Plug-in San Diego Electric Vehicle Infrastructure Needs Assessment Methodology Report

Plug-in SD

December 2018

Prepared for
California Energy Commission

Prepared by
San Diego Association of Governments (ARV-16-011)
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Executive Summary

The San Diego Association of Governments (SANDAG), in partnership with the Center for Sustainable Energy (CSE), was awarded a second California Energy Commission (CEC) grant (ARV-16-011) to continue implementation of the San Diego Regional Plug-in Electric Vehicle Readiness Plan (ARV-14-036). Plug-in San Diego (Plug-in SD or PISD) launched in 2015 and developed regional resources to enable electric vehicle (EV) infrastructure permitting and installation streamlining and offer a no-cost “EV Expert” to provide general and technical support to interested stakeholders (e.g., local governments, commercial property owners, workplaces, multi-unit dwelling residents, and property managers) to help ensure the San Diego region is EV-ready (ARV-16-036).

In 2017, SANDAG accepted the second EV Planning and Readiness Grant (ARV-16-011) to address barriers to Plug-in Electric Vehicle (PEV) and Electric Vehicle Charging Station (EVCS) deployment in the San Diego region. Plug-in SD continues to conduct outreach and education in support of legislated mandates and local, regional, and statewide EV targets and greenhouse gas (GHG) emissions-reduction goals. The PISD program also has continued to provide EV Expert services.

As part of the second phase of PISD, the Plug-in San Diego Electric Vehicle Infrastructure Needs Assessment Methodology Report (Report) was developed in conjunction with the interactive Needs Assessment Mapping Tool (Mapping Tool)\(^1\). The Report describes the methods and assumptions used to identify current and future areas that would benefit from additional EV charging infrastructure in the San Diego region and how the Report was translated into a companion web-based interactive Mapping Tool.

In 2015, SANDAG adopted San Diego Forward: The Regional Plan (2015 Regional Plan). The 2015 Regional Plan provides a blueprint for how the San Diego region is expected to grow and evolve via a framework of regional transportation investment through 2050. The 2015 Regional Plan’s major goals support innovative mobility, healthy communities, and a vibrant economy. The 2015 Regional Plan offers more transportation choices—transit, ridesharing, walking, biking—that are better linked with housing and jobs to help reduce passenger-vehicle GHG emissions. EVs also are identified as a strategy to reduce GHG emissions by substituting conventional vehicle miles traveled with EV miles traveled (eVMT).\(^2\) The development of the Mapping Tool through ARV-16-011 aims to support the region’s increase in eVMT of plug-in hybrid vehicles and local and state goals by identifying opportunity areas for publicly accessible charging within the San Diego region.

The Report outlines the methodology used to identify current and future EV weekday work trips in relation to existing publicly available EVCS to better understand which areas in the San Diego region could benefit from additional charging infrastructure. The SANDAG travel model projects weekday work trips and therefore was used to forecast potential EV trips within the region. Publicly accessible charging infrastructure was used to ensure equitable distribution and access to charging. The identified trips and existing chargers were then compared to three growth scenarios for EVs on roads throughout the San Diego region into the future. To support state goals and ensure that this analysis was geographically equitable, special consideration was taken for disadvantaged communities (DACs) and where workplace trips via automobile were taken. This analysis identifies current and probable areas in which there could be a demand for publicly accessible charging infrastructure in 2020, 2025, and 2030 that would be attributable to DACs and other EV drivers.

\(^1\) [https://www.sandag.org/index.asp?classid=17&subclassid=46&projectid=511&fuseaction=projects.detail]

Introduction
This Report documents the regional approach used to analyze publicly accessible EV infrastructure needs in the San Diego region today and into the future. This Report was developed through Plug-in SD (ARV-16-011), a CEC-funded grant. The analysis and development of an online interactive mapping tool and supporting methodology was led by SANDAG and supported by work conducted by CSE. The Mapping Tool was developed to help inform regional and local EVCS siting by identifying gaps in the existing charging network. To do this, EV owners, their weekday work trip travel patterns, and existing infrastructure were analyzed to identify how to best support the growth of EVs within the San Diego region. To support state goals and ensure this analysis was geographically equitable, special consideration was taken for DACs. This Report describes the context in which the work was done, the methodology used to develop the interactive mapping tool, and the conclusions reached as a result.

Process
The following sections outline the methodology used in developing the Needs Assessment Mapping Tool.

Identifying Electric Vehicle Home Locations
ZIP code-level EV-registration data for 2016 compiled by IHS-Markit was provided by the National Renewable Energy Laboratory (NREL) through the San Diego Regional Clean Cities Coalition via CSE. The dataset included all registered EVs in the San Diego region by registration type. “Government” and “fleet” registration types were removed from the dataset, as charging strategies and infrastructure were assumed to be in place. Dealer/manufacturer-registered vehicles were excluded as they do not yet participate in travel activity and rental EVs comprise a very small number of overall EV registrations and were not expected to make home-to-work trips.

ZIP code-level data provides a subregional geographic distribution of EVs in the region (113 ZIP codes in San Diego County), but in order to be used with results from the SANDAG Activity Based Travel Model (ABM), a more granular geography was needed. Traffic Analysis Zones (TAZs) are small units of geography that exchange trips in the ABM. TAZs vary in size from city blocks in urban areas to Census Tracts in rural areas (there are 4,884 TAZs in the San Diego region; see Figure 1 for a comparison to ZIP codes) and are delineated to contain similar land uses and discrete connections to highway, transit, and active transportation networks. They align well with ZIP code and Census Tract boundaries, so data can be easily aggregated up to, or disaggregated from, both geographies.

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3 [https://www.sandag.org/index.asp?subclassid=120&fuseaction=home.subclasshome](https://www.sandag.org/index.asp?subclassid=120&fuseaction=home.subclasshome)
As the regional planning agency for the San Diego region, SANDAG is responsible for producing a long range Regional Transportation Plan (RTP) every four years. To support the modeling efforts that underlie this planning process, SANDAG generates housing, population, and detailed demographic data for both existing conditions (Annual Estimates program) and future projections (Regional Growth Forecasts) for a variety of geographies, including TAZs. For 2016, EV registrations within a given ZIP code were assigned proportionally to TAZs based on the number of households (occupied housing units) with additional weighting for demographic characteristics identified by the UC Davis Plug-in Hybrid & Electric Vehicle Research Center as influencing the likelihood to purchase a new EV as shown in Table 1. Weights based on the number of households and structure type (detached home versus attached home) were applied directly at the TAZ level. SANDAG maintains a detailed regional housing inventory down to the parcel level that is used for input to both the Annual Estimates program and the Regional Growth Forecast. Weights for household income and the number of vehicles per household were derived at the Census Tract level then applied to the TAZs within each tract. Although this data is available at the TAZ level for estimate and forecast years, the values for TAZs with a small number of households can have a high degree of variability. More reliable values for income and vehicle availability are available at the Census Tract level. While larger than TAZs, Census tracts still provide a high degree of geographic granularity (there are 627 Census Tracts in the San Diego region).

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4 http://www.sdforward.com/
5 https://www.sandag.org/resources/demographics_and_other_data/demographics/estimates/index.asp
6 https://www.sandag.org/index.asp?subclassid=84&fuseaction=home.subclasshome
7 https://phev.ucdavis.edu/project/uc-davis-gis-ev-planning-toolbox-for-mpos/
Table 1 – Demographic Criteria Influencing Likelihood to Purchase New EV

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Odds Ratios for EV Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $25k</td>
<td>1</td>
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<tr>
<td>Less than $50k</td>
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<tr>
<td>Less than $75k</td>
<td>1.82</td>
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<tr>
<td>Less than $100k</td>
<td>3.52</td>
</tr>
<tr>
<td>Less than $150k</td>
<td>7.94</td>
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<tr>
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<td>15.2</td>
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<tr>
<td>Less than $200k</td>
<td>30.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicles Available</th>
<th>Odds Ratios for EV Purchase</th>
</tr>
</thead>
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<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>4</td>
<td>1.33</td>
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<tr>
<td>5</td>
<td>1.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Housing Structure Type</th>
<th>Odds Ratios for EV Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached</td>
<td>1</td>
</tr>
<tr>
<td>Detached</td>
<td>1.43</td>
</tr>
</tbody>
</table>

For future years of 2020, 2025, and 2030, CSE produced the Plug-in Electric Vehicle Market Growth Analysis (Appendix A) for the San Diego region with three EV sales scenarios. The years 2020, 2025, and 2030 were used because they align best with local, regional, and state planning horizons and goals. The “low” scenario is based on counts produced by the California Air Resources Board’s EMission FACtors (EMFAC) model. EMFAC EV counts for future years are based on an estimated regulatory path for meeting California emission rules, not actual vehicle sales or other market data.\(^8\) The “medium” scenario is derived from a linear regression based on EV sales data over the previous six years. The “high” scenario is based on a second-order polynomial fit over the same EV sales data, showing an accelerated growth curve. Cumulative projected sales and EMFAC counts for future years are shown in Table 2.

Table 2 – Projected EV Sales and EMFAC Counts for Future Years by Scenario

<table>
<thead>
<tr>
<th></th>
<th>Low (EMFAC)</th>
<th>Medium (Linear)</th>
<th>High (Polynomial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>28,959</td>
<td>61,122</td>
<td>64,516</td>
</tr>
<tr>
<td>2025</td>
<td>102,950</td>
<td>126,588</td>
<td>148,311</td>
</tr>
<tr>
<td>2030</td>
<td>188,276</td>
<td>168,764</td>
<td>208,436</td>
</tr>
</tbody>
</table>

Future EV sales were disaggregated to TAZs in a similar manner to the 2016 vehicle registration data. Because the future counts/projections were for the entire region, an additional step was added to distribute the regional

total of EVs to ZIP codes based on the 2016 ratio of EVs by ZIP code to the regional EV total. This provided additional geographic specificity based on past market conditions. The ZIP code-level counts/projections were then assigned proportionally to TAZs using the same households plus weighting criteria of household income, structure type, and vehicle availability data from the SANDAG Series 13 Regional Growth Forecast.9

**Trip End Assignment**

The ABM simulates detailed travel patterns (tours) for every person within the San Diego region over the course of a typical day. For each trip, an origin, destination, trip purpose, mode of travel, and travel time are produced as outputs. Trip origins and destinations can be aggregated to TAZs based on mode choice and other criteria. In order to match commuting patterns of EV drivers more closely, the data was filtered to only include automobile-based home-to-work trips during the traditional five-day workweek. While it is possible that EV drivers may exhibit different commuting behaviors than drivers of traditional fuel vehicles, the ABM does not currently account for this based on the Household Travel Behavior Survey10 data it is calibrated to. Although the ABM does produce outputs on vehicle fuel type at the fleet level (the composition of vehicles regionwide), it is not appropriate for analysis at small geographies such as TAZs. Home-to-work commute trips typically produce consistent travel patterns, are repeated frequently, and offer opportunities for longer vehicle charging times than other trip types. EV trip ends were assigned to destination TAZs in proportion to the number of workweek trips from the corresponding origin TAZs. The number of EVs in a home TAZ was divided equally among the number of work trips originating from that TAZ. These fractional EV trips were then summed by destination TAZ to arrive at trip end probability. For example, a TAZ with 100 EVs and 500 work trips originating from it would add 0.2 potential EV trip ends to the destination TAZ of each trip. Trip end probabilities were calculated by TAZ for 2016, 2020, 2025, and 2030 for the low, medium, and high scenarios.

**Existing Charging Station Locations**

Existing publicly accessible EV charging station locations in San Diego County were obtained from the Department of Energy’s Alternative Fuels Data Center (AFDC).11 Locations were filtered by fuel type to remove non-electric stations. Where possible, a location was removed from the dataset if its access information listed restrictions that severely limited their availability to the public (i.e., guest use only for chargers located in hotel parking areas). The AFDC inventory includes the number of charging points (ports) by charger type (level 1, level 2, and DC Fast)12 for each location.

**Demand Relative to Existing Charging Infrastructure**

A spatial analysis was performed for each TAZ in order to calculate the number of ports located close enough to provide at-work EV charging opportunities. For the purposes of this analysis, 0.25 miles from the boundary of a TAZ polygon was chosen as the distance threshold for a station to be considered near enough to provide charging. SANDAG typically uses a 0.25-mile threshold when analyzing whether a transit stop provides reasonable access to employment opportunities and is considered a reasonable threshold for the purposes of this Mapping Tool. Nearby ports were summed by total and by type (level 1, level 2, and DC Fast) for each TAZ. EV trip end probabilities were ranked and assigned a percentile relative to the region for all scenarios and years in order to identify areas of potential high and low demand. The ratio of trip end probabilities to

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11 https://afdc.energy.gov/
existing nearby ports was calculated for each TAZ. Although identifying an optimum ratio of ports to EVs has proven elusive,\textsuperscript{13} the ratio of trip end probabilities does provide a metric that could be used to help identify areas that may be underserved by the current charging infrastructure.

**Disadvantaged Communities**

Disadvantaged communities (DACs) were identified using CalEnviroScreen 3.0 from the California Office of Environmental Health Hazard Assessment. CalEnviroScreen is a Census Tract-level scoring system based on pollution burdens and socioeconomic characteristics.\textsuperscript{14} Tracts in the top 25 percent of scores (most burdened/vulnerable) statewide are considered DACs. CSE explored an alternate conceptualization of disadvantaged communities using CalEnviroScreen data, limiting environmental burden categories to ones that could be lessened through EV adoption (air pollution-related factors) and the top 25 percent of scores to San Diego County. The resulting DACs largely mirrored the DACs identified in the CalEnviroScreen map (Appendix C). Due to this similarity, it was decided to use the original CalEnviroScreen disadvantaged communities, as these boundaries have funding implications tied to Senate Bill 535 (De León, 2012) (25% of cap-and-trade funds must be used for projects that reduce GHG emissions in these areas).\textsuperscript{15} Tracts in the top 50 percent of scores also were identified to include areas that while not designated as DACs, face greater environmental burdens and/or socioeconomic vulnerability than the region as a whole.

While CalEnviroScreen DACs are based on the socioeconomic and environmental factors in the areas where people live, residents of DACs travel elsewhere for work and other activities. ABM output was used to identify zones with high concentrations of automobile-based home-to-work trip ends originating from the DACs identified by CalEnviroScreen (25% of scores). While many of these TAZs are outside of disadvantaged communities, the availability of public charging infrastructure in these zones would accrue benefits to commuters from DACs traveling by EV.

**Incentives**

A review of existing incentive programs for EV charging infrastructure installation was performed by CSE to determine whether geographic areas with incentives could be delineated (Appendix B). The criteria used by incentive programs operating within the San Diego region are largely based on the characteristics of individual housing and commercial developments rather than districts or proximity to transportation infrastructure, so the creation of an incentive layer was not feasible.

A current incentive for EV buyers is gaining access to high occupancy vehicle (HOV) lanes. It is possible to identify origin and destination TAZs that would have significant reductions in commute times for HOV versus standard freeway lane travel using the ABM. However, uncertainty over future policies for reduced- or zero-emission vehicle access to HOV facilities in the San Diego region make projecting the impact of this incentive challenging.

**Future Tool Updates**

SANDAG produces a long-range RTP every four years and is currently in the middle of an RTP cycle that includes the development of a new regional growth forecast (Series 14) as well as updates to the ABM. Upon completion of the growth forecast, EV home locations will be re-disaggregated to TAZs based on updated income, vehicle-availability, and structure-type data. The updated version of the ABM will be calibrated to an updated Household Travel Behavior Survey (HTBS), which is used to determine mode choice and travel

\textsuperscript{13} Di Filippo, J.; Moriyama, M.; Terai, T.; Trumbull, K.; Zhang, J. (2017) “Prioritizing Workplace EV Charging Stations Investments in LA County” UCLA Luskin School of Public Affairs, Los Angeles, CA.

\textsuperscript{14} CalEnviroScreen 3.0, https://oehha.ca.gov/calenviroscreen

\textsuperscript{15} SB 535 Disadvantaged Communities, https://oehha.ca.gov/calenviroscreen/sb535
patterns in the model. In addition to recording a greater number of responses than previous surveys, the new HTBS uses GPS data to capture travel patterns more accurately and includes information on vehicle fuel type. Results from the new ABM will be used to recalculate potential EV trip ends for both existing conditions and current and future years across all the low, medium, and high scenarios.

As additional sources for acquiring EV charging station location information become available, these could be used to augment the AFDC inventory in the Mapping Tool. SANDAG is currently exploring options for the creation of a comprehensive regional parking inventory. Once completed, data from the inventory could be included in the analysis to identify TAZs with publicly accessible parking facilities.

Results
Areas with high potential EV trip ends were distributed throughout the western portion of the region. This focus is due to higher population concentrations in the western portion of the region, and as a result, a higher potential for EV ownership. As was expected, the highest clustering of trip ends occurred in or near office-heavy major employment centers such as University–Sorrento Valley, Kearny Mesa, Palomar Airport, Rancho Bernardo, and Poway. Retail-intensive employment areas such as Mission Valley also depict clustering, but to a lesser degree. This pattern was consistent across scenarios and years (the medium scenario for 2025 is shown in Figure 2 as an example). Several recreational employment areas outside of urban areas (i.e., casinos/resorts, San Diego Safari Park) also showed a high potential for EV trip ends but with little to no clustering or similar values nearby. It should be noted that although these areas may appear prominently on the map, TAZs tend to be larger in more rural areas and therefore carry more visual weight than smaller, similarly scoring TAZs.
Figure 2 – Potential Trip End Destinations, 50th Percentile and Above, Medium Scenario 2025
Discussion
The Needs Assessment Mapping Tool identifies areas within the San Diego region that would likely benefit from additional EVCS infrastructure. This tool was developed for planning staff and decision makers throughout the region and is meant to be used as a planning resource to help local, regional, and state agencies reach their climate planning goals. It should be noted that the Mapping Tool, as a regional mapping exercise, is not intended to identify parcel-specific locations but rather TAZ-level areas that could benefit from additional infrastructure. If future funding allows, the Mapping Tool could be expanded to include land use considerations. This could help identify commercial centers, mobility hubs, transit centers, and other potential land uses that would complement EVCS infrastructure.

The EV market is rapidly changing in San Diego and throughout the State of California, with more EVs added to the market every year. The increased number of EV models on the market and the growth in used EVs offers more affordable options more accessible to a wider range of drivers. The EV-ownership characteristics identified by UC Davis provide a current look at factors that increase one’s propensity to own an EV. Thus, forecasting EV home locations is another limitation of this Mapping Tool. As EVs become more affordable and public charging becomes more accessible, the ability or inclination to own an EV will likely increase. If this tool proves valuable, and future funding allows, EV ownership characteristics and how they can change over time could be explored to better forecast EV home locations. This will result in better forecasting of potential EV trip ends and in turn provide a more realistic look at gaps in the region’s EVCS network. To date, there are no published works that explore how EV-ownership characteristics will change in the future.

As development of the Needs Assessment progressed, it became apparent that many of the current EVCS funding opportunities are generally focused on private workplaces and allocated at the discretion of the program administrator. While there is great value in these programs, as they help the region reach EVCS and EV goals, program participation is limited. Furthermore, the biggest barriers to adoption are infrastructure and installation costs and site-specific electrical capacity served by the grid. Thus, an incentive program for publicly accessible charging stations—like the Regional Electric Vehicle Infrastructure Charging Program16 being developed by SANDAG—would be valuable.

As the San Diego region grows and evolves, this Mapping Tool can be updated and expanded upon to include considerations and barriers mentioned in this Report.

Appendices

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Plug-in Electric Vehicle Market Growth Analysis

Plug-in SD

June 2018

Prepared for
San Diego Association of Governments (ARV-16-011)

Prepared by
Center for Sustainable Energy
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Executive Summary

This report details the development of forecasts for new electric vehicle (EV) sales in the San Diego region in support of a regional needs assessment for EV charging infrastructure. These forecasts rely on extrapolation of time-series regressions of past estimated sales data for battery electric vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV). Several regression equations using different methods and time periods were created, examined, and compared. A low and a high scenario were created using these methods.

The forecasts indicate we might expect roughly 170,000 to 210,000 cumulative EV sales by 2030, with BEVs making up the bulk of those sales, as shown in Table 1.

Table 3 – Cumulative estimated past and projected sales from the beginning of the San Diego region’s EV market through a given year by method and vehicle type

<table>
<thead>
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<th>Through year</th>
<th>Linear</th>
<th>Second-order polynomial</th>
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<tbody>
<tr>
<td></td>
<td>BEV</td>
<td>PHEV</td>
</tr>
<tr>
<td>2018</td>
<td>22,305</td>
<td>19,682</td>
</tr>
<tr>
<td>2019</td>
<td>28,059</td>
<td>22,991</td>
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<tr>
<td>2020</td>
<td>34,471</td>
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<tr>
<td>2022</td>
<td>49,267</td>
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<td>2025</td>
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<tr>
<td>2030</td>
<td>103,513</td>
<td>65,251</td>
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<td>2050</td>
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</table>

These numbers roughly align with other estimates for 2025, but differ as time goes on. Additionally, the forecasts do not reflect a glide path needed to reach regional share of statewide EV-deployment goals. Although the region is does not have a binding EV-adoption requirement, SANDAG has pledged to support the development of regional charging infrastructure as part of its Regional Transportation Plan.
Introduction

This report provides an analysis of potential growth in the San Diego region’s electric vehicle market. The analysis was conducted by the Center for Sustainable Energy (CSE) through the Plug-in San Diego (Plug-in SD) program for the San Diego Association of Governments (SANDAG). This analysis informs the regional needs assessment for electric vehicle charging station (EVCS) infrastructure, which in turn will inform future investments in the region.

Numerous methodologies are currently used in data forecasting, many of which are used to forecast EV markets. Some forecasting techniques are based on expert opinions, such as the Delphi method, which involves assembling and interviewing a panel of experts (Hyndman and Athanasopoulos indicate that the typical suggested panel is “between 5 and 20 experts with diverse expertise”) to obtain an estimate. The panel then anonymously iterates on the estimate until a consensus is reached. These methods are sometimes useful for forecasting where input data are not available. Though these techniques can be useful in certain situations (such as for estimating the impact of a novel policy intervention or technology), they are often inaccurate (relative to statistical techniques utilizing observed data) and time-consuming to perform.17

Regression is commonly used to estimate the relationship between a dependent variable and one or more explanatory variables. For forecasting EV sales, the number of sales (the dependent variable) can be regressed against time (the explanatory variable). These time-series regressions can be useful for extrapolating future values based on past trends. More sophisticated regression techniques, such as ARIMA, allow for more rigorous model specification (such as autocorrelation, which can reduce bias in the residuals and error terms) or incorporation of additional external factors (such as gas prices).18

More advanced statistical methods or “machine learning” techniques, such as neural networks, are also used. Included in machine learning techniques are a variety of sophisticated methods that allow for incorporation of non-linear relationships or unseen features.19, 20 These methods often require large “training” datasets for use in training the model.

CSE opted to project San Diego EV sales using regression because it has found using time-series regressions of past sales data to extrapolate future sales a reliably reasonable method for projecting EV markets. This method has been used by California’s Clean Vehicle Rebate Project (CVRP). Additionally, the method’s relatively low cost and simplicity make it among the more accessible and easily understood methodologies available. Other methods—ARIMA, in particular—may provide useful results for comparison to these and other findings and may be useful to explore as next steps if desired.

Process

Several key steps were undertaken to transform publicly available historical data into a format useful for forecasting future sales of battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) in the San Diego region. These initial data-preparation steps allowed for subsequent creation of forecasts that use

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18 Ibid. https://www.otexts.org/fpp/8
20 Ibid. https://www.otexts.org/fpp/9/3
San Diego-specific data. BEVs and PHEVs were forecast separately to allow SANDAG to estimate the impact of EV charging stations on increasing electric range for PHEVs and enabling more BEV trips.\(^{21}\) In discussion of the results relative to other forecasting work and in the context of state legislation and goals, BEV and PHEV estimates are grouped and are being referred to generally as EVs.

**CVRP data download and filtering**

In the absence of monthly new vehicle sales data, rebate data from the CVRP\(^{22}\) combined with estimations of CVRP participation rates (discussed in the next section) provide a reasonable approximation of the overall sales volume in San Diego. To calculate estimated monthly sales volume by vehicle type, the CVRP rebate data was filtered to include rebates approved for vehicles located in San Diego County. The filtered data was aggregated to monthly rebates by vehicle type, then entered into a table showing total rebates by vehicle type for the San Diego region.\(^{23}\)

**Factoring in CVRP participation rates**

Though a large portion of consumers receive rebates from the CVRP, not every EV consumer applies for a rebate. Reasons for non-participation in the program vary and have changed as the program has been modified to restrict eligibility to consumers who meet income criteria.\(^{24}\) To account for non-participation in the program in estimating vehicle sales, rebate totals were divided by San Diego-specific participation rates\(^{25}\) (approximately 83% for BEVs and 66% for PHEVs) for the period before the income criteria were implemented (March 2016); the statewide participation rate (50% for both types)\(^{26}\) was used for the period after implementation of the income cap.

**Fitting lines using regression**

Regression equations were created using Microsoft Excel to extrapolate future EV sales. Regressions using two time frames were created to examine differences in fit due to data-selection parameters and size. Specifically, data from the most recent 12 months were used to examine recent trends in isolation from the rest of the dataset. Estimates based on these trends were then considered in the context of the expected future market, including legislative requirements and goals. As discussed in the results section, trends based on the most recent 12 months of data showed a dramatic downward trend that quickly dropped to zero sales per month, and were discarded as unlikely given the policy landscape in California, which requires automakers bring electric vehicles to market. Though it can be useful to examine recent trends, time-series regressions are most stable and reliable when calculated using a large dataset (though opinions vary about the optimal number of data points). Equations based on smaller datasets are more sensitive to outliers and short-term changes in the observed data, especially at the beginning and end of the time series.

---

\(^{21}\) Per SANDAG Regional Plan Mitigation Measure GHG-4C – Fund Electric Vehicle Charging Infrastructure (SANDAG).


\(^{23}\) Excel workbook containing these tables is available separately from this document.

\(^{24}\) Clean Vehicle Rebate Project Eligibility Guidelines: https://cleanvehiclerebate.org/eng/eligibility-guidelines


\(^{26}\) San Diego-specific numbers were not available, so statewide figures were used. California Air Resources Board (2017). “Proposed Fiscal Year 2017–18 Funding Plan for Clean Transportation Incentives.” (I-29).
The following equations were applied separately to the BEV and PHEV markets to enable consideration of BEV and PHEV market impacts separately in anticipated future analyses:

- Linear trends using all estimated sales (i.e., from the first month with estimated sales, approximately six years of data)
- Second-order polynomial trends using all estimated sales
- Linear trends over the most recent 12 months of estimated sales
- Second-order polynomial fit over the most recent 12 months of estimated sales

Linear time-series regression typically yields a line showing conservative, constant growth. These lines are useful for predicting growth scenarios that do not include a disruptive event or policy or an accelerating market expansion that leads to increasing growth over time. This consistent growth makes linear trends useful for baseline predictions.

The second-order polynomial trend typically yields a line with increasing growth over time. In other words, the sales rate accelerates as time passes. These trends are sometimes used by demographers to predict population growth and may be useful for predicting EV markets where policy drivers, technological developments, product innovation, or other market forces drive increasing growth over time. Higher-order polynomials may produce more complex shaped lines, including cyclical trends, which are often over-fit to historical data and may not be appropriate for forecasting.

These equations were used to extrapolate future sales, then summed to create a table showing total estimated past and projected future sales over several time periods. This table showing selected time points is in the Results section of this report. The supporting Excel workbook has monthly data projected out to 2050.

**Results**

All eight equations were calculated and extrapolated monthly to graph through 2030, as shown in Figure 1 and Figure 2. The linear regressions using all data are well-fit to the input data\(^{27, 28}\) and show modest growth over time. These trends show San Diego BEV and PHEV sales reaching more than 61,000 cumulative vehicles by the end of 2020. The linear regressions based on the most recent 12 months of data were not well fit to the data\(^ {29}\) and showed sharply declining EV sales, reaching zero additional vehicles per month in 2020.

---

\(^{27}\) Note: there may be evidence of autocorrelation in the residuals, which could lead to bias in the error estimates summarized in this report.

\(^{28}\) BEV: \(R^2 = 0.735\), SE = 71.6, F = 241, P = 0.000; PHEV: \(R^2 = 0.605\), SE = 37.0, F = 98.2, P = 0.000

\(^{29}\) BEV: \(R^2 = 0.265\), SE = 70.9, F = 3.61, P = 0.087; PHEV: \(R^2 = 0.258\), SE = 36.3, F = 3.47, P = 0.092
Figure 3 – BEV extrapolations

Figure 4 – PHEV extrapolations
The second-order polynomial trends based on all data showed encouraging fits, but varying degrees of realism in longer term forecasts.\textsuperscript{30} In 2023, the BEV trend is approximately 40 percent larger than the linear trend based on all available estimated monthly sales data. By 2030, the polynomial BEV extrapolation has diverged dramatically from the linear trend, predicting approximately twice as many sales as the linear trend. The PHEV polynomial is much closer to the PHEV linear trend and shows mostly increasing growth over time. The polynomials based on the most recent 12 months of data both show poor fit\textsuperscript{31} or unrealistic trends, which are discussed in the next section.

**Discarding unrealistic data**
Several lines were discarded due to unrealistic trends based on the regulatory environment, state goals, and announcements from major automakers. As shown in Figure 1 and Figure 2, the 12-month BEV and PHEV linear fits show declining monthly growth, quickly reaching zero additional vehicles per month starting in early 2020. As California requires manufacturers bring EVs to market as part of the Zero Emissions Vehicles Program, it is unlikely that EV sales will decline at this rate in one of California’s largest vehicle markets. Similarly, the 12-month second-order polynomial for PHEV produced an even more aggressively negative slope, where growth reaches zero additional new vehicles per month in January 2018.

These results are largely attributable to a declining number of rebates issued during the last 12 months. The implementation of a wait list in the CVRP program may play a part in that trend, and it may not be reflective of a downturn in the broader California market. Additionally, the Toyota Plug-in Prius—one of the most popular PHEV models on the market—was unavailable for a portion of this period while the updated Toyota Prius Prime was released.\textsuperscript{32} As more vehicles enter the market, the absence of a single vehicle is unlikely to have as large of an effect on overall sales. Figure 3 shows projected new BEV and PHEV sales through 2030 based on trends using all sales; trends based on 12-month fits were not included for the reasons described above. Linear trends represent a possible low scenario and are shown with solid lines. The polynomial trends represent a possible high scenario and are represented by dashed lines.

\textsuperscript{30} BEV: Adjusted $R^2 = 0.744$, SE = 70.2, $F = 130$, $P = 0.000$; PHEV: Adjusted $R^2 = 0.611$, SE = 37.4, $F = 52.8$, $P = 0.000$

\textsuperscript{31} BEV: Adjusted $R^2 = 0.105$, SE = 74.6, $F = 1.65$, $P = 0.246$; PHEV: Adjusted $R^2 = 0.646$, SE = 23.9, $F = 11.0$, $P = 0.004$

\textsuperscript{32} https://insideevs.com/in-december-every-fourth-prius-was-plug-in-prime-version/
Figure 5 – High and low projected EV sales scenarios

Figure 6 – High and low projected EV sales scenarios by vehicle type
As discussed, the PHEV linear and polynomial forecast show very similar results, even out to 2030. However, the polynomial function for BEVs shows much higher growth than the linear projections, reflecting a rapid increase in BEV sales toward the end of the input data. Table 2 shows the cumulative sum of past and projected future sales (using the more-likely trends based on all estimated sales, as shown in Figure 3) over several time frames.

Table 4 – Cumulative estimated past and projected sales from the beginning of the San Diego region’s EV market through a given year by method and vehicle type

<table>
<thead>
<tr>
<th>Through-year</th>
<th>Linear</th>
<th>Second-order polynomial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All estimated sales</td>
<td>All estimated sales</td>
</tr>
<tr>
<td></td>
<td>BEV</td>
<td>PHEV</td>
</tr>
<tr>
<td>2018</td>
<td>22,305</td>
<td>19,682</td>
</tr>
<tr>
<td>2019</td>
<td>28,059</td>
<td>22,991</td>
</tr>
<tr>
<td>2020</td>
<td>34,471</td>
<td>26,651</td>
</tr>
<tr>
<td>2022</td>
<td>49,267</td>
<td>35,019</td>
</tr>
<tr>
<td>2025</td>
<td>76,391</td>
<td>50,197</td>
</tr>
<tr>
<td>2030</td>
<td>103,513</td>
<td>65,251</td>
</tr>
<tr>
<td>2050</td>
<td>532,525</td>
<td>299,167</td>
</tr>
</tbody>
</table>

Discussion
These forecasts provide insight into possible future new EV sales numbers; however, there are limitations to the accuracy of any forecast. Comparing these forecasts to other models can be informative.

Comparison to other projections
In 2012, Governor Brown signed an executive order setting a goal of 1.5 million Zero Emission Vehicles (ZEVs) sold in California by 2025. With the San Diego region reflecting 9 to 10 percent of the statewide auto market, that would indicate between 135,000 and 150,000 ZEVs, including BEVs, PHEVs and fuel-cell electric vehicles.

In January 2018, Governor Brown published a new executive order with an enhanced goal of 5 million ZEVs in 2030, which would translate to 450,000 to 500,000 in the region.

The National Renewable Energy Laboratory (NREL) has produced multiple projections further analyzing this state goal that include the San Diego market. The methodology and data supplying these projections may have changed over time; however, it is instructive to compare NREL’s estimates to those produced in the above analysis.

---

35 The forecasts created in this analysis and the forecasts created by NREL and CARB all estimate fewer than 450,000 total sales by the end of 2030. Given the gubernatorial requirement, another scenario which incorporates accelerating growth to 5 million total sales by 2030 should also be considered in the growth analysis.
Table 5 – San Diego region projected EV sales through a given year compared with NREL

<table>
<thead>
<tr>
<th></th>
<th>BEV</th>
<th>PHEV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>NREL</td>
<td>27,000</td>
<td>55,000</td>
</tr>
<tr>
<td></td>
<td>Linear</td>
<td>66,692</td>
<td>38,354</td>
</tr>
<tr>
<td></td>
<td>Polynomial</td>
<td>82,576</td>
<td>38,849</td>
</tr>
<tr>
<td>2025</td>
<td>NREL</td>
<td>128,104</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linear</td>
<td>76,391</td>
<td>50,197</td>
</tr>
<tr>
<td></td>
<td>Polynomial</td>
<td>97,446</td>
<td>50,865</td>
</tr>
<tr>
<td>2030</td>
<td>NREL 2030</td>
<td></td>
<td>297,000</td>
</tr>
<tr>
<td></td>
<td>Linear</td>
<td>103,513</td>
<td>65,251</td>
</tr>
<tr>
<td></td>
<td>Polynomial</td>
<td>141,925</td>
<td>66,511</td>
</tr>
</tbody>
</table>

Source: CA Statewide Needs Assessment, 201436

Source: EVI-Pro Tool, 201737

Source: National Infrastructure Assessment, 201738

The 2014 Statewide Needs Assessment projection for the year 2024 estimates higher uptake of PHEVs than BEVs. The later NREL reports do not provide distinction between PHEVs and BEVs in San Diego’s share of modeled national EV sales, which is based, in part, on “linear growth to 20% of LDV [light-duty vehicle] sales in 2030.”39 The 2025 linear projection comes very close to NREL projection for the same year. However, the 2030 NREL projection exceeds both the linear and polynomial projections, indicating NREL’s use of an upward sloping curve.

The Air Resources Board’s EMission FACtors (EMFAC) emissions database40 is a generated by the federal-approved EMFAC model used for estimating mobile source conformity to federal air quality rules. EMFAC is widely used in transportation planning. As electric vehicles are a key measure to reducing air pollution in California, vehicle counts and usage have been incorporated in the most recent (2014) approved version of the model. These counts are based on an estimated regulatory path for meeting California emission rules, not actual sales or other market data.41 The table below compares this projection result to the scenario in the EMFAC model.

---

36 California Statewide Plug-In Electric Vehicle Infrastructure Assessment. May 2014. Table 2  
https://www.nrel.gov/docs/fy15osti/60729.pdf
37 NREL EVI-PRO online Tool. This tool was removed in late 2017 and is expected to be updated in early 2018 with update infrastructure scenarios. The 2030 National analysis was based on the EVI-Pro tool.
39 Ibid. (5).
40 https://www.arb.ca.gov/emfac/
41 EMFAC Technical Documentation, Section 3.3.3.3.1.  
Table 6 – Projected EV sales through a given year compared with EMFAC

<table>
<thead>
<tr>
<th></th>
<th>Linear</th>
<th>Poly</th>
<th>EMFAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>41,987</td>
<td>42,744</td>
<td>13,511</td>
</tr>
<tr>
<td>2019</td>
<td>51,050</td>
<td>52,874</td>
<td>20,088</td>
</tr>
<tr>
<td>2020</td>
<td>61,122</td>
<td>64,516</td>
<td>28,959</td>
</tr>
<tr>
<td>2022</td>
<td>84,286</td>
<td>92,663</td>
<td>53,032</td>
</tr>
<tr>
<td>2025</td>
<td>126,588</td>
<td>148,311</td>
<td>102,950</td>
</tr>
<tr>
<td>2030</td>
<td>168,764</td>
<td>208,436</td>
<td>188,276</td>
</tr>
<tr>
<td>2050</td>
<td>831,692</td>
<td>1,533,297</td>
<td>330,257</td>
</tr>
</tbody>
</table>

Figure 7 – Cumulative estimated sales by 2025 and 2030 with gubernatorial requirements

The EMFAC electric vehicle category includes both BEVs and PHEVs, but discounts the number of PHEVs to 40 percent to reflect the amount of all electric operation, consistent with the ARB 2012 Advanced Clean Cars rulemaking. The table above applies the EMFAC discount to PHEV sales in both the linear and polynomial projection.

The EMFAC model seems to underestimate the number of vehicles in the 2018–2020 timeframe, as the number of EVs sold, especially BEVs, has been outpacing compliance deadlines. Because the EMFAC model

---


is based a compliance scenario and not actual sales, it does not reflect this trend. Both the projections and EMFAC model seem to get closer in the 2025–2030 timeframe and show substantial divergence in 2050. This should give confidence in the use of these projections in the 2025–2030 time period. Although additional compliance scenarios were added in the 2017 midterm review, they still show a larger proportion of PHEVS than estimate for San Diego based on current sales. Figure 6 below shows these varying compliance scenarios.

Figure 8 – Cumulative Vehicle Technology Type by Compliance Scenario (2018–2025)

Demographic Factors Associated with EV Adoption
EV adoption will continue to grow in all the projected scenarios; however, adoption to date has not proceeded evenly across the region. UC Davis has developed an EV market simulation tool as part of their EV Planning Toolbox, which includes demographic factors that influence the likelihood to purchase a new EV. These factors include income, number of vehicles available, and housing type, with the researchers assigning an odds ratio based on how much the factored influenced PEV purchases. Table 4 below shows the percentage of households purchasing a new vehicle and the odds ratios associated with these factors.

---

44 Ibid, Figure 10, page a-20
45 https://phev.ucdavis.edu/project/uc-davis-gis-ev-planning-toolbox-for-mpos/
Table 7 – Demographic factors influencing EV adoption

<table>
<thead>
<tr>
<th>Income level</th>
<th>Percent New Car Household</th>
<th>Odds ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; $25k</td>
<td>3.60%</td>
<td>1</td>
</tr>
<tr>
<td>&lt; $50k</td>
<td>3.80%</td>
<td>0.98</td>
</tr>
<tr>
<td>&lt; $75k</td>
<td>5.80%</td>
<td>1.82</td>
</tr>
<tr>
<td>&lt; $100k</td>
<td>8.10%</td>
<td>3.52</td>
</tr>
<tr>
<td>&lt; $150k</td>
<td>22%</td>
<td>7.94</td>
</tr>
<tr>
<td>&lt; $200k</td>
<td>18.50%</td>
<td>15.2</td>
</tr>
<tr>
<td>&gt; $200k</td>
<td>38.20%</td>
<td>30.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicles available</th>
<th>Percent New Car Household</th>
<th>Odds ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>33.90%</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>35.90%</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>19.20%</td>
<td>1.18</td>
</tr>
<tr>
<td>4</td>
<td>7.50%</td>
<td>1.33</td>
</tr>
<tr>
<td>5</td>
<td>3.50%</td>
<td>1.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Housing type</th>
<th>Percent New Car Household</th>
<th>Odds ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attached</td>
<td>32.90%</td>
<td>1</td>
</tr>
<tr>
<td>Detached</td>
<td>67.10%</td>
<td>1.43</td>
</tr>
</tbody>
</table>

This shows that income is strongly associated with EV purchases, although income is correlated to any new car purchase. Greater household vehicle availability and detached housing also increase the odds of PEV purchase. UC Davis’s tools were created in 2015, and updated versions that may reflect more recent market trends are expected in mid-2018. Since California has put policies into place encouraging the purchase of EVs by low- and moderate-income consumers and programs to get charging infrastructure into attached housing have launched, there may be some increase in adoption among these groups, although adoption by high-income households is likely to remain highest.

Conclusions

Although rebate growth declined from late 2016 to 2017, the market is expected to grow rapidly over the next decade and beyond. Automakers are responding to aggressive regulatory requirements by offering a greater variety of vehicles. Range also is increasing as battery costs are declining, making EVs a practical choice for more consumers. California’s regulations mean that even if one manufacturer falls short of their ZEV requirement, they will have to buy credits from another manufacturer, ensuring that the overall market continues to grow. Though more uncertainty exists in how the market will look by 2050, we can be confident in planning now for more EVCSs to support a growing fleet of EVs in the region.

Additional work could be done to create scenarios for future spatial distribution of forecast vehicles. The vehicle sales estimates, combined with the spatial-distribution scenarios and travel-modeling data, would provide useful context for prioritizing installation of public and workplace EVCSs to support the growing electric vehicle fleet across the county.
As a mission-driven nonprofit organization, CSE works with energy policymakers, regulators, public agencies and businesses as an expert implementation partner and trusted information resource. Together, we are the catalysts for sustainable energy market development and transformation.
EMFAC Background
The Air Resources Board’s EMission FACtors (EMFAC) emissions database (https://www.arb.ca.gov/emfac/) is generated by the federally approved EMFAC model, which is used for estimating mobile source conformity to federal air quality rules. EMFAC is widely used in transportation planning. As electric vehicles are a key measure to reducing air pollution in California, vehicle counts and usage have been incorporated in the 2014 EPA approved version of the model and have been updated in the 2017 update to the model. These counts are based on an estimated regulatory path for meeting California’s emission rules. Additionally, the 2017 update was based on new compliance estimates based on the Advanced Clean Cars Mid-term Review.

EMFAC Results
Table A summarizes the different electric vehicle counts for the SANDAG region in EMFAC 2014 versus 2017. This is compared to the second order polynomial projections which the Center for Sustainable Energy (CSE) produced using actual sales trends in the San Diego Region. An explanation of the difference between the 2014 and 2017 EMFAC is included later in this memo.

Table H

<table>
<thead>
<tr>
<th></th>
<th>2014 CSE</th>
<th>2014 EMFAC</th>
<th>2017 CSE</th>
<th>2017 EMFAC</th>
<th>Percent difference between 2014 and 2017 EMFAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>30,924</td>
<td>13,511</td>
<td>30,924</td>
<td>17,419</td>
<td>22%</td>
</tr>
<tr>
<td>2019</td>
<td>39,051</td>
<td>20,088</td>
<td>39,051</td>
<td>20,722</td>
<td>3%</td>
</tr>
<tr>
<td>2020</td>
<td>48,470</td>
<td>28,959</td>
<td>50,262</td>
<td>24,967</td>
<td>-16%</td>
</tr>
<tr>
<td>2022</td>
<td>71,507</td>
<td>53,032</td>
<td>75,033</td>
<td>36,854</td>
<td>-44%</td>
</tr>
<tr>
<td>2025</td>
<td>117,792</td>
<td>102,950</td>
<td>127,456</td>
<td>61,777</td>
<td>-67%</td>
</tr>
<tr>
<td>2030</td>
<td>168,529</td>
<td>188,276</td>
<td>181,166</td>
<td>104,110</td>
<td>-81%</td>
</tr>
<tr>
<td>2050</td>
<td>1,338,996</td>
<td>330,257</td>
<td>1,400,525</td>
<td>186,964</td>
<td>-77%</td>
</tr>
</tbody>
</table>

Notably, the number of electric vehicles decreases after 2020 in the 2017 versus 2014 models—and continues to trend downward in subsequent years. This is based on the latest ZEV-compliance scenarios where most of the credits are going to longer-range electric vehicles that earn more credits—meaning that
the automakers can achieve compliance while selling fewer total plug in-vehicles (FCEVs are also included in
the EMFAC vehicle counts).

The 2014 EMFAC estimates seemed to converge with the CSE estimate for 2025 and 2030; however, the
2017 EMFAC shows a much lower number of EVs on the road for 2022 and beyond. The San Diego region
would achieve much higher than minimum compliance numbers following current sales trends.

**EMFAC Emissions Methodology**
The major difference between 2014 and 2017 models is due to the updated compliance scenario, as noted
above. This is illustrated by the graphics below, with the thin green line representing the smaller number of
electric vehicles and eVMT associated with these vehicles.

46 Advanced Clean Cars Midterm Review, Appendix A: Analysis of Zero Emission Vehicle Regulation Compliance
Scenarios https://www.arb.ca.gov/msprog/acc/mtr/appendix_a.pdf

47 ZEV discussion starting at slide 70:
EMFAC 2017 used a higher “utility factor” for PHEVs, stating that more of the miles would be driven electric by PHEVs; however, the major difference was the updated compliance scenario, as noted above. The CSE second-order polynomial estimates for BEVs and PHEVs were combined using a utility factor of 0.4 for all years for the 2014 model, 0.4 for 2018 and 2019, 0.467 for 2020, 0.5 for 2022, and 0.59 for 2025 and beyond.

EMFAC 2017 also included more light- and medium-duty trucks in the counts; however, this number is relatively small compared to the overall number of electric vehicles.

**EMFAC Web Database Query**
The numbers were pulled from the EMFAC Web Database using the following queries:

EMFAC2017 (v1.0.2) Emissions Inventory  
Region Type: MPO  
Region: SANDAG  
Calendar Year: Each Year (2018,2019,2020,2022,2025,2030,2050)  
Season: Annual  
Vehicle Classification: EMFAC2011 Categories – ALL (only LDA LT1, LT2, and MDV are included in Electric fuel type)  
Model Years: Aggregated  
Speeds: Aggregated  
Fuel Type: Electric

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49 https://www.arb.ca.gov/emfac/2017/
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Introduction
California has long sought widespread deployment of electric vehicles (EV) and infrastructure to support state goals for reducing air pollution and greenhouse gas emissions. EV efforts in California have been driven both by private and public investment. Public funding from federal, state, and local agencies has resulted in a variety of geographically focused incentive programs for EV infrastructure. Most California incentive programs have been directly aimed at pushing the state towards the goal of 1.5 million zero emission vehicles (ZEVs) on the road by 2025. However, a recent 2018 Executive Order (B-48-18) sets a 2030 goal of 5 million ZEVs on the road and will create even greater demand for electric vehicle charging station (EVCS) infrastructure within the state.

In 2015, the San Diego Association of Governments (SANDAG) adopted San Diego Forward: The Regional Plan (2015 Regional Plan). The 2015 Regional Plan provides a blueprint for how the San Diego region is expected to grow and evolve through a framework of regional transportation investment through 2050. The 2015 Regional Plan’s major goals support innovative mobility, healthy communities, and a vibrant economy. The 2015 Regional Plan offers more transportation choices—transit, ridesharing, walking, biking—that improve economic links with housing and jobs to help reduce passenger vehicle greenhouse gas emissions. EVs also are identified as a strategy to reduce greenhouse gas emissions by substituting conventional vehicle miles traveled (VMT) with electric vehicle miles traveled (eVMT). SANDAG could specifically help increase the eVMT of plug-in hybrid vehicles and generally support the use of EVs by helping fund the expansion of a publicly accessible regional charger network. This investment could dramatically increase eVMT and go above and beyond what would be expected under state policy alone.

This Incentives Analysis Report (Report) reviews the costs associated with EVCS installations and the relevant California-focused incentives to deploy EV-charging infrastructure to meet state goals. It identifies program requirements and components of several existing incentive programs that could be applicable to the SANDAG development of a San Diego regional incentive program for public EVCS infrastructure.

EVCS Costs
EVCS are classified into three categories: Level 1 (L1), Level 2 (L2) and direct current fast charging (DCFC). One major distinction between these three levels is the input voltage: L1 uses 110/120 volts, L2 uses 208/220/240 volts, and DCFCs use between 200 and 600 volts. Various manufacturers produce each level of EVCS with a variety of products, prices, applications, and functionality.

EVCS Unit Costs
Level 1 EVCS
Most EVs are sold with a portable L1 charger, and a limited number of EVCS manufacturers offer stationary L1 models for residential and commercial applications. Most L1 charging within residential settings is conducted from 110/120v outlets that run to the driveway or personal garages of EV drivers. The power output of L1 charging varies slightly, but typically is between 12 amps and 16 amps of continuous power output. At these

51 DC Fast Chargers are sometimes referred to as Level 3 chargers, but the Society of Automotive Engineers that develops the American standards has not finalized their classification requirements for Level 3 chargers, which are expected to be higher-powered than current DC fast chargers.
53 Ibid.
levels of power output, a L1 charger will deliver between 3.5 and 6.5 miles of range per hour of charging. These charging rates are satisfactory for drivers who do not fully deplete their battery daily and who can plug their vehicle in overnight or for other extended periods of time. With portable L1 chargers, EVs can obtain a charge almost anywhere there is access to a wall outlet. Table 1 shows available L1 EVCSs and current unit costs.

Table 9 – List of Popular Level 1 EVCS

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Max Charging Rate (electric miles delivered per hour)</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerovironment</td>
<td>Turbocord Dual</td>
<td>5</td>
<td>$499</td>
</tr>
<tr>
<td></td>
<td>Turbodock</td>
<td>7</td>
<td>$1,299</td>
</tr>
<tr>
<td>Clipper Creek</td>
<td>ACS-15</td>
<td>5</td>
<td>$379</td>
</tr>
<tr>
<td></td>
<td>ACS-20</td>
<td>7</td>
<td>$379</td>
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<tr>
<td></td>
<td>ACS-25</td>
<td>8.5</td>
<td>$469</td>
</tr>
<tr>
<td></td>
<td>PCS-15</td>
<td>5</td>
<td>$395</td>
</tr>
<tr>
<td>Telefonix</td>
<td>PowerPost</td>
<td>7</td>
<td>$1495</td>
</tr>
</tbody>
</table>

Level 2 EVCS
Level 2 EVCSs are common solutions for both residential and commercial/workplace settings. Units offer higher power output than L1 chargers and have additional functionality not available with L1 chargers. In general, L2 EVCSs are broken down into two categories: non-networked EVCS (commonly referred to as “dumb” EVCS) and networked EVCS (commonly referred to as “smart” EVCS), which sell for a higher cost.

**Non-Networked (Dumb) Level 2 EVCS**
Non-networked L2 EVCSs are used in almost all kinds of EVCS installations. Dumb L2s may be designed for indoor or outdoor use (e.g., NEMA 3R, NEMA 6P, NEMA 4x rated) and typically produce between 16 and 40 amps of power output, which will deliver between 14 and 35 miles of electric range per hour of charge.

Non-networked L2 EVCSs are generally useful for installation scenarios in which electricity is being paid for by one person or entity and is not shared among several users. Furthermore, when electrical capacity is available, non-networked L2 EVCSs are useful for EV drivers who need higher power output (compared to a L1 outlet) but cannot afford (or don’t need) the amenities offered by smart, networked L2 EVCSs. Table 2 below shows a list of popular non-networked EVCS models and their associated costs.

---

54 Pedestal-mounted unit.
55 Prices shown are for base models (single-port, wall-mounted if available).
Networked (Smart) L2 EVCS

Networked EVCSs are sometimes used in residential settings; however, they are more common in commercial/workplace settings where payments are required by each user or electricity billing is complicated. They may be rated for indoor or outdoor use using the appropriate National Electrical Equipment Manufacturers Association (NEMA) ratings (e.g., NEMA 3R, NEMA 6P, NEMA 4x rated\(^{57}\)) and typically produce between 16 and 40 amps of power output, which will deliver between 14 and 35 miles of electric range per hour of charge. Some networked L2 EVCSs can adjust their power output or offer additional features such as remote access/control via Wi-Fi or cellular connection, access control/ability to accept multiple forms of payment, load balancing across multiple EVCSs, and more. A convenient feature of some models of networked L2 EVCS can limit charging to certain hours, which allows the operator to maximize a time-of-use (TOU) electricity rate structure and only allow charging when electricity is the cheapest (usually sometime between 9 p.m. and 6 a.m.)\(^{58}\) or in midday periods when solar production is highest. Therefore, while smart EVCSs are more expensive than dumb L2 EVCSs, they have much more functionality and can provide more options that may ultimately save costs on electricity. Data from networked chargers also is important to program design and evaluation. Table 3 shows a list of popular networked L2 EVCS models and their associated purchase costs.

\(^{56}\) Prices shown are for base models (single-port, wall mounted if available).
\(^{57}\) https://www.nema.org/Products/Documents/nema-enclosure-types.pdf
\(^{58}\) https://www.sdge.com/residential/pricing-plans/about-our-pricing-plans/electric-vehicle-plans

---

Table 10 – List of Popular Nonnetworked (Dumb) Level 2 EVCS\(^{56}\)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Max Charging Rate (electric miles delivered per hour)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerovironment</td>
<td>EVSE-RS</td>
<td>25</td>
<td>$539</td>
</tr>
<tr>
<td></td>
<td>Turbocord 240V</td>
<td>14</td>
<td>$499</td>
</tr>
<tr>
<td>Clipper Creek</td>
<td>LCS-15</td>
<td>10</td>
<td>$379</td>
</tr>
<tr>
<td></td>
<td>LCS-20</td>
<td>14</td>
<td>$379</td>
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<td></td>
<td>LCS-25</td>
<td>17</td>
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<tr>
<td></td>
<td>LCS-30</td>
<td>20.5</td>
<td>$499</td>
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<tr>
<td></td>
<td>HCS-30</td>
<td>20.5</td>
<td>$565</td>
</tr>
<tr>
<td></td>
<td>HCS-40</td>
<td>27.5</td>
<td>$565</td>
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<td></td>
<td>HCS-50</td>
<td>34</td>
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<tr>
<td></td>
<td>CS-40</td>
<td>27.5</td>
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<td></td>
<td>CS-60</td>
<td>41</td>
<td>$1,995</td>
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<tr>
<td></td>
<td>CS-100</td>
<td>68.5</td>
<td>$2,195</td>
</tr>
<tr>
<td>ChargePoint</td>
<td>ChargePoint Home 16A</td>
<td>14</td>
<td>$499</td>
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<tr>
<td></td>
<td>ChargePoint Home 32A</td>
<td>27.5</td>
<td>$649</td>
</tr>
<tr>
<td>EMotorWerks</td>
<td>Juicebox Pro 40 Lite</td>
<td>34</td>
<td>$645</td>
</tr>
<tr>
<td>Tesla</td>
<td>Wall Connector</td>
<td>68.5</td>
<td>$500</td>
</tr>
<tr>
<td>WattZilla</td>
<td>Wall Watz</td>
<td>64</td>
<td>$999</td>
</tr>
<tr>
<td></td>
<td>WaltZilla</td>
<td>41</td>
<td>$1,099</td>
</tr>
<tr>
<td><strong>Average for this list</strong></td>
<td></td>
<td><strong>30.8</strong></td>
<td><strong>$857.77</strong></td>
</tr>
</tbody>
</table>
Table 11 – List of Popular Networked Level 2 EVCS

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Max Charging Rate (electric miles delivered per hour)</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerovironment</td>
<td>Turbodock</td>
<td>14</td>
<td>$1,798</td>
</tr>
<tr>
<td>ChargePoint</td>
<td>CT4000 Series</td>
<td>25</td>
<td>$3,990</td>
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<tr>
<td></td>
<td>CPF25</td>
<td>27.5</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td>Home Charger 16A</td>
<td>14</td>
<td>$499</td>
</tr>
<tr>
<td></td>
<td>Home Charger 32A</td>
<td>27.5</td>
<td>$649</td>
</tr>
<tr>
<td>EMotorWerks</td>
<td>Juicebox Pro 75</td>
<td>64</td>
<td>$579</td>
</tr>
<tr>
<td>EV Box</td>
<td>Business Line</td>
<td>27.5</td>
<td>$1,790</td>
</tr>
<tr>
<td>Sema Connect</td>
<td>ChargePro 6</td>
<td>25</td>
<td>$1,995</td>
</tr>
<tr>
<td>WattZilla</td>
<td>QuadZilla</td>
<td>68.5</td>
<td>$7,795</td>
</tr>
<tr>
<td></td>
<td>DUO</td>
<td>68.5</td>
<td>$3,495</td>
</tr>
<tr>
<td></td>
<td>UNO</td>
<td>68.5</td>
<td>$1,995</td>
</tr>
<tr>
<td></td>
<td>WaltZilla</td>
<td>68.5</td>
<td>$1,795</td>
</tr>
<tr>
<td></td>
<td><strong>Average for this list</strong></td>
<td><strong>44.6</strong></td>
<td><strong>$2,409.50</strong></td>
</tr>
</tbody>
</table>

**DC Fast Chargers**

DCFC are the highest powered and fastest charging EVCS on the market. They often are used as range extenders along major travel corridors for long-distance trips and in urban environments to support drivers without home charging or very high mileage drivers. Most DCFC charge at rates of 25–50 kilowatt (kW); however, Tesla’s Superchargers charge at speeds of 100–120kW. At current charging speeds, these chargers are ideal for locations where a person would spend 30 minutes to an hour, such as restaurants and shopping centers.

Current DCFCs require power inputs of 480+ volts and 100+ amps (50–60 kW) and can produce a full charge for an EV with a 100-mile range battery in slightly more than 30 minutes (178 miles of electric drive per hour of charging). However, next generations of DCFC are expected to produce upwards of 150 to 350 kW of power. This increased capability could reduce charging times and accommodate larger EV trucks and long-haul vehicles.

It is important to note that not every EV model is capable of DCFC, and therefore cannot be utilized by every EV driver. Furthermore, there are multiple standards in use in the United States for DCFC connectors, whereas there is only one common standard for L1 and L2 charging (SAE J1772 receptacle). The three DCFC connector types are: CHAdeMO (Asian standard), CCS (European standard), and Tesla (proprietary standard developed prior to EVs being manufactured by major automakers). Most incentive funding for public DCFC requires installation of both CHAdeMO and CCS connectors. Currently, CHAdeMO connectors are the most commonly available connector type in the United States, totaling roughly 3,676 ports, followed by Tesla and

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59 Assumes the vehicles that these EVCS are charging average 3.5 miles/kWh.
CCS with 2,811 and 1,511 respectively. These numbers are rapidly changing, with Tesla planning to more than double the number of Supercharger stations in 2018 and Electrify America’s effort to install 2,000 CHAdeMO and CCS ports nationwide. Manufacturers do not generally make pricing available publicly, but DCFC units normally range from around $10,000 for a single standard station to $40,000 for a higher power, multi-standard station. Installations costs for DCFC also range from $8,000–$51,000 per unit.

Table 12 – List of DC Fast Chargers

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Connector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>Terra 53</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td></td>
<td>Terra HP</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td>Andromeda</td>
<td>ORCA Inceptive</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td></td>
<td>ORCA Mobile</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td></td>
<td>ORCA Air Secure</td>
<td>CHAdeMO</td>
</tr>
<tr>
<td></td>
<td>ORCA Rescue</td>
<td>CHAdeMO</td>
</tr>
<tr>
<td>Blink Network</td>
<td>DC Fast Charger</td>
<td>CHAdeMO</td>
</tr>
<tr>
<td>BTC Power</td>
<td>DC Fast Charge Gen 2</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td>Bosch</td>
<td>Power DC plus</td>
<td>CCS</td>
</tr>
<tr>
<td>ChargePoint</td>
<td>Express CPE-200</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td>EFACEC</td>
<td>QC45</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td>Signet</td>
<td>FCK50</td>
<td>CCS or CHAdeMO</td>
</tr>
<tr>
<td>Tesla</td>
<td>Supercharger</td>
<td>Tesla</td>
</tr>
<tr>
<td>Tritium</td>
<td>Veefil-RT</td>
<td>CCS or CHAdeMO</td>
</tr>
</tbody>
</table>

**EVCS Installation Costs**

**Level 1, 2 and DC Fast EVCS**
While costs of installing an EVCS vary greatly from project to project, the primary cost drivers for installation are:

- Power source proximity
- Power availability
- Number and type of EVCS

**Power Source Proximity**
When referring to power source proximity, in general, the further away the power source is from the EVCS, the more expensive it will be to install due to increased material and labor costs. Furthermore, longer runs may require more materials as well as different materials. For example, a standard 30-amp L2 EVCS would require 8 American Wire Gauge (AWG) if the distance from the power source were less than 100 feet.

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However, if the distance is more than 100 feet, 6 AWG (holds higher amperage and is thicker than 8 AWG) would be required to compensate for the decrease in voltage over long distances.

The amount of trenching required is another factor that is highly dependent on the EVCS’s proximity to the power source. Trenching is the act of digging up the ground to lay wiring and conduit underneath and then refilling it smoothly. This can be done with dirt, concrete, asphalt, etc. Dirt or grass (softscape) is generally the cheapest surface type through which to trench because dirt can be dug up and reused, while asphalt and concrete (hardscape) must be dug up using expensive equipment and the asphalt or concrete typically must be replaced with new material, adding significant costs for materials and labor. As a result, hardscape trenching is often one of the biggest costs in an EVCS installation project.

**Power Source Availability**

Adding any new appliance to a building or residential property will often require substantial electrical demand, and EVCSs are no different. Depending on their age, some buildings will not have the electrical capacity to support EVCS. In these cases, one can request a service upgrade from their utility or they can load balance, load shave, or manage loads. Service upgrades from the utility are often expensive and require that the utility shut off service to the entire building while they install additional capacity. Furthermore, the utility may choose not to provide the service upgrade even if requested. If this is the case, one can choose to load balance, load shave, or manage loads. Each of these is a form of redistributing electricity demand in the building to maximize existing capacity. Often, this means shifting large loads from daytime to nighttime when electricity demand is smaller on the grid and in the building. This is a more cost-effective solution compared to requesting a service upgrade, but regardless, one’s ability to install further electrical capacity is still limited in this case.

**Number and Type of EVCS**

Different types of EVCS require distinctive materials and therefore have varied associated costs. For example, the wiring and conduit required for a L1 EVCS is much thinner and less costly than wiring and conduit required for DCFCs. DCFCs also require bigger and more expensive breakers and will sometimes require a new dedicated sub-panel to be installed. These are often sited in parking lots and could require costly trenching and paving. Additional costs for networked units typically come with a required monthly or annual network subscription, which can add long-term costs to the project.

The number of installed chargers matters on a project, especially when electrical capacity is limited. For example, if a building has 200 amps of available capacity and the property owner wants to install five 40-amp EVCSs, the owner should be able to do so without running over capacity; the installation in this case would be relatively cost-effective. However, if the property owner wants to install one more EVCS, they would need to pay for a service upgrade or a load-balancing solution, both of which can add significant costs to an install project. In this case, the main cost driver is the number of chargers installed.

**Cost Scenario**

The scenario in Table 5 outlines a high-cost scenario for installing a smart 30-amp L2 EVCS. It outlines most of the possible costs that one could incur when installing a L2 EVCS to provide a baseline of costs.\(^{64}\)

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\(^{64}\) Electricity, networking, and maintenance costs were not included in this portion – it is assumed that an incentive program would only provide funding for the installation of EVCSs and not for their ongoing usage. There also are costs for potentially installing bollards or wheel stops to protect the EVCS and repainting if installation triggers handicap accessibility requirements, etc.
The following costs were found in the 2016 RSMeans database, a nationwide repository of standard material and labor costs for electrical equipment.

*Table 13 – EVCS Installation Scenario and Associated Costs, 2016*

| Scenario: One networked, 30-amp Level 2 EVCS being installed in a parking lot that is 100 feet away from the power source. Since breaker spots are not available on main building panel, a sub-panel must be installed to accommodate this EVCS. |
|---|---|---|---|
| Material | Quantity | Cost per Unit | Total Cost |
| EVCS | 1 | $1,000 – $5,000 each | $1,000 – $5,000 |
| 60 amps of Wiring/Conduit | 100 feet | $16.21/foot | $1,621 |
| Panel Board | One 225-Amp Panel | $4,350 each | $4,350 |
| Trenching | 100 feet | $47.79/foot | $4,779 |
| **Total Cost** | | | **$11,750 – $15,750** |

As shown in Table 5, the installation of one EVCS can cost up to $16,000. As noted previously, this is a high-cost scenario that is not representative of the average; however, it helps establish a maximum cost threshold for determining incentive amounts. Costs that vary in a quote can be found in trenching, panel board, and conduit—these can be shared among multiple charging stations, in which case the per-unit costs of a multi-unit installation may come closer to the national average of $3,100.

**San Diego Area-Specific Costs**

The EV Project, which ran from 2010–2013, resulted in a wide range of data managed by the Idaho National Laboratory. The EV Project still represents the most comprehensive source on average costs of publicly accessible and residential L2 EVCS installations for several regions across the country, including San Diego. Of the 13 regions studied, the project ranked San Diego as the region with the fifth highest average cost of installing publicly accessible L2 EVCS. The report shows that on average, it costs $4,004 per EVCS to install—this includes all costs associated with installing a unit but does not include the cost of the EVCS unit itself. Figure 1 shows the results from all 13 markets.
The report regarding costs of residential EVCS installations by geographic region lists average costs as well as maximum costs. These costs only include the cost of installation and not the cost of the EVCS unit. Out of the same 13 regions studied, the San Diego region had the fourth highest average and maximum costs for EVCS installation. The report shows that on average, it costs $1,424 to install residential L2 EVCSs and at a maximum, it costs $4,407. Figure 2 and Figure 3 below show the results from all 13 markets.

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66 Ibid.
Lastly, the EV project identified average permit costs for residential EVCS installations. The project identified total permit costs and permit costs as a percentage of the total project cost. As shown by Figure 4 below, San Diego has not only the highest total permit cost (by a substantial margin), it also has the highest permit cost as a percentage of the total project costs. The City of Encinitas has offered a fee waiver for residential EVCS installations after the close of the EV Projects, but other jurisdictions have generally not lowered permit fees as they are set based on a cost-recovery calculation.

Figure 11 – Maximum Installation Cost for Residential Level 2 EVCS

Figure 12 – Average Permit Fee by Market

67 Ibid.
68 Ibid.
Incentive Programs Review

There are numerous ways to approach the design of incentive programs, and the results can vary along many factors such as incentive type, technology funded, program administration, outreach, and overall scope (geographic, duration, total funding, etc.). This section reviews how other EVCS incentive programs have been designed.

Statewide – Electric Vehicle Service Provider Specific Programs

EV Project

The EV Project worked with governments, utilities, and other stakeholders to install 12,500 public and residential EVCS across the country. This project was in operation from 2010 until 2013 and at the time was the largest EVCS deployment and evaluation project of its kind. These funds were used to pay for the costs of installation of EVCS and the EVCS unit itself, any EVCS or installation hardware required, permits, and any other capital expenses. The EV Project did not have funding tiers, and most projects were evaluated on a case-by-case basis. The EV Project also established a large-scale evaluation project resulting from EVCS installations to gather data on costs, best practices, and lessons learned that can be used by industry professionals in future EVCS installation projects.\(^6^9\) Funding for this project was provided through a combination of public and private funds primarily coming from the U.S. Department of Energy, ECOtality, and, in California, some funds also came from the California Energy Commission (CEC).

NRG Settlement (EVgo)

The EVgo Program was established as part of a settlement between NRG and others with the State of California stemming back to actions in 2001. The settlement stated that NRG must invest $100 million toward increasing EV charging infrastructure in the State of California. As a result, NRG EVgo expanded to deploy make-ready EV charging infrastructure as well as EVCS units. The settlement included $50.5 million

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69 Ibid.
70 https://avt.inl.gov/project-type/ev-project
for “Freedom Stations,” which include at least one DCFC station and one L2 EVCS; $40 million for “make-ready” stubs (conduit and wiring capacity); and $9 million for low-income carsharing programs, workforce training, and other related programs.71

The $40 million available for make-ready stubs was only available to sites that would accept a minimum of 10 stubs. Eligible sites included businesses, multi-unit dwellings, public agencies, and any other site that had parking capacity to host at least 10 stubs. Over the course of the project, 10,000 total stubs were installed and each stub was installed with a minimum 30-amp capacity. Applicants were not required to install EVCS units onto the stubs after they were put in the ground, but were fully responsible for the installation of EVCS whether contracting with EVgo or another provider.

The $50.5 million available for Freedom sites was distributed throughout the state. The Los Angeles Basin placed 110 stations, 55 were received in the San Francisco Bay Area, 15 in the San Joaquin Valley, and 20 in San Diego County. It was also designated that 20 percent of the Freedom Stations be installed in low-income areas. NRG EVgo identified sites within these regions and solicited representatives from those sites to come to an agreement on installation. For Freedom Station sites, NRG EVgo retained ownership and operation of the EVCS, and will continue to operate these stations as long as the site host allows. This program was most active from 2013–2016, although some additional work continued into 2017 and 2018. Make-ready installations ended in early 2017, with the final Freedom Station sites under construction in 2018.

Volkswagen Settlement (Electrify America)
Electrify America is a program that results from Volkswagen’s settlement for its improper diesel emissions reporting. The $2 billion program includes $1.2 billion for increasing EV-charging infrastructure throughout the country ($800 million in California alone). San Diego is one of six designated metropolitan areas in California benefiting from workplace and MUD charging station installations. Electrify America designated certain EVCS vendors for specific regions of the country that are tasked with identifying workplaces, MUDs, and highway sites suitable for large EVCS deployments (ten or more per site for L2 installations). Greenlots has been designated for the San Diego region and is currently accepting applications as well as actively identifying suitable sites.72

This program pays for the complete cost of installation, including the EVCS unit itself. Greenlots will then own, maintain, and operate the EVCS at no responsibility of the applicant for ten years. This program is unique in that much of interaction with applicants is handled directly by the electric vehicle service provider (EVSP), and applicants simply act as a site host for the EVCS. This reduces application requirements, removes payment burden from the applicants, and allows the EVSP to exercise expertise when selecting EVCS and designing the site layout. DCFC installations at sites adjacent to major transportation are handled separately from the workplace/MUD program and follow terms similar to EVgo Freedom Stations.

Public Utility Commission Approved Utility Programs
Prior to 2014, utilities were limited in the types of investments they could make to support EVs, as the Public Utilities Commission did not want the utilities to extend their monopolies into a new competitive market using ratepayer funds. However, this changed as the utilities were able to demonstrate certain market failures for public L2 charging as well as the benefits to the utility grid from greater control over chargers. Senate Bill 350

71 http://www.cpuc.ca.gov/General.aspx?id=5936
72 http://info.greenlots.com/elam
(De León, 2015) (SB 350) extended this further and asked utilities to propose a variety of programs that support widespread transportation electrification.

**Power Your Drive (San Diego Gas & Electric)**

The San Diego Gas & Electric (SDG&E) Power Your Drive Program seeks to identify workplaces and MUDs in the SDG&E service territory that are willing to host EVCSs at their locations. Over the life of the program, SDG&E seeks to install 3,500 EVCSs in 350 total locations, with at least 10 EVCS per site (5 for MUDs). Site selection is at the discretion of SDG&E as they will own, maintain, and operate the EVCS. The electricity will be paid for either by individual residents (in MUDs) or by the property owner (in MUDs or workplaces).

This program is for the installation of networked L2 EVCSs—participants must also pay a one-time participation fee of $630 per EVCS for businesses (ten minimum; $6,300 total) or $235 per EVCS for MUDs (five minimum; $1,175 total). If located in a disadvantaged community, the participation fee is waived. Power Your Drive charging stations are run directly from a SDG&E service transformer and are not dependent on the site hosts existing electrical supply. All units will be put on a special Grid Integrated Rate. This rate varies hourly and reflects actual grid conditions, encouraging charging when there is ample grid capacity on the grid while discouraging charging when the supply of power is constrained or there is grid congestion. The Grid Integration Rate can be quite costly if an EV driver needs to charge during a peak period.

**EV Charge Network (Pacific Gas & Electric)**

Pacific Gas & Electric’s (PG&E) EV Charge Network seeks to install the electrical capacity for EVCSs in various workplace and MUD locations throughout PG&E’s service territory and is willing to install at least ten EVCSs per site. Applicants to the program have the option of either owning or sponsoring EVCSs (sponsorship option is only available for MUDs or workplaces in DACs). If applicants choose to own the EVCSs, they will pay for and install EVCSs chosen from a preapproved list of vendors and will receive a rebate from PG&E. If the applicant is eligible for sponsorship and chooses this option, the applicant will pay a one-time participation fee and choose EVCS from a pre-approved list of vendors. PG&E will then install, own, and operate the EVCS. Applicants in DACs will receive an increased rebate amount for EVCS (through the ownership option) or a decreased participation fee (through sponsorship option).

This program is available only for networked L2 EVCSs that are automatic demand response (ADR) capable, meaning they can receive signals from the grid to either shut off or slow down power output during certain times or days. All the technologies on the preapproved list are EVCSs of this type. The applicant has a degree of flexibility on how the EVCSs will be used. For example, they can be available for the public, for employees or residents only, offered at no cost, or require payment for usage.

**Charge Ready (Southern California Edison)**

The Southern California Edison (SCE) Charge Ready Program is a $22 million pilot project. Of the $22 million, $2.8 million was allocated for a broad-based EV-awareness marketing campaign with the rest reserved for EV infrastructure incentives.

Charge Ready is focused on the deployment of L1 and L2 EVCS throughout SCE’s territory with 10 percent of participating sites located within DACs. Eligible sites include non-residential customers (e.g., destinations, workplaces, MUDs, etc.). Through Charge Ready, SCE installs and maintains the supporting electrical infrastructure.

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73 https://www.sdge.com/residential/electric-vehicles/power-your-drive
75 https://www.edison.com/home/innovation/electric-transportation/charge-ready-a-plan-for-california.html
infrastructure, such as the panels, conduit, and wiring, and the program covers the full cost, including any needed permits. Participants own and maintain qualified EVCSs, and the program provides a rebate to cover some of the cost of the EVCSs and installation on the wiring supplied by SCE. SCE evaluates applications for participation partly based on existing and future EV-adoption potential.

SCE has evaluated EVCS for qualification under Charge Ready through an open rolling solicitation and maintains an active list of eligible EVCSs with a noted EVCS base cost by EVCS type. These costs are based on an average cost of units qualified for the program. The EVCS types and associated base costs are:76

- L1 without network capability: $1,396
- L2 with network capability by external device shared among multiple stations: $1,611
- L2 with network capability integrated into the station: $2,188

SCE tiers the EVCS rebate incentives by participant as follows:77

- Disadvantaged Communities: 100 percent of EVCS base cost
- Multi-unit Dwellings: 50 percent of EVCS base cost
- Other: 25 percent of EVCS cost base

Participants are required to pay the difference between the EVCS cost and the Charge Ready rebate and are expected to operate and maintain the EVCS for at least ten years. Additionally, participants must grant an easement to SCE for the electrical infrastructure.

Investor Owned Utility Projects Under SB 350

SB 350, passed in 2015, authorized the CPUC to direct investor-owned electric utilities in California to propose programs that “accelerate widespread transportation electrification.” These programs are designed to increase the adoption of EVs and support goals for reduced greenhouse gas and criteria pollutants.

San Diego Gas & Electric

The Public Utilities Commission reviewed seven projects submitted for decision by SDG&E. Six projects received priority review because they are less than $5 million in total project spend and one project received standard review because it is greater than $4 million in project spend. Table 6 and Table 7 provide high-level information on the proposed projects.

https://www.sce.com/wps/portal/home/business/electric-cars/Charge-Ready/!ut/p/b1/hc9NT4NAEAbg3-KBozlQujuZ2zbidret91NWucbDrcklI90s5z3YMpNMrnNpPncwQTVKi6-y9NFlb2jqrwv0dpit5zoRUBknEwqX56n7CFAKLvwebHuAP4rq_vwT05fMChCtqXfEfFbjyyByuZUsVL4cCryQvHvJpRgl48Io9NgqKBcJvdyDZOFDgs8Rj3gfOGK0cqk1B93PDV17nP[NEN8v0R5N-9b0413bHo53Dhx0Xecaa01VuC927-C3yM4leW5L-1O5wT1HKw51_dDefVYy6bQ11dl4/ds/L2dBiSEv0ZFBIS9nQSEh?ecid=van_chargeready

76 https://www.sce.com/wps/portal/home/business/electric-cars/Charge-Ready/!ut/p/b1/hc9NT4NAEAbg3-KBozlQujuZ2zbidret91NWucbDrcklI90s5z3YMpNMrnNpPncwQTVKi6-y9NFlb2jqrwv0dpit5zoRUBknEwqX56n7CFAKLvwebHuAP4rq_vwT05fMChCtqXfEfFbjyyByuZUsVL4cCryQvHvJpRgl48Io9NgqKBcJvdyDZOFDgs8Rj3gfOGK0cqk1B93PDV17nP[NEN8v0R5N-9b0413bHo53Dhx0Xecaa01VuC927-C3yM4leW5L-1O5wT1HKw51_dDefVYy6bQ11dl4/ds/L2dBiSEv0ZFBIS9nQSEh?ecid=van_chargeready

77 https://www.sce.com/wps/portal/home/business/electric-cars/Charge-Ready/Charge-Ready-Support/!ut/p/b1/hc_LDolwFATQT-q0PpRQs3y3glwRz2RhWp0m1C-P3iwkuNHFvblpz1k1w2j4N03g3x_FmLhN4ebBPWJha56SsQOjvhz8bdcxpcDDkqGeexnCBn8a-Y8M7y2eTQlZVvXobG677-C-CekjHvIK9RESH4HeF0F7mfgvQvQId16B1zAFgysFaY5zNoSgtkldjWUlrAa-HHF9dzD0NGPqAkHagzdld4/ds/L2dBiSEv0ZFBIS9nQSEh/sce_HashableContentPane_6-hash/sce_HashableContentPane_39-hash/sce_HashableContentPane_40-hash
### Table 14 – SDG&E Standard Review Project

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Total Project Spend</th>
<th>Technologies Supported</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealership Incentives</td>
<td>$1.8 Million</td>
<td>N/A</td>
<td>Incentivize dealerships to increase their knowledge and sales of EVs. 1,500 incentives will be offered ($250 to salesperson and $250 to dealership).</td>
</tr>
<tr>
<td>Electrify Local Highways</td>
<td>$4 Million</td>
<td>DCFC and L2</td>
<td>Install 20 grid-integrated L2 and 2 DCFCs at each of 4 Caltrans locations in Chula Vista, National City, El Cajon, and Escondido. Site selection based on DAC and new construction.</td>
</tr>
<tr>
<td>Medium/Heavy-Duty and Forklift Port Electrification</td>
<td>$2.4 Million</td>
<td>EVSE, circuit, load research meter, and data logger</td>
<td>Conduct 30–40 EVCS installations that include a combination of components such as EVSE, circuit, load research meter, and data logger.</td>
</tr>
<tr>
<td>Fleet Delivery Hub Electrification</td>
<td>$3.7 Million</td>
<td>Grid-integrated EVCS</td>
<td>Install grid-integrated charging infrastructure to support 90 delivery vehicles at approximately 6 locations.</td>
</tr>
<tr>
<td>Green Taxi/Shuttle/Rideshare</td>
<td>$3.5 Million</td>
<td>L2 and DCFC</td>
<td>Install grid-integrated L2 and DCFC EVSE at 5 locations (15 total public charging stations) to encourage the adoption of EVs in Taxi/Shuttle/ Rideshare fleet (4 Taxis, 2 Shuttles, 50 TNCs).</td>
</tr>
<tr>
<td>Airport Ground Support Equipment</td>
<td>$2.8 Million</td>
<td>Proprietary chargers</td>
<td>Install 45 charging ports to support 90 vehicles. Metring and data loggers on 15 existing charging ports.</td>
</tr>
</tbody>
</table>

### Total Spend  $18.2 Million

### Pacific Gas & Electric

The Public Utilities Commission reviewed seven projects submitted for decision by PG&E. Five projects received priority review because they are less than $5 million in total project spend and two projects received standard review because they are greater than $5 million in project spend. Table 8 and Table 9 provide high-level information of the proposed projects.
<table>
<thead>
<tr>
<th>Project Name</th>
<th>Total Project Spend</th>
<th>Technologies Supported</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FleetReady Program</td>
<td>$210 Million</td>
<td>Make-ready infrastructure</td>
<td>Own, install, and maintain make-ready infrastructure to support 788 EVCS installations for non-light-duty vehicles, which will support 8,800 charge ports</td>
</tr>
<tr>
<td>Fast Charge Program</td>
<td>$22.4 Million</td>
<td>Make-ready infrastructure for DCFC</td>
<td>Install make-ready infrastructure for DCFC for light-duty vehicle use at up to 52 sites or 234 charging points over five years</td>
</tr>
<tr>
<td><strong>Total Spend</strong></td>
<td><strong>$234.4 Million</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Total Project Spend</th>
<th>Technologies Supported</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home EV Charger Information Resource Pilot</td>
<td>$500,000</td>
<td>N/A</td>
<td>Build out its current webpages to maximize outreach efforts to provide home EV charging information to those living in DACs</td>
</tr>
<tr>
<td>Medium/Heavy-Duty Fleet Customer Demonstration</td>
<td>$3.36 Million</td>
<td>N/A</td>
<td>Identify a fleet in a DAC area and • install make-ready infrastructure to support medium/heavy-duty EVs at private fleet locations, • provide a rebate for EV charging station purchase, and • provide technical assistance on installation and usage of EVCS In-fleet applications</td>
</tr>
<tr>
<td>Electric School Bus Renewable Information</td>
<td>$2.21 Million</td>
<td>Make-ready infrastructure</td>
<td>Install make-ready infrastructure to support electric school bus deployment in a DAC (two to five total school buses) that will be charged during peak renewable generation periods</td>
</tr>
<tr>
<td>Idle Reduction Technology</td>
<td>$1.72 Million</td>
<td>Idle electrification technology</td>
<td>Provide 15 electrified parking spaces to a parking site located in a DAC and implement idle electrification technology at truck stops in that area</td>
</tr>
<tr>
<td><strong>Total Spend</strong></td>
<td><strong>$7.79 Million</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

78 [http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF](http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF)
79 [http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF](http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF)
Southern California Edison
The Public Utilities Commission reviewed seven projects submitted for decision by SCE. Five projects received priority review because they are less than $5 million in total project spend and two projects received standard review because they are greater than $5 million in project spend. Table 10 and Table 11 provide high-level information of the proposed projects.

Table 18 – SCE Priority Review Projects

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Total Project Spend</th>
<th>Technologies Supported</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Make-ready Installations to Customers</td>
<td>$4 Million</td>
<td>Make-ready infrastructure</td>
<td>Provide a rebate for the cost of hiring an electrician, make-ready infrastructure, and a permit for installing residential EV chargers.</td>
</tr>
<tr>
<td>Urban DCFC Clusters Pilot</td>
<td>$4 Million</td>
<td>DCFC</td>
<td>Install and maintain 5 DCFC sites in urban areas that will have a total of 50 DCFC ports.</td>
</tr>
<tr>
<td>Electric Transit Bus Make-ready Project</td>
<td>$4 Million</td>
<td>Make-ready infrastructure</td>
<td>Install make-ready infrastructure at bus depots and routes for a total of up to 20 charge ports in SCE territory.</td>
</tr>
<tr>
<td>Port of Long Beach Rubber Tire Gantry Crane Electrification Project</td>
<td>$3.5 Million</td>
<td>Make-ready Infrastructure</td>
<td>Provide make-ready infrastructure to support up to nine electrified gantry cranes at the Port of Long Beach.</td>
</tr>
</tbody>
</table>

**Total Spend $7.79 Million**

Table 19 – SCE Standard Review Projects

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Total Project Spend</th>
<th>Technologies Supported</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium- and Heavy-Duty Make-Ready Infrastructure</td>
<td>$554 Million</td>
<td>Make-ready infrastructure</td>
<td>Install make-ready infrastructure to support an estimated 18,234 electric medium- and heavy-duty vehicles at 930 sites with 10,491 charge points.</td>
</tr>
<tr>
<td>Commercial EV Rate without demand charges</td>
<td>N/A</td>
<td>N/A</td>
<td>Provide an EV rate for commercial customers that either allows for no demand charges (for low-demand customers) or a phased-in demand charge for medium- and high-demand customers.</td>
</tr>
</tbody>
</table>

**Total Spend $554 Million**

http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF
http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M212/K643/212643024.PDF
Competitive Rebates and Reimbursement Programs

Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)

Established by Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) and extended by Assembly Bill 8 (Perea, 2013), the CEC is responsible for managing the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). Since 2008, this program has been providing grants to develop and deploy advanced transportation technologies and alternative and renewable fuels that will help the state achieve its climate goals. The CEC has an annual program budget of around $100 million. As of 2017, ARFVTP has disbursed more than $65 million on approximately 7,800 charging stations of all types. This funding has been allocated through periodic competitive solicitations. The San Diego region has received numerous awards under different Program Opportunity Notices (PONs) totaling approximately $1.4 million.

Under PON 11-602 released in 2012, ChargePoint and AeroVironment were awarded funding for residential charging projects in the San Diego region. Additionally, UC San Diego received grants for workplace and public charging and AeroVironment received additional grants for charging to support the Car2Go electric carshare fleet. The PON had a $500,000 maximum award for residential programs and a $75,000 maximum for workplace L1 and L2 EVCSs. It did not have match requirements or specific funding levels per charging port. Funding could cover the cost of the EVCS, installation, and other costs associated with planning and completing the installations.

The ChargePoint MUD award worked to identify MUD properties that could host charging stations provided free through the program. The AeroVironment program made charging stations available to single-family homeowners purchasing or leasing a vehicle at a qualified dealership. Installations were provided by local contractors and the only out-of-pocket cost for most participants was the cost of a city permit.

Under PON 13-606 (2014), the San Diego region received additional awards for public charging. This PON included destination, corridor, workplace, and MUD charging as eligible project types with per-project funding amounts of $50,000–$500,000 for destination and corridor projects, $50,000–$200,000 for workplace projects, and $10,000–$30,000 for MUD projects. Unlike PON 11-602, public agencies and nonprofits are required to lead destination and corridor charging projects. There were no restrictions on applicant type for private workplace or MUD charging.

Match requirements were 25 percent of total award amount for destination and corridor projects and 50 percent for private workplace and MUD projects. The City of San Diego and County of San Diego each received $500,000 awards. The City of Coronado received approximately $125,000. The Cities of San Diego and Coronado had already identified a vendor to supply and install the charging equipment before applying for funding.

http://www.energy.ca.gov/altfuels/
http://docketpublic.energy.ca.gov/PublicDocuments/16-ALT-02/TN217569_20170512T074739_20172018_Investment_Plan_Update_for_the_Alternative_and_Renewab.pdf
http://www.energy.ca.gov/contracts/PON-11-602_NOPA_R2.pdf
http://www.energy.ca.gov/contracts/PON-11-602/
http://www.energy.ca.gov/contracts/PON-13-606/
The County of San Diego used all the funding to provide make-ready stubs for charging at their facilities, then solicited vendors to place and maintain charging infrastructure on these stubs at no cost to them. Subsequent CEC solicitations focused on corridor Fast Charging, mostly outside the San Diego region.

**California Electric Vehicle Infrastructure Project (CALeVIP)**

In 2017, the CEC established the California Electric Vehicle Infrastructure Project (CALeVIP). CALeVIP works with local partners to design and implement EV-charger incentive projects to support installation of charging throughout California. CALeVIP is funded by ARFVTP and works to remove barriers to EV adoption as well as support the state’s goals to improve air quality, fight climate change, and reduce petroleum use. CALeVIP is currently funded to just over $33 million, with the potential for up to $200 million. CALeVIP used the NREL EV Infrastructure Projections (EVI-Pro) tool to estimate the gap from existing infrastructure to the 2025 need for EV-charging ports (by technology type) at a county level. The program accomplishes its infrastructure installation goals through the implementation of geographically targeted incentive projects (throughout California) that address a region’s EV-charging needs. CALeVIP prioritizes incentive projects across California based on the magnitude of the gap (the larger the gap, the higher the priority). Additionally, it coordinates the availability of other possible funding partners (which may have some bearing on the overall prioritization of projects in the system).

The EVI-Pro tool represents statewide travel data housed in its Transportation Secure Data Center to conduct the evaluation. The range does not account for chargers at single-family homes. The EVI-Pro tool accounts for variations and uncertainty in vehicle and charger technologies, user demographics, market adoption conditions, the shared use of chargers, and EV travel and charging preferences. EVI-Pro has indicated a large need of charging (particularly DCFC) in the San Diego region, making it possible for San Diego County to become a higher priority region for a CALeVIP incentive project. Furthermore, the existence of a successful regional charging program would potentially complement CALeVIP efforts (e.g., if the regional charging program covers L2 charging, a CALeVIP program could complement these efforts with DCFC incentives).

With the approval of the utility lead programs mentioned above, the CEC recognized that a funding mechanism with more flexibility than the grant solicitations could be needed to meet specific needs or fill geographic gaps in infrastructure. The CEC selected the Center for Sustainable Energy as the third-party administrator for CALeVIP to provide vouchers or rebates that could provide this level of flexibility as well as to simplify the funding process. The first project was launched in Fresno County in late 2017, with more projects to be launched in coming years.

**Charge Up! (San Joaquin Valley Air Pollution Control District)**

The Charge Up! program provides funding to entities located in the San Joaquin Valley Air Pollution Control District’s boundaries that are seeking to install publicly accessible EVCS. The program provides up to $5,000 per single-port EVCS or $6,000 per dual-port EVCS and has been funded continuously since 2013. To receive funds, applicants must show invoices for purchase of EVCS and for the electrical contractor’s services, as well as any other costs for which an invoice can be obtained. Applicants who purchased EVCSs or received work from a contractor prior to applying are not eligible.

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88 https://calevip.org/
89 https://www.afdc.energy.gov/evi-pro-lite
90 http://valleyair.org/grants/chargeup.htm
This program is designed for public-access charging; therefore, the requirements set out to define “publicly accessible” as “available and opened to the public for a minimum of 30 hours per week during hours that would be reasonably used by the public.” Funding is available for smart L2 EVCSs, and there is a small funding amount available for DCFC. Applicants must produce a yearly report from these EVCSs showing the total usage of the EVCSs throughout the year. It is important to note that the Air District allows non-networked L2 EVCS to be funded as long as a third-party monitoring device that allows usage reports be obtained.

**Charge! Program (Bay Area Air Quality Management District)**

Bay Area Air Quality Management District (BAAQMD) has been allocating funds to clean-air vehicle and infrastructure projects through its Transportation Fund for Clean Air (TFCA) Regional Refund since the 1990s. Since 2010, TFCA has made awards to applicants that have resulted in the installation and operation of more than 2,500 EVCSs. In 2017, BAAQMD authorized $5 million in funds for Charge! to help offset a portion (up to 75%) of the cost of purchasing and installing EVCSs. The Charge! program funds were available to applicants between October 2017 and March 2018 and the program is expected to receive more funding in FY 2019.

Charge! focuses on L1, L2, and DCFC of 40 kW or greater output at MUDs, transit parking facilities, destinations, transportation corridor facilities, and workplaces. Awards could be between $10,000 minimum (e.g., at least one DCFC or three L2 EVCSs) and $500,000 (maximum cap per applicant) and can cover up to 75 percent of the total eligible project costs with at least 25 percent of project costs covered by the applicant as match.

BAAQMD tiers incentives by EVCS type and includes base funding amounts that all projects are eligible for and adder project for projects that meet certain additional criteria:

- **Base funding**
  - L1 $750
  - L2 low-power (3.3 to 6.6 kW) $1,500
  - L2 high-power (>6.6 kW) $3,000
  - DCFC (40 kW or greater) $18,000

- **Plus-up (additional to base funding)**
  - L2 dual-port +$1,000
  - Any EVCS paired with solar: $1 per watt of newly installed solar up to the base funding level of the EVCS project
  - DCFC in a transportation corridor, open 24 hours per day, 7 days a week and located within one mile of heavy volume highway or freeway +$7,000

Eligible project expenses include EVCSs (that meet required specifications) and all associated costs (e.g., shipping, fees, etc.), along with permit fees, EVCS installation, and other electrical hardware used in the installation and operation of the EVCS.

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In addition to cost match, applicants are also required to:

- Install the EVCS within nine months
- Keep the EVCS operational for three years
- Transmit utilization data to BAAQMD
- Achieve a minimum amount of usage of the EVCS over the three-year period

All incentive funds are paid out on a reimbursement basis, with 85 percent of the total incentive available after EVCSs are installed and made operational. The remaining 15 percent of incentive funds is available at the end of the three-year operational period.

**Charge Up L.A.! (Los Angeles Department of Water and Power)**

This program provides funding for the purchase of residential, workplace, and public-access EVCSs and is available for any LADWP customer. This program has $21.5 million of funding and is available through July 2018 or until program funds are exhausted. The funding is allocated on a first-come, first-served basis and is given in the form of a rebate; therefore, it is available to anyone who can provide proof of purchase of qualified EVCS.

Residential applicants can receive a rebate for up to $500 toward their expenses for purchasing qualified L2 EVCSs. This funding is only available for purchase costs associated with the EVCS and does not include the cost of installation. Residential applicants can choose to install a separate meter that will allow them to be on a discounted TOU rate for the EVCS only.

Commercial applicants can receive a rebate for up to $4,000 per EVCS for the associated purchase and installations costs. To qualify, applicants must have a minimum of three parking spaces available to employees, customers, visitors, or tenants. An additional EVCS rebate is available for every additional ten spaces at the same location, with a maximum of 20 rebates given to each applicant.

**Incentive Program Overview**

In reviewing relevant incentive programs, CSE focused on five key components that make an incentive program successful, as identified by The Luskin Center of Innovation (Luskin Center) at UCLA. Those five components are:

- Incentive Type
  - Type of incentives given (rebate, tax credit, grant, etc.)
- Qualifying Expense
  - Materials or labor that can be reimbursed through an incentive
- Match Requirements
  - Monetary contribution or action that the participant must undertake to qualify
- Incentive Tiers
  - The incentive levels participants can receive given certain application criteria
- Project Size
  - Scope of the project in terms of total funding to be allocated for the project, duration, applicable geographic locations, etc.

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95 https://www.ladwp.com/EV
96 http://innovation.luskin.ucla.edu/sites/default/files/Siting%20Analysis%20for%20PEV%20Charging%20Stations%20in%20the%20City%20of%20Santa%20Monica.pdf
CSE identified these key five components for each incentive program described in the previous section and listed them in the following tables. Utility transportation electrification programs under SB 350 are not included here, as many implementation details are still being developed. When launched, these programs will offer even more examples for comparison.

Table 20 – Luskin Center Key Program Components of EVCS Funding/Incentive Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Incentive Type</th>
<th>Qualifying Expense</th>
<th>Match Requirements?</th>
<th>Incentive Tiers?</th>
<th>Project Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV Project</td>
<td>Fee Reduction/Waiver</td>
<td>All</td>
<td>No</td>
<td>No</td>
<td>8,300 L2 stations, 100+ DCFC</td>
</tr>
<tr>
<td>NRG EVgo</td>
<td>Fee Reduction/Waiver</td>
<td>All except EVCS Unit</td>
<td>Easement</td>
<td>No</td>
<td>$100 million in project funds, $20,000/participant</td>
</tr>
<tr>
<td>Electrify America</td>
<td>Fee Reduction/Waiver</td>
<td>All</td>
<td>No</td>
<td>No</td>
<td>Workplaces and MUDs, $800 million project funds for California</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program</th>
<th>Incentive Type</th>
<th>Qualifying Expense</th>
<th>Match Requirements?</th>
<th>Incentive Tiers?</th>
<th>Project Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARFVTP</td>
<td>Reimbursement</td>
<td>All except permits</td>
<td>Most 25% of total project cost</td>
<td>N/A</td>
<td>Varied by Program/Grant funding opportunity</td>
</tr>
<tr>
<td>BAAQMD Program</td>
<td>Reimbursement</td>
<td>All</td>
<td>25% of total project cost</td>
<td>Yes</td>
<td>$5 million in funds allocated</td>
</tr>
<tr>
<td>Charge Up! – SJVAPCD</td>
<td>Rebate</td>
<td>All</td>
<td>Prove $2 million in liability insurance</td>
<td>Yes(^{97})</td>
<td>$50,000 max per site, only for public-access chargers</td>
</tr>
<tr>
<td>Charge Up L.A.! – LADWP</td>
<td>Rebate</td>
<td>EVCS Unit – Residential All – Commercial</td>
<td>No</td>
<td>No</td>
<td>$500 total for residential, up to $4,000 per EVCS for commercial, $21.5 million in program funds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program</th>
<th>Incentive Type</th>
<th>Qualifying Expense</th>
<th>Match Requirements?</th>
<th>Incentive Tiers?</th>
<th>Project Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Your Drive – SDG&amp;E</td>
<td>Fee Reduction/Waiver</td>
<td>All</td>
<td>Easement and Program Fee</td>
<td>Yes(^{98})</td>
<td>350 total locations, 3,500 total chargers, available for SDG&amp;E Customers</td>
</tr>
</tbody>
</table>

\(^{97}\) $5,000 single-port; $6,000 dual-port.
\(^{98}\) Two tiers – one for DACs and one for non-DACs. Non-DACs pay program fee, DACs do not.
As noted in the “Project Size” section of some of the incentive programs in Table 12, each incentive program specifies which locations are eligible (e.g., workplaces, MUDs, public-access locations). Each applicant type has different charging needs and property types, and therefore incentive amounts often differ between these applicants. Table 13 outlines which type of applicants are eligible for each program.

Table 21 – Markets Served by EVCS Incentive/Funding Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Single-Family Homes</th>
<th>MUD</th>
<th>Workplaces</th>
<th>Commercial/Public Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARFVTP</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>BAAQMD Programs</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Charge Up! – SJVAPCD</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Charge Up L.A.! – LADWP</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Electrify America</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>EV Project</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>NRG EVgo</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>EV Charge Network – PG&amp;E</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Power Your Drive – SDG&amp;E</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Interestingly, only three of the programs listed above include single-family homes as eligible locations for applicants, with two of those inactive since 2013. Several likely reasons for this could be that garages of single-family homes are typically the least expensive place to install EVCSs and single-family homeowners may have higher incomes on average compared to residents of MUDs, therefore requiring fewer dollars for financial assistance. This may be worth exploring further, as San Diego County has a substantially higher rate of home ownership (53%) than both Los Angeles County (46%) and San Francisco County (37%).

**Summary and Future Considerations**

While each of the programs described in this report have the general goal of increasing EV charging infrastructure, each have individual secondary goals that make the programs and efforts unique. These

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99 Eligible Participants can choose to either own or sponsor EVCSs. Ownership entails the participant paying for, installing, owning, and operating the EVCS unit, and the participant will receive a rebate for the purchase of EVCSs. Sponsorship entails PG&E paying for the EVCSs and installing them which they will own and operate. With the ownership option, participants simply receive a rebate for the purchase of the EVCS unit and with the sponsorship option, participants pay a one-time program fee.

100 [https://www.energy.gov/eere/electricvehicles/charging-home](https://www.energy.gov/eere/electricvehicles/charging-home)

101 Census Quick Facts
secondary goals can be driven by many regional factors that impact their target area, including income levels, availability of existing charging (as well as type of existing charging), regional travel patterns and demand, etc. To be successful, an incentive program should understand the specific audience it serves and create its program goals based on their needs and unique perspectives. Data-reporting transparency from past programs also can inform the design of a SANDAG program.

Eligibility requirements regarding the types of sites and minimum project sizes represent one of the most important program design decisions. SANDAG might want to develop a broader-reaching regional charger program. A program that can cover a broad range of installation scenarios could be very impactful, as many programs had restrictive eligibility to them.

Any incentive amount can help encourage more charging station installations; however, incentives levels should be set to encourage individual station installations while ensuring enough funding to meet a regional target. Offering increased incentives for disadvantaged or underserved areas can help encourage deployment to those areas. Incentives can be sized to cover the costs of installations, the cost of the charging unit, and some portion of network or service costs. Covering network costs is especially important when usage-data reporting is a program requirement.

Ease of customer access to any incentive program is an important consideration not just for execution, but for continued success. Competitive grants have spearheaded programs and led to many deployments, but they have been limited in scope and impact. Additionally, competitive grants limit many projects and their execution due to cut-off dates or specific grant requirements.

An outreach strategy is essential to ensure that potential applicants are aware of programs and provide targeted outreach to DACs that may be less aware of past and current programs and may miss out on offers or special benefits specific these areas.

The incentive programs identified in this report offer a good overview of the types of incentive programs that are available; however, more work can be done to explore each program in more depth and examine new programs starting up under SB 350 or programs in other parts of the country. After an examination of programs, more administration and oversight methods on program budgets, sources of funding, staffing needs, performance-tracking methods and other ways to ensure more accurate oversight can influence development of a regional charging program and identify elements to help guide development of the San Diego program.

The final table provides an overview of different goals of each incentive program. SANDAG and others can use this information to help identify their own program goals and subsequently identify strategies for attainment.
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce data pertaining to costs, usage, and best practices of EVCS deployment to be used for future analyses</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increase access to EV charging technologies in low-income communities</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ease program requirements on the site host to relieve participation challenges</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increase charging infrastructure in businesses and MUDs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provide grid stability through VGI and ADR programs with EV chargers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provide charging infrastructure consistent with regional plans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Encourage larger projects to reduce administrative burdens and ensure more deployment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
As a mission-driven nonprofit organization, CSE works with energy policymakers, regulators, public agencies and businesses as an expert implementation partner and trusted information resource. Together, we are the catalysts for sustainable energy market development and transformation.
EVCS Funding Opportunities

Plug-in SD

June 2018

Prepared for
San Diego Association of Governments

Prepared by
Center for Sustainable Energy
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**Introduction**

For over a decade, California has pioneered the development of electric vehicle (EV) infrastructure or electric vehicle charging stations (EVCSs) and continues to outpace the rest of the country through its support of state goals for EVs on California roads. Public funding from federal, state, and local agencies has resulted in a variety of geographically focused incentive programs for EV infrastructure. These programs have been directly aimed at pushing the state towards the goal of 1.5 million zero emission vehicles (ZEVs) on the road by 2025. In 2018, another ambitious and significant marker for California set the bar for 5 million ZEVs on the road by 2030. Governor Brown’s Executive Order encourages substantial investments in electric and fuel cell vehicles, along with the necessary infrastructure to charge and fuel them. The Legislature and Governor annually appropriate Greenhouse Gas Reduction Fund (GGRF) to a variety of clean transportation, clean energy, and natural resources programs. This includes a $2.5 billion investment plan to boost the EV market in all regions of the state over multiple years. The investment includes $1.6 billion ($200 million per year for eight years) in dedicated funding for EV rebates and coordinates with the private sector to jumpstart the construction and installation of 250,000 EV-charging stations throughout the state by 2025. Recognizing the existing pace of ZEV infrastructure deployment is insufficient, the Governor also laid out a 2018 Climate Investment Plan that calls for $900 million over eight years to accelerate infrastructure deployment and aggressively sets the stage for legislative discussion on how to better leverage public funds and restructure the existing rebate program to attract more buyers to the ZEV market.

In 2015, the San Diego Association of Governments (SANDAG) adopted San Diego Forward: The Regional Plan (2015 Regional Plan). The 2015 Regional Plan provides a blueprint for how the San Diego region is expected to grow and evolve through a framework of regional transportation investment through 2050. The 2015 Regional Plan’s major goals support innovative mobility, healthy communities, and a vibrant economy. The 2015 Regional Plan offers more transportation choices—transit, ridesharing, walking, biking—that are better linked with housing and jobs to help reduce passenger vehicle greenhouse gas emissions. EVs also are identified as a strategy to reduce greenhouse gas emissions by substituting conventional vehicle miles traveled (VMT) with electric vehicle-miles traveled (eVMT). SANDAG could specifically help increase the eVMT of plug-in hybrid vehicles and generally support the use of EVs by helping fund the expansion of a publicly accessible regional charger network. This investment could dramatically increase eVMT and go above and beyond what would be expected under state policy alone.

This EVCS Funding Opportunities Report (Report) provides an overview of the current funding gateways for installation or purchase of EVCSs available in the San Diego region and identifies gaps in funding that would allow this vision to be realized. In efforts to identify where the gaps lie, this Report reviews sectors of the market that currently need EV charging, identifies areas of future need, and finally matches current funding opportunities to those sectors in need to identify gaps. The gaps will direct efforts to be made in future funding to help ensure each sector of the market has adequate access to charging.

**EV Charging Sectors**

The goal of this section is to identify sectors of the market that either currently need EV charging or will need charging in the future. This section will identify how many EV chargers, the type, and the number needed to reach the Governor’s goal of 1.5 million ZEVs on the road in California by 2025 and 5 million by 2030.

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102 [https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ggrfprogrampage.htm](https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ggrfprogrampage.htm)


Identifying need by market sector will provide a baseline of demand to compare against current funding opportunities, which will be applied to help identify gaps in funding.

**EV Charging Market Sectors**

EV charging comes in one of three types: Level 1 (L1), Level 2 (L2), and DC fast charging (DCFC). Among these, EVCS can either be networked or non-networked (commonly referred to as smart or dumb). These criteria provide a baseline for the types of equipment that are most commonly used in the market.

Beyond the type of EVCS technology, there are a variety of applications for these EVCSs that require different models of funding. The most common applications or places to install EV charging are at single-family homes, multifamily properties, workplaces (for employee use), public installations (which can be anywhere, e.g., commercial properties or public facilities), or for use by fleets. Due to the lack of consistency in reliable data, information on fleets was not included in this report.

**Estimated Charging Demand in 2025 in San Diego County by Sector**

The EVI-Pro tool, developed by the National Renewable Energy Laboratory (NREL) and the California Energy Commission (CEC) to help decision-makers plan for future EV-charging deployment, provides county-level results for estimations of EV charging demand by 2025. This tool augments the baseline of EV-charging demand by providing the number of chargers expected for each application and technology type. Figure 1 describes how many EVCSs are needed by application and technology type.

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Current Funding Opportunities
The following section identifies funding opportunities that currently exist for San Diego County, and nationwide.

Power Your Drive
The San Diego Gas & Electric (SDG&E) Power Your Drive Program\textsuperscript{106} was approved by the California Public Utility Commission in January 2016. The program seeks to identify workplaces and Multi-Unit Dwellings (MUDs) in the SDG&E service territory that are willing to host EVCSs at their locations. Over the lifetime of the program, SDG&E will install EVCSs in 350 locations. SDG&E approves sites that are seeking to install at least ten EVCS per site (five for MUDs). SDG&E will own, maintain, and operate the EVCSs while the electricity is paid for either by end-user or by the site host.

To be eligible, applicants must be either a workplace or MUD, dedicate at least five parking spaces for EVCS deployment, pay the required participation fee,\textsuperscript{107} and agree to promote EVs. However, even if applicants meet all criteria, it is at the discretion of SDG&E to determine which sites move forward. The program is only available for EVCS installation of smart L2 units and applicants pay a one-time participation fee of $630 per EVCS for workplaces (ten minimum; $6,300 total) or $235 per EVCS for MUDs (five minimum; $1,175 total). Power for the EVCSs is run directly from a SDG&E service transformer, and the EVCSs do not use electricity from the property’s side of the meter.

Electrify America
Electrify America (EA) program is the result of Volkswagen’s settlement for its improper diesel emissions reporting. Issued by the United States Environmental Protection Agency (EPA) as a notice of violation of the Clean Air Act, the scandal now funds a $2 billion program that includes $1.2 billion to be used for increasing EV-charging infrastructure throughout the country and 800 million in California alone. The California Air Resources Board has jurisdiction of EA investment plan in California\textsuperscript{108} and designates certain EVCS vendors for specific regions of the country to identify workplaces, MUDs, and highway sites suitable for large EVCS deployments (ten or more per site). Greenlots has been designated the EV service provider (EVSP) for the San Diego region and is currently accepting applications as well as actively identifying suitable sites. Greenlots selects the sites that will be the most effective for EVCS deployment based on applications received and the sites they select themselves. Therefore, not every application will be accepted.

This program pays for the complete cost of installation, including the EVCS unit itself. Once installed, Greenlots owns, maintains, and operates the EVCS at no responsibility to the applicant. This program is unique in that much of interaction with applicants is handled directly by the EVSP and applicants serve only as a site host for the EVCS. This reduces application requirements, removes payment burden from the applicants, and allows the EVSP to exercise expertise when selecting EVCSs and designing the site layout. While L2 and DCFC charging units have been mentioned as eligible technologies, it is unclear at this time which are eligible.

Tesla Workplace Charging Program
Tesla is currently offering free chargers to Tesla drivers who request them at their workplace, building on previous programs that offered Tesla charging stations for hotels and hospitality sites.\textsuperscript{109} This is a new program that is in the pilot stage and is meant to be as easy as possible for the end user. Users simply submit an online

\textsuperscript{106} \url{http://webarchive.sdge.com/clean-energy/electric-vehicles/power-your-drive-faq}
\textsuperscript{107} This fee is waived for participants that are located in CalEnviroScreen disadvantaged communities.
\textsuperscript{108} \url{https://www.arb.ca.gov/msprog/vw_info/vsi/vw-zevinvest/documents/zip_factsheet.pdf}
\textsuperscript{109} \url{https://www.tesla.com/charging-partners#apply}
request, which is followed by a short consultation with a Tesla representative. Applicants receiving multiple Tesla EVCSs can request universal J1772 connectors to provide charging for non-Tesla EVs as well. The program is open-ended at this juncture, and many step-by-step details are not indicated. Determination of if each site will move forward is at the discretion of Tesla. Since the program is privately funded, Tesla is interested in support sites that provide benefits to their own customers, not all EV drivers. Tesla also is developing details to offer this program for residents or property owners/managers of MUD properties in the future.

**Funding Gaps**
The goal of this section is to compare the current funding opportunities identified in the previous section with the EVI-Pro tool’s analysis of the demand for the short-term goal EVCS in 2025. This information provides a baseline for what is expected to be installed through funding programs and what is needed in the region to provide an idea of where funding will be required in the future. Figure 2 provides an overview of EVCS installation numbers expected from each of the current funding opportunities – subtracted are the needs estimated to provide a deficit to show where funding is needed.

*Figure 15 – Expected EVCS Funding Gaps*

<table>
<thead>
<tr>
<th></th>
<th>L2 Needed</th>
<th>L2 Planned</th>
<th>L2 Gap↓/Surplus↑</th>
<th>DCFC Needed</th>
<th>DCFC Planned</th>
<th>DCFC Gap↓/Surplus↑</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family Homes</td>
<td>5267</td>
<td>0</td>
<td>5267↓</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Multifamily Properties</td>
<td>658</td>
<td>1428</td>
<td>770↑</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Workplace</td>
<td>4050</td>
<td>3142</td>
<td>908↓</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Public</td>
<td>5485</td>
<td>35</td>
<td>5450↓</td>
<td>1980</td>
<td>55</td>
<td>1925↓</td>
</tr>
</tbody>
</table>

**Future Funding Opportunities**
This section provides an overview of planned funding opportunities to fill the gaps listed in Figure 2. It is important to note that many of these programs are in their early stages of development and exact numbers of planned EVCS installations are not available. Most of these programs, however, have developed a scope identifying the type and application of EVCS it will fund. These numbers can be used to estimate where gaps may or may not be filled.

*California Electric Vehicle Infrastructure Project (CALeVIP)*
In 2017, the CEC established the California Electric Vehicle Infrastructure Project (CALeVIP). The project works with local partners to design and implement regional EV-charger incentive projects to support installation of charging throughout California. CALeVIP is funded by the CEC’s Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) and works to remove barriers to EV adoption and support the state’s goals to improve air quality, fight climate change, and reduce petroleum use. It has currently funded just over $15 million, with the potential to provide up to $200 million in program funding. The program accomplishes its goals through the implementation of geographically targeted incentive projects (throughout California) that address a region’s EV-charging needs. The program prioritizes incentive projects across California based on the magnitude of the gap, and coordinates availability of other possible funding partners (which factors into the overall prioritization of projects in the system). The EVI-Pro tool indicated that a large

110 https://calevip.org/
need for charging exists, particularly in DCFC, throughout the San Diego region, making it possible for San Diego County to become a higher-priority region for a CALeVIP incentive project. A successful regional charging program, like the 2015 Regional Plan,\(^{111}\) would potentially complement CALeVIP efforts if the regional program covered L2 charging and CALeVIP implemented DCFC incentives.

**Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)**

The Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)\(^ {112}\) was established by Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) and authorizes the CEC to develop and deploy alternative and renewable fuels and advanced transportation technologies to reach the state’s climate change policy goals. Assembly Bill 8 (Perea, Chapter 401, Statues of 2013) re-authorized the ARFVTP through January 1, 2024, and will continue to fund alternative fuels, infrastructure, and support programs for EV-charging station development.

Competitive solicitations for DCFC along major corridors were issued by the CEC in the past and are likely to occur in the future.\(^ {113}\) These solicitations have been for a limited number of sites along certain highway segments as defined by the CEC. The CEC also has shifted funding priority from the state’s most heavily traveled routes (e.g., U.S. 101 and Interstate 5) to focused funding along secondary routes. For example, funding awarded two station sites on State Route 49 from Auburn to Grass Valley (this is a similar distance to State Route 67 from El Cajon to Ramona). This funding is limited to the best-scoring application for the segment with minimum technical requirements for the equipment and competitive scoring based on the firm’s experience, budget, implementation plans, site location, and other external factors. Due to the increased need for DCFC, future solicitations could include both underserved corridors as well as increasing capacity in already-served corridors. Funding was limited to approximately $175,00 per charging site with a 25 percent match requirement for most segments. The match requirement was, however, waived for certain segments with expected low utilization.

**California Capital Access Program (CalCAP)**

Financing programs, along with direct incentive programs, can also help property owners offset the upfront cost of charging-station installations. The California Capital Access Program (CalCAP) Electric Vehicle Charging Station Financing Program\(^ {114}\) is a state-sponsored program that is aimed at encouraging private lending to support the build-out of EV infrastructure by small businesses and MUDs. Loans of up to $500,000 are available to cover the cost of installation, equipment, and ongoing operations for all levels of EV charging. The CEC funds a loan-loss reserve for private lenders and offers a rebate of 10–15 percent of the total loan upon successful payback on the loan. The rebate can make the loan very low-interest and support positive cashflow depending on the terms on the loan. Despite these advantages, the program has seen very low participation and may undergo changes in the future. CalCAP has received $2 million in CEC funding with the goal to leverage $6–10 million in private lending.

**Residential Charging Program – SDG&E**

SDG&E has proposed a program to fund residential EVSE installations.\(^ {115}\) A unique feature of this program includes funds to cover the wiring from the service panel to the charging station, as well as the station cost. This program is still subject to final Public Utilities Commission approval as of the writing of this report, but the proposed decision would authorize $140 million recovered from ratepayers to install up to 60,000 L2

\(^ {111}\) [http://www.sdforward.com/](http://www.sdforward.com/)

\(^ {112}\) [http://www.energy.ca.gov/altfuels/](http://www.energy.ca.gov/altfuels/)


\(^ {114}\) [http://treasurer.ca.gov/cpca/calcap/evcs/index.asp](http://treasurer.ca.gov/cpca/calcap/evcs/index.asp)

\(^ {115}\) [http://www.cpuc.ca.gov/sb350te/](http://www.cpuc.ca.gov/sb350te/)
EVCSs at both single- and multi-family households. The program has an additional target of 25 percent of total installs made in designated disadvantaged communities. In conjunction with residential charging, SDG&E has proposed additional pilot projects that could expand the number of EVCSs in the region.

**Recommendations**

To provide ease in EV use and to increase vehicle adoption, more charging infrastructure needs to be deployed. An analysis of the state of California ZEV policies, allotted infrastructure funding, and future funding opportunities has shown that overall, the majority of use types will require more funding for L2 EV charging. Notably, both L2 and DCFC funding solutions are needed in public applications.

Regarding the residential sector, there is currently no funding opportunity available for L2 charging in single-family homes, though the proposed residential program from SDG&E may help cover part of this funding gap. For multi-family residences, both the SDG&E and Electrify America programs fund L2 EVCSs, though inclusion in the program is at the discretion of the provider and applicants must meet specific site requirements that limit many potential applicants.

Another notable funding gap shows a need for both L2 and DCFC in the public realm. The EVI-Pro tool identifies a need for 1,980 public DCFCs. Currently, only the Electrify America program, which focuses primarily on interregional travel has funds for public DCFC. Fast charging is one of the most expensive applications and technology types, making this a clear need for funding in this space. The new CALeVIP program may offer opportunities for funding in this area.

As battery technology improves and costs for EVCS decrease over time, a greater emphasis will be placed on DCFCs and their ability to serve more vehicles in a shorter period of time—whether in MUDs, workplaces, or elsewhere. For these reasons, funding for DCFC should be heavily analyzed and considered in the San Diego area and throughout the state of California.
As a mission-driven nonprofit organization, CSE works with energy policymakers, regulators, public agencies and businesses as an expert implementation partner and trusted information resource. Together, we are the catalysts for sustainable energy market development and transformation.
Census Tracts scoring in the top 25 percent statewide (most burdened/vulnerable) were selected within San Diego County to be identified as Disadvantaged Communities (DACs), consistent with the definition from Senate Bill 535 (De León, 2012). An alternative conceptualization of DACs was created using CalEnviroScreen data that omitted environmental and health factors identified by the Center for Sustainable Energy (CSE) unlikely to be related to or affected by EV adoption. Scores for drinking water, pesticides, toxic release, cleanup sites, groundwater threats, hazardous waste, impaired water bodies, solid waste, low birth weight, and cardiovascular disease were removed from consideration. The overall percentile for environmental burden and socioeconomic vulnerability was recalculated based on tracts within San Diego County. This resulted in a similar geographic distribution of DACs (see Figure A1).
Areas where the availability of EV charging infrastructure could accrue benefits to DACs were identified using travel patterns from the Activity Based Model (ABM). Trip ends for work-based travel (commutes) via automobile originating from DAC Census Tracts were summed at the Traffic Analysis Zone (TAZ) level (see Figure A2 for an overview of the pattern of travel). TAZs in the 50th percentile and above were included in the layer for benefit-accruing areas.

Figure A2 – Work Trip Ends Originating from DACs