages clean vehicle rebates for California, Massachusetts, and New York and will soon manage Oregon's program. The company also manages CALeVIP and has applied for other California mobility voucher programs.

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<sup>35</sup> <http://datascience.ucdavis.edu/>

<sup>36</sup> <https://www.csus.edu/cba/analytics/certificate.html>

<sup>37</sup> May 2018 National, State, Metropolitan, and Nonmetropolitan Area Occupational Employment and Wage Estimates [https://www.bls.gov/oes/current/oes\\_40900.htm](https://www.bls.gov/oes/current/oes_40900.htm)

One opportunity is for the air districts in the Sacramento region to pool funding to develop a customer service bootcamp—a one-day, hands-on training in partnership with local businesses that clearly outlines employers’ expectations for customer service, teaches ZEV terminology, and has ample opportunity to practice. Each bootcamp could be immediately followed by a job fair for ZEV-related positions.

## ZEV-related occupations

BLS tracks jobs related to electric vehicles and infrastructure and median wages for those jobs. Table 4 lists the labor category and median wages from BLS and education requirements from public job postings in April 2019.

*Table 3: ZEV-related occupations, mean wages, education requirements*

ZEV-related occupations	Median annual wages in Sacramento metro area <sup>38</sup>	Typical education and training requirements
Chemists	\$82,460	Advanced degree
Materials scientists	\$85,680	Advanced degree
Electrical engineer	\$115,250	Advanced degree
Industrial engineer	\$91,580	Advanced degree
Mechanical engineer	\$98,290	Advanced degree
Mechanical engineering technician	\$63,480	Bachelor’s degree
Software developer	\$106,870	Bachelor’s degree
Industrial designer	\$68,780	Bachelor’s degree
Equipment assemblers	\$41,390	AA or technical training
Team assemblers and fabricators	\$31,780	AA or technical training
Computer-controlled machine tool operators, metal and plastic	\$47,280	AA or technical training
Machinists	\$40,810	AA or technical training
Equipment assemblers	\$41,390	Technical or on-the-job training
Service technicians (light-duty vehicles)	\$49,680	Technical training or certificate program
Service technicians (bus and truck)	\$57,810	Technical training or certificate program
Heavy-equipment mechanic (e.g., construction equipment)	\$58,320	Technical training or certificate program
Urban and regional planners	\$87,780	Bachelor’s or advanced degree
Electrical power-line installers and repairers	Information not released	Information not released
Electricians	\$61,190	Apprenticeship and license

<sup>38</sup> May 2018 National, State, Metropolitan, and Nonmetropolitan Area Occupational Employment and Wage Estimates [https://www.bls.gov/oes/current/oes\\_40900.htm](https://www.bls.gov/oes/current/oes_40900.htm)

ZEV-related occupations	Median annual wages in Sacramento metro area <sup>38</sup>	Typical education and training requirements
Electrical drafter	\$71,240	AutoCAD certification and experience
Electrician helper <sup>39</sup>	\$39,850	High school or equivalent
Construction project manager	\$109,260 <sup>40</sup>	Bachelor's and experience
Insurance appraiser, auto damage	\$72,390	High school or equivalent
Customer service representative	\$40,410	High school or equivalent
Office clerks	\$36,370	High school or equivalent
Driver/Sales worker <sup>41</sup>	\$39,500	High school or equivalent
Executive administration	\$63,530 <sup>42</sup>	AA or certificate program

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<sup>39</sup> In Sacramento, this position is usually called “wireman assistant” and is a pre-apprentice job

<sup>40</sup> The BLS wage classification closest to the “project manager” position used by EVgo, ChargePoint, Black & Veatch, and Fiedler Group

<sup>41</sup> The BLS wage classification closest to the “field technician” position used by JUMP, Gig, and other shared mobility providers

<sup>42</sup> The BLS wage classification closest to the “project manager” position used by Center for Sustainable Energy and Frontier Energy

## Implement accredited alternative fuel vehicle technician training at local community colleges

Rio Hondo College, a community college in Whittier, California, is the only college to offer a degree program in alternative fuels and advanced transportation. Unlike automotive programs that squeeze in classes about ZEVs, the Rio Hondo program emphasizes computer diagnostics, network communication, and electrical systems. Program lead John Frala developed the accredited program with grants from the National Science Foundation and leveraged his long-time relationship with SunLine Transit. Today, the program partners with SunLine, Toyota, Honda, Tesla, and Proterra to have access to vehicles, components, diagnostic tools, and career paths.

Table 5 compares the required classes in three Rio Hondo automotive programs.<sup>43</sup> To earn a degree, students also complete general education classes that are included in the cost.

Table 4: Comparison of required classes in Rio Hondo automotive programs

<b>EV and Fuel Cell Technology Technician (Associate degree and certification exam) Cost: \$4,490</b>	<b>Alternative Fuels/Advanced Transportation (Biofuels and natural gas) (certificate program) Cost: \$1,894</b>	<b>Automotive Technology (Associate degree and certification exam) Cost: \$4,490</b>
Automotive Electrical Tools & Diagnostic Procedures	Introduction to Automotive Service and Repair: Under-hood Service	Introduction to Automotive Light Service
Introduction to Hybrid & Electric Vehicle Technology	Introduction to Automotive Service and Repair: Undercar Service	Body and Chassis Electrical Systems
Automotive Specialized Electronics Training	Automotive Electrical Tools and Diagnostics Procedures	Engine Electrical Systems
Advanced Hybrid / Electric Vehicle	Introduction to Automotive Light Service	Upper End Engine Rebuilding and Machining
Fuel Cell Technology Fundamentals	Introduction to Engine Diagnosis and Tune-Up	Suspension, Steering & Alignment Service
DC and AC Fundamentals	Computerized Engine Controls & Diagnostics	Automotive Brake Systems
DC Electronic Circuits and Devices	Alternative Fuels I	Manual Drive Trains and Axles
AC Electronic Circuits and Devices	Alternative Fuels II	Automatic Transmission/Transaxle
Automotive Electrical Tools & Diagnostic Procedures	Introduction to Hybrid & Electric Vehicle Technology	Heating and Air Conditioning
	Automotive Specialized Electronics Training	

<sup>43</sup> Rio Hondo has additional certificate programs for conventional vehicles than included in this report.

Automakers also work with community colleges to deliver Professional Automotive Career Training that certifies a student for one automaker's vehicles. Butte College in Oroville is the closest school to the Sacramento region to offer automaker-specific training.

American River College (ARC),<sup>44</sup> Sierra Community College (SCC),<sup>45</sup> and Yuba College<sup>46</sup> have certificate courses in auto repair and offer limited training in ZEVs, but are aware of the demand for technicians that can service electric vehicles.

ARC and SCC said that access to vehicles was an impediment to implementing ZEV programs. Combustion vehicles are inexpensive and easy to obtain for hands-on training, but not advanced technology vehicles. During the project the team arranged:

- A connection between ARC and AC Transit (in the Oakland area) about hands-on education with AC Transit's battery and fuel-cell buses.
- Communication between ARC and Ryder about curriculum that Ryder is developing about heavy-duty high-voltage electric vehicles. ARC submitted a proposal to Ryder and the program is in development. ARC started a heavy-duty EV certificate program in late 2019.
- A connection between Sierra College and the regional Nissan EV testing center to facilitate vehicles and electric drive-train components for hands-on education. Nissan donated five hybrid electric transmissions and planned to donate a car.
- Arrangements to donate retired fleet EVs and a decommissioned Smith Electric Truck to ARC and SCC.

Dealerships stated that the training from ARC and SCC does not completely meet their needs. Service managers said that they hire graduates for entry-level jobs, but to work on cars the technician must complete the automaker specific program. Completing certification can be on with a combination of on-the-job training and computer-based learning, but service managers prefer to hire people with the certification.

Conversations with ARC and SCC teachers indicated that the colleges are interested, but not ready implement additional automotive programs. The West Sacramento campus of Sacramento City College plans to build a second building and double the size of the campus. Conversations are underway about including Rio Hondo's EV degree program in the new building. During the project, the team contacted all the automakers about offering PACT programs in Sacramento with no response.

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<sup>44</sup> [http://web.arc.losrios.edu/~autotech/cert\\_alternatefuel.htm](http://web.arc.losrios.edu/~autotech/cert_alternatefuel.htm)

<sup>45</sup> <https://www.sierracollege.edu/academics/divisions/baape/auto-tech.php>

<sup>46</sup> <https://yc.yccd.edu/>

## Conclusion

The urban areas of the Sacramento region are well positioned to support a growing ZEV market. To encourage more ZEV adoption among high-mileage drivers, area stakeholders need consensus approach to deploying ZEVs and infrastructure requirements beyond urban drivers and battery-electric vehicles.

In addition to placing DCFC plazas and hydrogen stations in locations that support and encourage long-distance drivers, regional organizations and businesses can:

- Adopt a common definition of ZEVs that includes batteries and fuel cells, and trucks and buses to clearly identify incentives and regulations that include—or exclude—all vehicles and infrastructure.
- Use the CALGreen code that requires EV capable parking spots to extend to DCFC plazas. charging infrastructure for heavy-duty vehicles or hydrogen stations by specifying that these comply with the intent to provide fuel for zero emission vehicles.
- Jointly fund a regional workforce development effort that can fill gaps in building trades, data sciences, and customer service. An effort to develop a multilingual call center specific to ZEVs and other new mobility efforts could become a job center in the Sacramento region.

By embracing a spectrum of zero-emission vehicles and fuels, and creating a skilled workforce, the Sacramento region can work together to substantially reduce greenhouse gas emissions and improve the region's economic base.

## Appendix A: List of Participating Organizations

- Sacramento Plug-In Vehicle (PEV) Collaborative
- Feather River AQMD
- Placer County APCD
- EL Dorado County AQMD
- Yolo-Solano AQMD
- Proterra
- New Flyer
- BYD
- Chanje
- Lightning Systems
- Thor Trucks
- Ryder
- UPS
- Yolo Transit/Yolobus
- Sacramento RT
- Sutter/Yuba Transit
- Unitrans
- EL Dorado Transit
- Roseville Transit
- SACOG Transit Coordinating Committee
- SunLine Transit (Thousand Palms/Palm Springs)
- PG&E
- SMUD
- American River College
- Universal Technical Institute
- Sierra Community College
- University of California
- Nissan
- GM
- Honda
- Mercedes
- Uber
- Lyft
- City of Roseville
- City of Sacramento
- County of Sacramento
- City of Davis

- City of Citrus Heights
- City of Vacaville
- City of Dixon
- City of Rocklin
- City of Auburn
- City of Colfax
- City of Woodland
- City of West Sacramento
- Phil Haupt Electric
- ChargePoint
- EVgo
- FirstElement Fuel
- Shell Hydrogen
- Envoy
- Electrify America