Sacramento Electric Vehicle Blueprint

Phase 1 EV Ready Communities Challenge

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Several organizations, departments and people played key roles in the development of this project. The City of Sacramento would like to acknowledge them here. First, we would like to thank the lead consultant, Frontier Energy, for their hard work and dedication to this project. Second the City wants to recognize the invaluable input from the sub-consultants, DKS and Lucy and Company. Lastly, the Department of Public Works, who oversaw this project, would like to express gratitude for the collaboration between and among the Sacramento PEV Collaborative as well as City departments, including Community Development and Economic Development. This project would not have been possible without the efforts of all the involved organizations and departments.

PREFACE

Assembly Bill (AB) 118 (Nùñez, Chapter 750, Statutes of 2007), created the Clean Transportation Program (also known as the Alternative and Renewable Fuel and Vehicle Technology Program). The statute authorizes the California Energy Commission (Energy Commission) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. AB 8 (Perea, Chapter 401, Statutes of 2013) re-authorizes the Clean Transportation Program through January 1, 2024, and specifies that the Energy Commission allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of approximately $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance, and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the Energy Commission's Clean Transportation Program Investment Plan, updated annually. The Energy Commission issued grant funding opportunity GFO-17-604 under the Clean Transportation Program to fund projects for Phase I of an expected two-phase effort for electric vehicle-ready communities. Phase I planning blueprints will identify the actions and milestones needed to proceed towards implementation of an electric vehicle-ready community. In response to GFO-17-604, the City of Sacramento submitted application #9, which was proposed for funding in the Energy Commission's Notice of Proposed Awards dated April 6, 2018, and the agreement was executed as ARV-14-042 on July 24, 2018.

ABSTRACT

The City of Sacramento was a proud award recipient of the California Energy Commission's (CEC) Phase 1 EV Ready Communities Challenge. The goals of this project were to develop actionable blueprint planning tools that further implement the City's Electric Vehicle (EV) Strategy and align with Statewide EV goals. This effort:

- Built on early, collaborative EV planning efforts led by the City with regional partners.
- Reviewed EV deployment data tracked progress to develop accurate, updated EV baseline metrics
- Evaluated how best to accelerate EV infrastructure in new construction
- Conducted technical work to develop recommended siting and prototypes for community wide EV charging infrastructure.
- Conducted extensive community engagement with business and industry, community members and key community-based organizations and partners, with a focus on disadvantaged and underserved communities
- Developed work products to equip the City for implementation of EV-related mobility initiatives and maximization of economic benefits, including evaluation of early pilots in Sacramento, and analysis of EV infrastructure service models and best practices for local hire and workforce development
- Analyzed lessons from early pilots and recommended next steps to accelerate innovative EV programs, such as car share, or visible community projects such as e-mobility hubs
- Prepared the City to compete for future funding solicitations and implement the City's adopted EV goals

Sacramento is uniquely poised to implement and test various programs to increase deployment of electric vehicles. The City is rapidly emerging as a test bed for EV deployments. As a mid-sized community with a diversity of land uses, its lessons are applicable to many other Californian cities. The region, community, and private sector in Sacramento are supportive and successfully collaborating to advance EV deployment in Sacramento, with the goal of testing strategies that can be duplicated statewide and across the nation. Success in these areas promises to deliver environmental and economic benefits.

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EXECUTIVE SUMMARY

The City of Sacramento was a recipient of the California Energy Commission's (CEC) Phase 1 EV Ready Communities Challenge.[1] The goals of this project were to develop actionable blueprint planning tools that further implement the City's *Electric Vehicle (EV) Strategy* and align with Statewide EV goals.[2]

This report presents highlights and key lessons learned from the seven tasks and associated sub-tasks. A key objective of the project team is to ensure that outcomes of the challenge are useful to community partners and other jurisdictions as they continue their EV deployments and investments; due to the extensive nature of the reports, staff is still examining the most effective way to share key outcomes. It is anticipated that selections from tasks will be made available on the City website and by request.

Each task was designed to strengthen the City of Sacramento's understanding of the unique EV context, opportunities and barriers within the City and equip the City to realize policy goals; some tasks built on previous tasks and others were standalone documents or resources that can be used moving forward. As a result of the effort, the City is better equipped to prioritize, implement, and test community and industry supported EV programs, projects, and polices.

The team analyzed existing data and projections and used over twenty data sources to develop a local EV model and infrastructure siting prioritization tool. Extensive stakeholder engagement helped inform recommendations and evaluate constraints and opportunities to accelerate EV adoption and EV supply equipment (EVSE) deployment in new and existing construction. As a result, the team identified priority locations for the City to invest in throughout the City. Some of the strongest recommendations from this report include amending building and city codes to increase the amount of EVSE, installing EVSE at select City facilities, developing EV economic programs to meet the future job demand, and investing in an e-mobility hub pilot.

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1 https://www.energy.ca.gov/contracts/GFO-17-604/

2 http://www.cityofsacramento.org/-/media/Corporate/Files/Public-Works/Electric-Vehicles/EVStrategy_171212_FINAL_CityOfSacramento.pdf?la=en

CHAPTER 1: Administration

Summary

The City of Sacramento (City) worked with the California Energy Commission (CEC) to manage, administer, and complete the proposed project, meeting the minimum expectations established in the scope of work. The City used CEC grant funds to issue a request for proposals (RFP) for a consultant to supplement a major barrier of limited staff resources. Through the RFP, the City selected Frontier Energy as the successful lead consultant (with DKS Associates and Lucy and Company as sub-consultants). The team was selected due to their combined expertise and ability to complete technical tasks, prepare planning and report documents, and facilitate community engagement. The City leveraged City staff time as in-kind match to complete groundwork and analysis that supported the consultant-lead project.

Further, the City sought review and advice of local partners to provide guidance and feedback on the project in a highly participatory manner.

In addition to the in-kind match, City staff oversaw compliance with grant terms and conditions, provided effective project management and delivery, and disseminated work products and lessons learned.

CHAPTER 2:
Task 2 Electric Vehicle Deployment Plan

Summary

Task 2 equipped the project team to conduct the remaining tasks, providing the technical baseline data from which the project team could analyze and address opportunities in new construction, existing construction, and through community programs as described in the following tasks. The project team engaged community partners and representatives of disadvantaged communities to vet the maps and help prioritize areas for infrastructure development, accounting for community priorities that other electric vehicle (EV) models may not account for.

Task 2.1: Electric Vehicle Data and Forecasts

The purpose of **Task 2.1** was to collect, analyze and summarize EV adoption, EV infrastructure, modeling tools, and EV forecasts in light of the City's goals from the EV Strategy, including a goal to achieve 75,000 zero-emission vehicle (ZEVs) in Sacramento by 2025. Accurate and comprehensive EV data can be difficult to collect and confirm. This task provided important context for the remaining Blueprint deliverables. The project team examined technical data related to electric vehicles, including the current population of zero emission vehicles in Sacramento, current charging infrastructure, vehicle ownership and new car sales, and projected timelines for the growth of the EV market. In addition, the task included an assessment of a range of demographic and land use factors, such as Sacramento's population and housing, characteristics of disadvantaged communities, opportunities to increase EV adoption and potential limiting factors, future land uses, car sharing, and more.

Table 1 shows the calculations used to arrive at the baseline estimate of 4,664 total ZEVs and 2,390 battery electric vehicles in Sacramento zip codes as of January 1, 2019.

Table 1: Estimated Baseline of All ZEVs as of January 1, 2019

	EV	FCEV	PHEV	Total
DMV 1/1/18 registrations	1,887	79	1,751	3,717
CVRP rebates 1/1/18-9/30/18	290	26	219	535
Additional 30% ZEVs that did not apply for rebate	87	8	66	161
Estimated ZEV registrations 10/1/18- 12/31/18	126	11	95	232
Total estimated vehicles in Sacramento on January 1, 2019	2,390	2,131	124	4,644

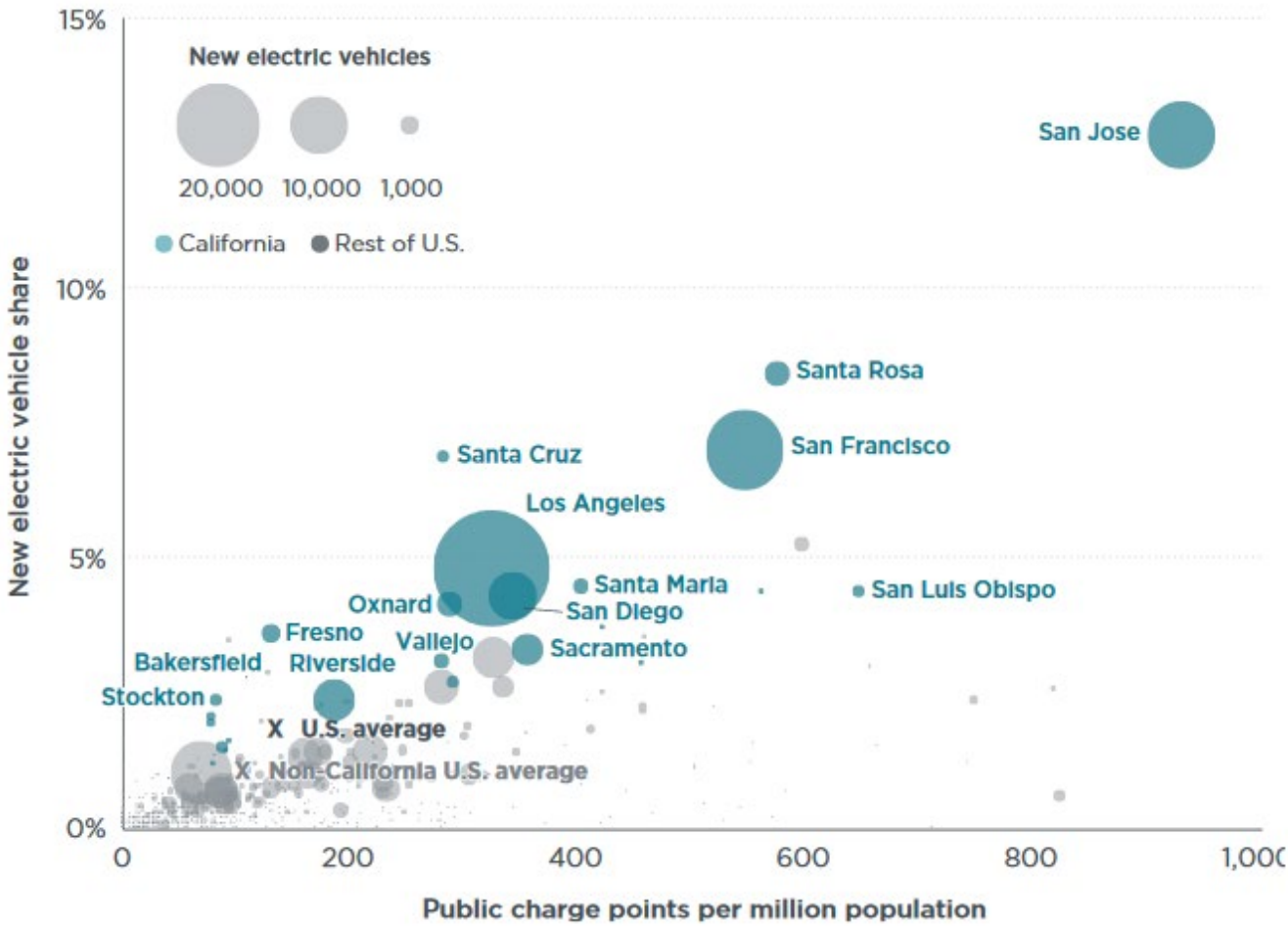
Source: City of Sacramento

ZEV adoption in Sacramento is lower than other areas of the state. The International Council on Clean Transportation (ICCT) publishes an annual report that quantifies EV market growth across California local markets.[3] The report calls out that Sacramento is the fifth largest metropolitan area by population and

3 https://www.theicct.org/sites/default/files/publications/CA-cityEV-Briefing-20180507.pdf

has a high percentage of public chargers per capita (**Figure 1**), yet is not in the top 30 cities for EV deployment.

Figure 1: Correlation of ZEV Adoption and Public Charging in Major Metro Areas



Source: Lutsey, Nic. 2018. *California's Continued Electric Vehicle Market Development*. ICCT, May 2018. https://theicct.org/sites/default/files/publications/CA-cityEV-Briefing-20180507.pdf.

Based on anticipated vehicle sale trends and the availability of ZEV options, **Task 2.1** identified the immense challenge in phasing out a fossil-fuel based fleet to achieve the City's targeted ZEV adoption levels. Even if over 40% of the new vehicles registered in Sacramento by 2023 were ZEVs, and 77% by 2025 were ZEVs, by 2025 just under 30% of Sacramento's vehicle stock would be ZEVs. These scenarios assume that Sacramento would capture 1.3% of new vehicle light-duty registrations every year, and are illustrated in **Table 2**.

Table 2: Illustration of Percentage of New Vehicle Sales Needed to Reach ZEV Target

Date	Registered ZEVs (Cumulative)	Total Vehicles	Assumed new registrations (ZEV and non-ZEV)	Assumed percentage of registration that are ZEVs	New ZEV registrations as a % of all new vehicles
1/1/2018	3,717*	591,134[1]	26,000***	0.63%	3%
1/1/2019	4,644**	617,134	26,000	0.75%	4%
1/1/2020	8,000	643,134	26,000	1.24%	15%
1/1/2021	12,000	669,134	26,000	1.79%	23%
1/1/2022	18,000	695,134	26,000	2.59%	35%
1/1/2023	27,000	721,134	26,000	3.74%	42%
1/1/2024	38,000	747,134	26,000	5.09%	65%
1/1/2025	55,000	773,134	26,000	7.11%	77%
1/1/2026	75,000	799,134		9.39%	
Total registered ZEVs – 2026 (estimated)			**208,000**		

Source: City of Sacramento. *From DMV data on 1/1/18. **Based on estimates developed in Task 2.1. *** Only assumes light-duty vehicles. Does not include new trucks, buses, or medium-duty vehicles that are included with DMV data.

According data from the Alternative Fuels Data Center and PlugShare,[4] Sacramento has 110 public and workplace charging locations that are open and under construction (as of April 2019). When all are completed, the sites will have 612 connectors, as listed in **Table 3**. Most chargers are in parking garages and lots, and at the area's largest employers including the Sacramento Municipal Utility District (SMUD), Kaiser, University of California (UC) Davis, government buildings, and colleges. The highest density of public chargers is within the Downtown core, leaving major gaps throughout the City, especially in disadvantaged communities.

Table 3: Public charging connectors available and under construction in Sacramento

Total Charging Connections	612
Level 1 (wall outlet—full charge in 8+ hours)	72
Level 2 (full charge in 4-6 hours)	454
DC Fast Charging (full charge in less than an hour)	39
Tesla-only (uses a specific connector)	47

Source: Alternative Fuels Data Center, PlugShare

Based on analysis conducted with the Electric Vehicle Infrastructure Projections (EVI-Pro)[5] model, the project team estimated that Sacramento would require more than 730 additional workplace Level 2 charging connectors, over 390 public Level 2 charging connectors, and over 300 DC fast charging connectors in addition to the public charging connectors currently available and under construction. Single family homes are estimated to need more than 53,000 additional at-home charging connectors. Car-sharing and on-demand transit may fill some of the gap by reducing the number of cars per household and compliment the City's other efforts to reduce vehicle miles traveled. These alternative forms of

4 https://www.plugshare.com/

5 http://www.energy.ca.gov/altfuels/2017-ALTI-01/documents/

transit may also alleviate inequities in education, employment, and health in Sacramento's disadvantaged communities.

As transit buses, school buses, and local delivery vans are adopted, they may have a larger impact on greenhouse gas reduction targets than light-duty vehicles. Medium and heavy-duty vehicles often need different infrastructure than passenger cars and light trucks but could present opportunities for co-locating charging equipment that could serve both vehicles.

Task 2.2 & 2.3: Local EV Model & User Guide

Tasks 2.2 and **2.3** developed a local model for EV deployment and an EV modeling user's guide so that data collected and analyzed in **Task 2.2** could be replicated in the future by both City of Sacramento staff as well as other cities, if interested. The guide described the process used to determine the number of EVs and electric vehicle supply equipment (EVSEs) in Sacramento at the beginning of 2019 and helped lay the groundwork for identifying actions the City of Sacramento can take to foster charging infrastructure deployment. Maps and forecasts were developed at the census tract level, which is not a perfect match to the City of Sacramento's boundaries. However, census tracts provided a consistent location for data from multiple sources, including:

- CalEnviroScreen (CES) identification of disadvantaged communities
- Clean Vehicle Rebate Program (CVRP) Data
- Census data
- Department of Motor Vehicles (DMV) data
- California New Car Dealers Association 2017 Vehicle Statistics
- EVI-Pro tool
- City of Sacramento's 2035 General Plan – forecasted population growth
- American Community Survey
- Alternative Fuels Data Center
- PlugShare
- UC Davis
- Sacramento Area Council of Governments (SACOG)

The data was used to develop the initial maps listed below, providing a foundation for ongoing analysis in later tasks. Maps produced for these tasks included:

- Locations of Existing Level 1 (L1) EV Charging Stations (Public and Private Connectors)
- Locations of Existing and Planned Level 2 (L2) EV Charging Stations (Public and Private Connectors)
- Locations of Existing and Planned Level 3 (DCFC) Charging Stations (Public and Private Connectors, Within and Adjacent to City of Sacramento)
- Locations of Publicly Owned Properties (Including City Facilities)
- Disadvantaged Areas Lacking Convenient Charging Access (Greater than 1/4 Mile from Existing/Planned Electric Vehicle Service Equipment)
- Plug-In Electric Vehicle Adoption Density Estimate by 2025 (by Census Tract) Assumes 35% Adoption Rate using UC Davis EV Toolbox
- CVRP Rebates: 2015-2018 (City Census Tracts)

- Existing Multi-Unit Dwellings (MUD) Density by City Census Tract Apartment Complexes of 3 or More Units
- Neighborhoods Likely to be Feasible for Car Sharing (two scenarios) American Community Survey (ACS)
- Potential Home and Workplace EVSE Demand Generators

Task 2.4: Sacramento EV Infrastructure Deployment Plan

The goal of this report was to establish Sacramento's EV Infrastructure Deployment Plan that described considerations about and target locations for deployment of charging infrastructure (EVSE) to support 75,000 EVs in Sacramento. This report pulled from the data in preceding tasks and other tasks that were conducted in parallel, including **Task 4.1**, which evaluated the current status and utilization of public and workplace EVSE.

In order to determine the scope for this task, the project team evaluated infrastructure needs based on findings from **Task 2.1** and other work products. To support 75,000 light-duty EVs, in addition to the existing charging connectors, it is estimated that Sacramento needs to add:

- 738 workplace L2 charging connectors
- 398 public Level 2 charging connectors
- 399 DC fast charging connectors
- 6,600 multifamily charging connectors
- 53,733 Level 1 or Level 2 charging connectors at single-family residences

The need for public and workplace charging, and other electric mobility programs, is greatest in Sacramento's disadvantaged communities that are disproportionately burdened by multiple sources of pollution and socioeconomic vulnerability. The report presented many options to address this gap, including options for requirements for EVSE in new construction, parking regulations, options for charging at public facilities, car sharing and shared mobility charging programs, and engagement and education. Later tasks examine these opportunities in greater detail.

Most notably, as a part of **Task 2.4**, the project team, in conjunction with stakeholders, developed a tool to assign scores/priority for EVSE investment by census tract using data in the EV Blueprint tasks (EVSE Priority Siting Tool). The score indicates the need for electric vehicle charging infrastructure based on twenty weighted variables. Each category (variable) was assigned a method of "Absolute" or formula-based "Ranking" and a relative weighting that could be adjusted over time, depending on specific priorities or challenges. The criteria can be adjusted based on technology, organization type and specific project priorities. For example, for projects looking to site DCFC, prioritizing census tracts with dwell times less than 2 hours could be an appropriate method to identify opportunities; whereas for projects looking to site L2 and L1, prioritizing dwell times greater than or equal to 2 hours could identify more appropriate opportunities. As a result, each census tract received a "need score," with 1 as the tract that had the most need for EVSE and 112 as the tract for the least need, for any given scenario. The tool is designed to use data to inform and guide conversations and EVSE siting decisions. However, it was designed as a starting point rather than be relied upon as the only decision-making criteria. The role of the tool as a supportive analytical resource is also reflected in its limitations: the tool focuses on identifying priority census tracts and does not narrow down to specific parcel recommendations.

Weighting factors were developed with input from City of Sacramento staff and the Sacramento Plug-in

Electric Vehicle (PEV) Collaborative steering committee. To maintain objectivity in rankings, a decision was made to limit values of the weighting factors for any single category as follows:

- +1: Average weighting
- +3: Higher than average weighting (limited to 20% of all factors)
- +5: Highest priority weighting (limited to 10% of all factors)
- <1: Lower than average weighting (limited to 20% of all factors)

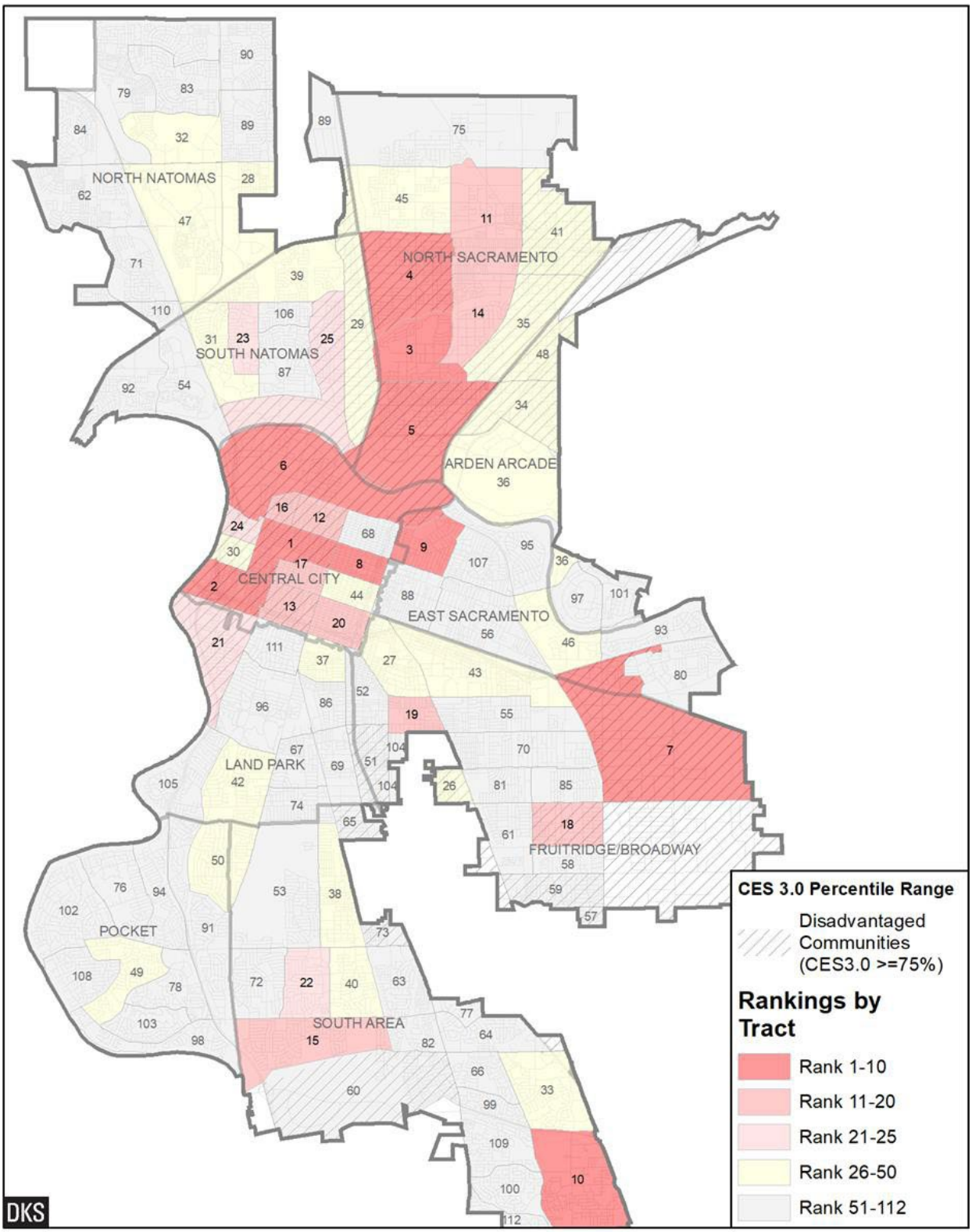
One scenario the team ran was to identify highest opportunity locations of City-owned properties that could potentially host public EV charging for nearby residents, with a focus on low-income and disadvantaged communities. Therefore, of the 20 total categories, the highest weighting factor of 5 (shown in bold in **Table 4** below) was selected for two categories (low-income residents and City-owned properties such as libraries, community centers, and parks). The higher-than-average weighting factor of 3 was selected for three categories (disadvantaged communities, percentage renters, and multifamily dwelling units). The lower-than-average factor of 0 (shown in red) was selected for two categories (jobs based on ACS data and vacant residential zoned acreage). The lowest-priority weighting of -1 (shown in red) was selected for the two existing EVSE categories, representing the fact that exiting EVSE does not necessarily support the need for additional EVSE nearby. The remaining 11 categories have an average assumed weighting of +1. The results of this scenario are displayed in **Figure 2**.

Table 4: Example Census Tract Weighting Factors, Scenario 1

Weighting Category	Weighting Type	Weighting Factor	Total %
Low Income	**Absolute**	**5.0**	2 10%
City Owned Properties (Libraries, Community Centers, Parks)	**Relative**	**5.0**	
Percent Renters	**Relative**	**3.0**	3 15%
Disadvantaged Communities (CES 3.0)	**Absolute**	**3.0**	
Multi-Family Dwelling Units	**Relative**	**3.0**	
CVRP Rebates	Relative	1.0	11 55%
City Owned Parking	Relative	1.0	
Employment (based on Parcel Land Use)	Relative	1.0	
SACOG Growth in Households	Relative	1.0	
SACOG Growth in Employment	Relative	1.0	
Work Based Dwell: >=2 hours (existing)	Relative	1.0	
Non-Work Based Dwell: <2 hours (existing)	Relative	1.0	
Non-Work Based Dwell: >=2 hours (existing)	Relative	1.0	
Work Based Dwell: >=2 hours (growth)	Relative	1.0	
Non-Work Based Dwell: <2 hours (growth)	Relative	1.0	
Non-Work Based Dwell: >=2 hours (growth)	Relative	1.0	
Jobs (ACS)	Relative	0.0	2 10%
Vacant Residential Zoned Acreage	Relative	0.0	
Existing EVSE (Level 2)	Relative	-1.0	2 10%
Existing EVSE (DCFC)	Relative	-1.0	

Source: City of Sacramento

Figure 2: Results—Census Tract Opportunities, Example Ranking for Intersection of City-Owned Land and Low-income Residents, Scenario 1



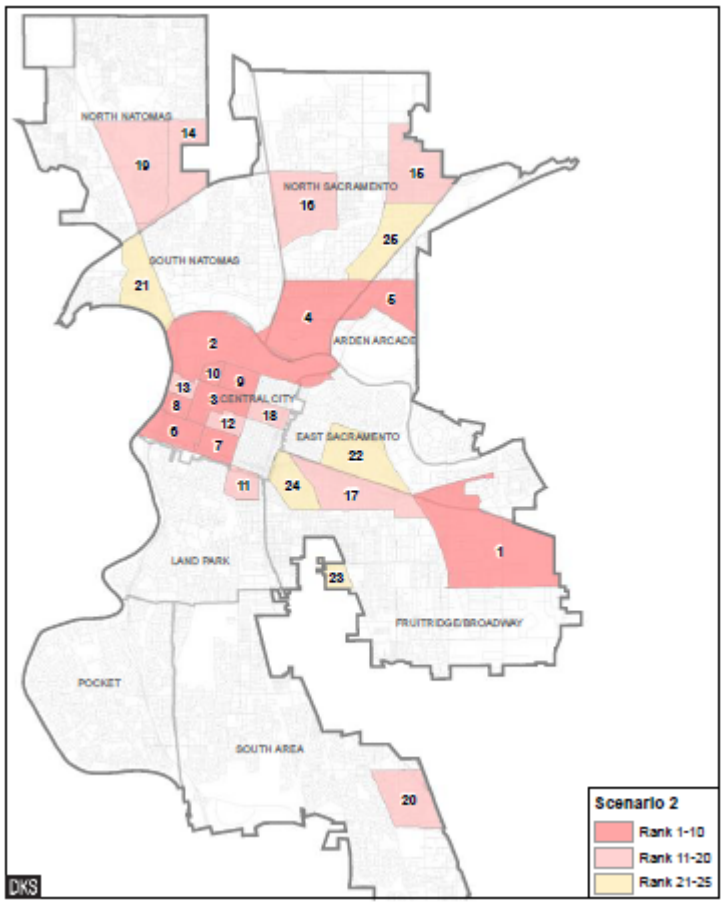
Source: DKS Associates

To demonstrate how results change when an organization uses different weighting factors for different purposes, the team created two other scenarios:

1. A second scenario focused on business charging in low-income communities. This scenario gives most weight to jobs and job growth factors; with the second highest weighting placed on low income, CES score, and workplace dwell time criteria (**Figure 3**).
2. A third scenario focused on residential charging in low-income communities with vacant land. This scenario gives most weight to low income and percentage renters; and the second highest weighting placed on criteria of vacant residential land, household growth, and non-work dwell time (**Figure 4**).

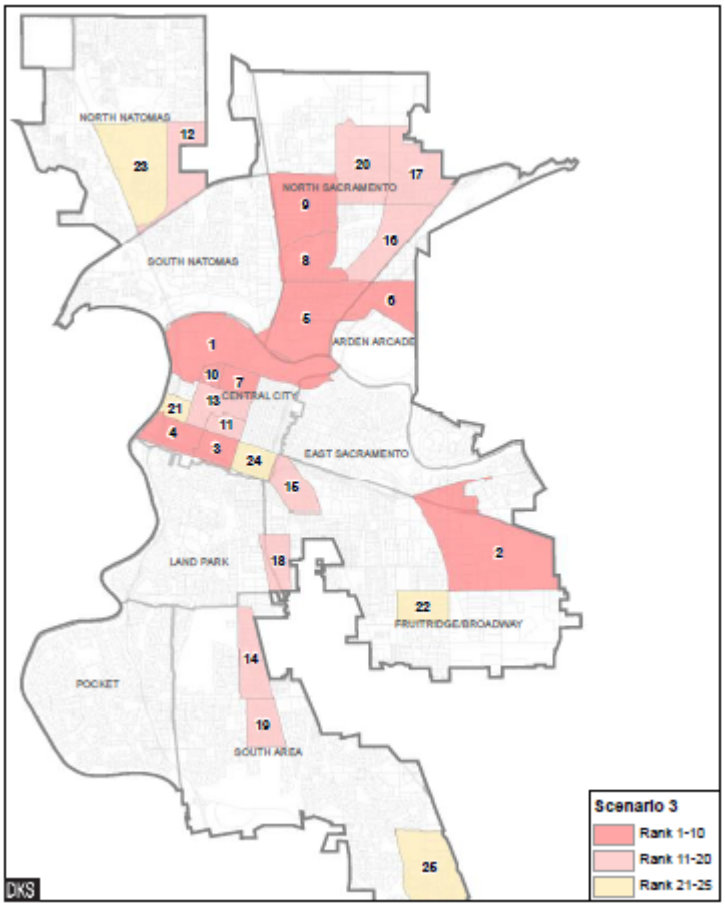
As the Sacramento EV Strategy continues to roll out, City staff, partners or other cities can quickly update the spreadsheet, which also contains geo-coding information that can be loaded into ArcGIS, Google Earth, and other map-based software to create a visual display. Data and methods for updating are explained in detail in the report.

Figure 3: Census Tract Opportunities:
Example Ranking of Business Charging Opportunities in Disadvantaged Communities, Scenario 2



Source: DKS Associates

Figure 4: Census Tract Opportunities:
Example Ranking of Residential Low-Income Opportunities with Vacant Land, Scenario 3



Source: DKS Associates

The team also developed a turnkey tracking spreadsheet to track vehicle deployment by quarter. Each year, the user can create a new tab in the spreadsheet and a new "starting number" (links to data sources are embedded in the spreadsheet). Tracking the number of ZEV cars, trucks, and buses on the road helps the City better understand deployment and infrastructure needs. Data linked in the tracking tool includes: CVRP Rebates + 30%, Clean Cars 4 All (new and used), California Air Resources Board (ARB) Clean Mobility, ARB Clean Off-Road Equipment (CORE), school bus awards, City fleet vehicles, County fleet vehicles, electric car share vehicles in the city, electric car share trips, other car share vehicles, other car share trips, ZEV buses, ZEV bus riders.

CHAPTER 3:
Community Electric Vehicle Planning Blueprint

Summary

Using information from **Task 2**, the project team evaluated options for advancing EV infrastructure in new construction and private property (both new and existing construction). To initiate the task, the consultant team evaluated constraints and opportunities, accounting for Sacramento's policy context and unique challenges for housing construction. This task included a cost-effectiveness report (which compared costs of different levels of EV-readiness in new construction), stakeholder meetings to further understand and inform EV opportunities for new development, recommendations for the City's code and permitting framework to accelerate EV-readiness in new construction, and a presentation to the Planning and Design Commission. All these tasks resulted in a blueprint report summarizing Sacramento's approach to advance EVSE in new construction.

Findings from the various **Task 3** components resulted in recommendations to amend the California Green Building Standards Code (CALGreen) and City Code, addressing the following components:

- Recommendations for code updates for EV-readiness and infrastructure requirements in the City Building and Construction Code (Title 15) for the next cycle of the California Building Code in 2019, which included recommendations to exceed mandatory CALGreen standards by recommending a requirement for EV ready parking spaces instead of EV capable spaces.
- Recommendations for updates to the City Planning and Development Code (Title 17) to incentivize and/or require EV-readiness through land use standards, including additional guidance for implementation of the City's 2040 General Plan update.

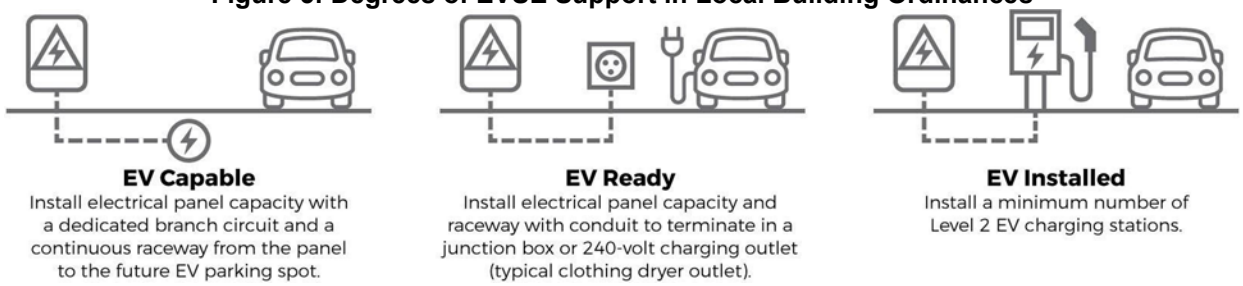
Task 3.1: Evaluate Constraints and Opportunities to Accelerate Electric Vehicle Supply Equipment (EVSE) in New Construction

This memo identified the existing building codes that determine EVSE in new construction, summarized reach codes and best practices/lessons learned or implemented in other cities, and modeled the energy used by an EV to new construction to help identify local ordinances, reach codes, and incentives to encourage more EVSE parking spaces than required by state code. This information prepared the team for engagement with affordable housing providers and local developers to help determine recommended options to accelerating EV infrastructure.

CALGreen dictates the measures that the built environment must put in place to meet climate reduction goals set forth in Assembly Bill 32, including "facilitating future installation of electric vehicle supply equipment". New codes are adopted every three years and outline mandatory, Tier 1 and Tier 2 requirements. 2019 starts a new code, with changes effective January 1, 2020. As in previous code cycles, it requires EV Capable parking spaces, meaning that the building includes capacity in the electrical panel and spacing for wiring for a building inhabitant to install wires, circuits, and plugs for EV charging equipment at a future date. EV Capable parking spaces do not require installation of a junction box or outlet, nor do they require installation of EVSE with a vehicle connection. Accordingly, EV Capable spaces

ensure capability for future EV charging infrastructure, but do not guarantee the installation of EV supply equipment. In other words, EV Capable spaces provide opportunities for potential EV charging connections if someone chooses to complete the installation, but EV Capable spaces do not ensure an actual charging connection for a vehicle is ever installed. **Figure 5** explains the different levels of EVSE support.

Figure 5: Degrees of EVSE Support in Local Building Ordinances



Source: City of Sacramento

The 2019 CALGreen codes will go into effect on January 1, 2020. The new code cycle requires:

- Single-family residences, including townhomes and duplexes, be EV Capable
- Non-residential new construction and major alterations ($200,000 or 1,000 square feet) to have up to 6% of parking spaces be EV Capable.
- Multifamily dwelling construction to have 10% of parking spaces be EV capable

Table 5 lists the non-residential EVSE requirements and voluntary measures that go into effect on January 1, 2020.

Table 5: Non-Residential EVSE Requirements and Voluntary Measures

Total number of parking spaces	Number of required EV Capable spaces	Tier 1 Required EV Capable spaces	Tier 2 Required EV Capable spaces
0-9	0	1	1
10-25	1	2	2
26-50	2	3	4
51-75	4	5	6
76-100	5	7	9
101-150	7	10	12
151-200	10	14	17
201	6% of total	8% of total	10% of total

Source: CALGreen

The report listed many opportunities and their associated benefits and constraints within building code, parking regulations, and city planning (including opportunities in the General Plan update). The report also outlined the process for the City to enact a local ordinance with the California Building Standards Commission (CBSC) to demonstrate the reach code is "reasonably necessary because of local climatic, geological, or topographical conditions." Because EVSE does not reduce energy use or save costs related to the building or parking lot, cost justification for local ordinances is typically based on retrofit costs. The jurisdiction must submit for reach code certification each time CALGreen is updated. Prior to filing with CBSC, the City must undergo a formal public input process. Cost is also a

consideration for reach codes. Understanding the process is essential to guide public engagement and future implementation of any reach codes the City pursues.

Task 3.2: EV Infrastructure Cost-Effectiveness Study for Sacramento

Completing a cost-effectiveness study for EVSE in Sacramento equipped the City of Sacramento and its contractors to conduct public outreach to gain feedback about possible City code changes. This information can also be used in justification for future reach code ordinances.

The list below shows estimated costs per parking space for each degree of EV support during new construction. Costs independent of building type or size.

- **EV Capable – $800 per parking space** for compliance with base CALGreen requirements, per the cost estimate ARB used in the CALGreen cost justification
- **EV Ready** – an average of costs reported by other jurisdictions and confirmed in stakeholder interviews. Sacramento stakeholders stated that **$1,100 total costs per EV Ready parking space** is a valid mean number based on 2019 construction costs. This represents an 11% increase over the mandatory costs.
- **EV Installed** – a pedestal-mount Level 2 EVSE that is not networked and does not accept payment was found to be approximately $3,000 according to 2015 and 2017 Department of Energy reports. Stakeholders stated that wall mounted EVSE can cost less than $3,000 and networked EVSE can cost more, but construction costs were about the same. Stakeholders agreed that **$6,000 per EVSE** was a valid mean cost. This represents a 60% increase over the mandatory costs.

The Energy Code (Title 24 Part 6) of the California State Building Codes will require additional energy efficiency measures and solar panels on all new construction. Discussion of increasing photovoltaics (PV) to support EVSE is a topic of interest to many stakeholders. However, this report concluded that a local ordinance that would require non-residential construction to install additional solar to offset the energy used during vehicle charging would not pass the cost-effectiveness requirement. Therefore, the City decided not to pursue this any further.

Lastly, it's important for developers and electric service providers to understand how adding EV parking spaces will impact the overall load profile on the utility, especially on the local transformers serving those developments. This is a complex issue requiring detailed utility data and was beyond the scope of this project, but to provide some initial indication of potential impacts the project team completed preliminary modeling to provide initial guidance on load impacts.

Task 3.3: Convene Stakeholder Meetings on EV Opportunities for New Development

Task 3.3 aimed to engage stakeholders to provide feedback and recommendations for a preferred option to accelerate EVSE installation in new construction. The team hosted three 60 to 90-minute focus group sessions, one for each of the following local stakeholder groups: developers, affordable housing and EV mobility and technology companies. The focus group participants were asked questions in an interactive setting; the open and free discussion generated ideas and insights the City of Sacramento can use going forward. Participants also discussed program barriers to provide service to low-income and disadvantaged communities. Overall, the three groups were supportive of proposals to introduce a local ordinance to

require EV Ready instead of EV Capable, and highlighted the importance of complementary programs to accelerate adoption in underserved communities. The participants provided general feedback including their perspective for related benefits, challenges, and opportunities.

Task 3.4: Recommended EV Readiness Framework

This task developed recommendations for the City's code and permitting framework to accelerate electric vehicle readiness in new construction. Recommendations included amendments and evaluation of other jurisdiction's efforts to exceed the CALGreen standards for EV compliance. The report listed options that the team thought were likely most-feasible for the City of Sacramento to implement in 2019 and 2020.

To submit an ordinance to the CBSC, the City must submit amendments documents including:

1. Cover letter
2. Proof of Publication (if required by City of Sacramento)
3. Copy of Signed Ordinance
4. Copy of Findings (usually the staff report submitted to City Council)

The ordinance must contain the language in the code with redlining of proposed changes. **Task 3.4** includes draft materials and code revisions for both the recommended CBSC (Building Code) revisions as well as City Code revisions. City staff can use these materials as a starting point to implement changes to various codes to increase EVSE, pending direction from City leadership and additional stakeholder vetting.

Task 3.5: Commission, Committee, and Council Hearings

City staff presented options for revised and new codes to the City's Planning and Design Commission on June 13th, 2019. This was the first formal public forum to discuss options to go beyond CALGreen minimum requirements. As discussed above, rather than pursuing Tier 1 or 2 as some other jurisdictions have done, recommendations from this project emphasize the cost-effectiveness of requiring EV Ready spaces in lieu of all mandatory EV Capable spaces required by CALGreen. Staff will use this material to bring forward recommended options for consideration by City leadership, providing balanced, cost-effective options to increasing EVSE in the City. The Planning and Design Commissioners reviewed and commented and were generally supportive of requiring EV Ready spaces and further accelerating EV infrastructure through other components of City Code. Planning Commissioners discussed issues such as progress towards EV goals and how to site what type of chargers and where.

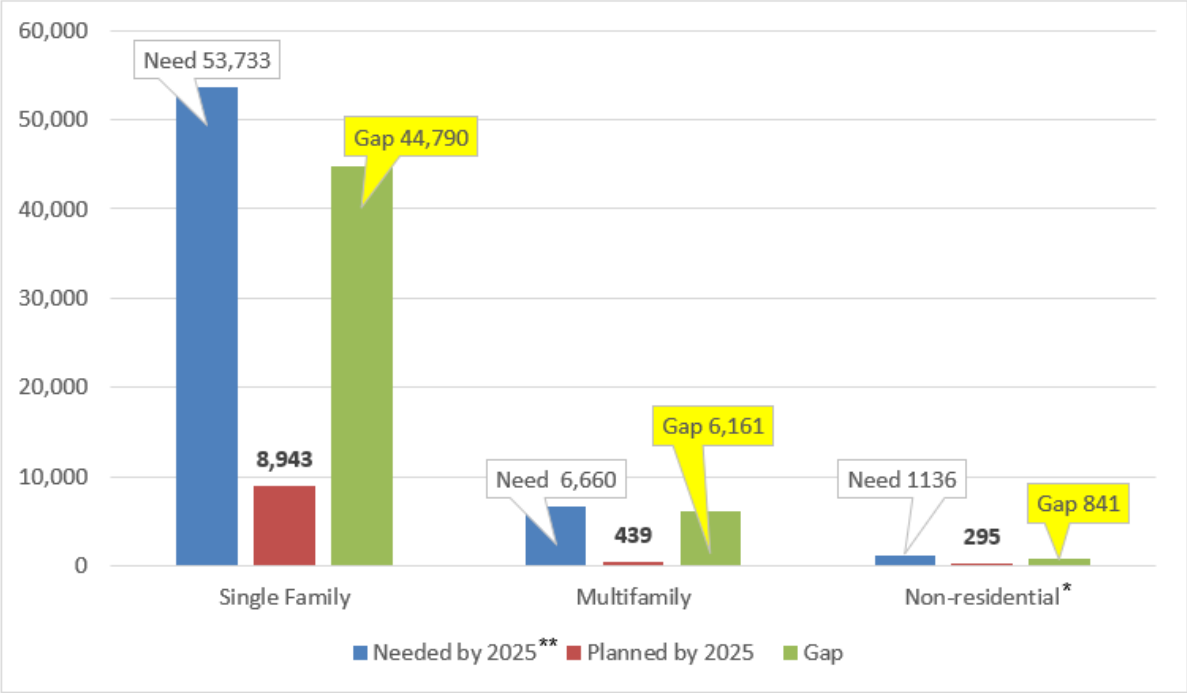
Task 3.6: Community EV Planning Blueprint

The goal of this task was to prepare a blueprint report summarizing Sacramento's approach to advance EVSE in new construction and compiling all findings from the preceding **Task 3** deliverables. This report also identified the contribution of future EVSE in new construction to achieve the goal of 75,000 zero emission vehicles by 2025.

Using data from **Task 2.1** and **2.4** and data provided by the City of Sacramento Community Development Department to project the number of EV spaces expected from new construction, the project team estimated the gaps in infrastructure that would still exist (as shown in **Figure 6**). The analysis in this task showed that the minimum code requirements will still result in a large gap in infrastructure (both public and private) needed to support 75,000 EVs by 2025, and the gap is greatest in disadvantaged

communities. DCFC was not included in the gap assessment since installation of DCFC are voluntary and dependent on many other factors that are difficult for the team to project. However, based on how quickly funds were reserved and provisionally reserved for DCFC rebates through the California Electric Vehicle Infrastructure Project (CALeVIP) in spring 2019, the City expects to see a significant increase in DCFC units available throughout the region by 2021.

Figure 6: Expected Gap in Charging Infrastructure by 2025



Source: City of Sacramento. *Public and workplace L2 chargers. ** Needed in addition to existing charging connectors.

Building and city codes are tools that cities can use to increase EV infrastructure. Summary of options for code revisions or other mechanisms to achieve City goals:

1. Begin the process for adopting a local ordinance that requires EV Ready as mandatory in single-family residential, multifamily, mixed-use, and non-residential new construction and major alterations in 2020.
2. Revise the "Transportation management plan measures" (City code 17.700.070) to specify that above-code EV charging and EV car share programs are acceptable measures.
3. Revise "Development standards for off-street parking facilities" (City code 17.608.040) to describe the location, size, and signage required for EV spaces in parking lots and structures.
4. Add a new section to "Development standards" that requires EV support in new parking structures that require electricity.
5. Revise the "Parking requirements of land use type and parking district" (City code 17.608.030) to require EV support consistent with the building code in stand-alone parking lots and structures.

6. Revise “Alternatives to standard parking requirements; other modifications” (City code 17.608.060) to enable developers to install above-code EVSE to deviate from minimum parking requirements.
7. Revise “Waiver of minimum and maximum parking requirements” to require that parking spaces above the maximum be constructed as EV installed.
8. Create a new code using tree shading requirements for parking lots (City code 17.612.040) as a guideline that will require minimum EVSE compliance for parking lot construction projects.
9. Coordinate with businesses and educators to develop a business case for EVs by increasing the workforce and supporting synergetic projects for car-sharing.
10. Support and/or seek funding for an e-mobility hub pilot, ideally in partnership with other agencies and local groups, for a project at a park-and-ride lot in a low-income/disadvantaged community. Consider leveraging funding from the upcoming Clean Mobility Voucher project and grants from SACOG.
11. Identify opportunities for increased insight from data collection and analysis.

The Sacramento EV Blueprint demonstrates that new construction alone cannot meet the need for charging infrastructure. To encourage more infrastructure, EV charging also needs an attractive business case. During the Sacramento EV Blueprint project, the City identified five approaches that may reduce costs of installing EV infrastructure or remove other barriers to deployment:

1. Job training – the project identified a crucial need for more electricians.
2. Hotels and car-sharing – because visitors often use rental cars, taxis, or ride-hailing, they already expect to pay for local transportation. Shifting that transportation to a shared EV scenario can increase the number of EVs in Sacramento, increase EVSE usage, build a profit model for car-share providers, and reduce the number of cars on Sacramento streets.
3. EVSE at City facilities – the team used the EVSE Priority Siting Tool and input from stakeholders to identify five recommended locations to add EVSE at City-owned properties: Hagginwood Community Center, Oak Park Community Center, Samuel C. Pannell Community Center, Martin Luther King Jr. Library, Oakbrook Park (under construction). (Refer to the description in **Task 2.4** for more background on the EVSE Priority Siting Tool.)
4. E-Mobility Hubs – these centers can serve as areas of connectivity where multiple modes of travel converge, and are of interest to many private and public organizations. These locations can provide an integrated suite of mobility modes—safe walking and biking, transit connections, and cars; amenities like lockers, wayfinding, and enjoyable waiting areas; and technologies like dynamic parking management strategies, real-time traveler information, and real-time ridesharing. The report included conceptual drawings and anticipated costs.
5. Disadvantaged Communities – the project team identified disproportionate need for EVs and EVSE in disadvantaged communities, with concepts for how services and infrastructure can better meet their needs. For example, in addition to recommendations for cost-effective Level 2 EVSE at existing community centers in disadvantaged communities, **Task 6.3** identifies recommended

components for e-mobility hubs that provide cross-cutting benefits, such as provision of e-commerce lockers that can provide storage for food banks or other services critical to the community.

Ongoing, proactive engagement with stakeholder groups will be necessary to implement any of the recommended options listed above. Sacramento has an effective stakeholder group, the Sacramento PEV Collaborative, which meets monthly and discusses efforts, needs, and upcoming opportunities. During the Sacramento EV Blueprint project, the EV Blueprint team met with additional groups and identified two more stakeholder groups that will be essential to meeting the City's 75,000 ZEV goal; local business districts and workforce industries. In addition, engaging expertise from data scientists and similar disciplines will be key in effectively implementing and evaluating the success of EV initiatives.

CHAPTER 4:
Public Charging Prioritization Plan

Summary

While **Task 3** focused on new construction, **Task 4** sought to better understand and optimize existing public and workplace EV charging infrastructure, with specific analysis focused on opportunities for City-owned EVSE. The project team conducted an in-depth evaluation of current status and utilization and developed a plan to optimize and increase public access at key facilities, with a focus on service in disadvantaged communities. This task helped address gaps between existing EV access and the EV infrastructure needs identified in the geospatial analysis in **Task 2**. Public engagement in various tasks allowed for early discussion and vetting of findings and priority locations for charging.

Task 4.1: Evaluate Current Status and Utilization of Public and Workplace EVSE

Although most early EV adopters currently charge their vehicles at home, public charging is an important part of the EV ecosystem. The need and demand for public and workplace charging connectors is dynamic and based on many factors including user type, travel patterns, advancements in battery technology and more. These types of chargers can help relieve range anxiety, improve connectivity between and within regions, increase consumer awareness, and improve equity and accessibility if planned appropriately. Public and workplace charging infrastructure is essential to spur increased EV adoption, particularly for residents of multi-family dwelling units and commuters traveling long distances to work in city limits.

Sacramento has over 600 public and workplace charging connectors within city limits. While Sacramento has been a long-standing leader in electrification and has implemented a range of initiatives to deploy EV programs and infrastructure, there is opportunity for continued improvement. Most public charging locations are in parking garages and lots; the area's largest employers including SMUD, Kaiser, UC Davis, government buildings; and colleges. Much of the existing infrastructure is in downtown Sacramento. Gaps still exist in areas such as South Natomas, which has the largest amount of multifamily housing in Sacramento; the Pocket area, with low-density suburban homes and higher density multi-family units and few workplaces; and in Sacramento's disadvantaged communities. This pattern indicates that current public and workplace infrastructure supports mostly commuters, but not residents in general.

Multiple incentive programs are currently available to increase the amount of publicly available EVSE in Sacramento, notably CALeVIP with over $14MM available to projects within Sacramento County. Major investment is still needed to achieve the 2025 targets. Recent public-private partnerships, such as Electrify America's Sac-to-Zero program, and the EV curbside charging pilot with EVgo, help provide a strong foundation for future efforts and increase the amount of EVSE infrastructure.

Understanding use of public and workplace EVSE is extremely difficult because the data is not shared openly. To get a sense of general usage patterns, data for five City-owned, City-operated garages was analyzed (Capitol Garage, Memorial Garage, Tower Bridge Garage, Old Sacramento Garage, and the City Hall Garage). Additionally, it is important to note that there has been an increase in demand for the EV

parking program and all City garages currently have a waitlist for membership. This could be a sign of increased EV adoption and that other public or workplace EVSE programs are likely to experience an increase in demand as well; for example, ChargePoint's top 15 workplace charging customers saw a significant growth in EV drivers from the fall of 2017 through the fall of 2018 (an average of 60% growth).[6]

While the majority of EV drivers do most of their charging at home, public and workplace charging infrastructure is essential to spur increased EV adoption, particularly for drivers without access to reliable home charging, with low-range EVs, or for the many regional trips that will continue to originate or end in Sacramento. However, an over-emphasis on free charging can lead to excessive public charging use and congestion at chargers by incentivizing drivers to disregard viable home charging options, ultimately limiting access to EV drivers who need it. Charging fees for use of EVSE has been shown to increase availability of chargers at otherwise congested sites by decreasing unnecessary charging or idle time. For example, a 2013 study from UC Davis found that when workplace charging is free, people use the EVSE four times more than they need to.

Task 4.2: Conduct Stakeholder Interviews for Public and Workplace EVSE Needs and Opportunities

The project team convened nine stakeholder interviews to gather opinions and insights into public and workplace EVSE opportunities and constraints. The types of stakeholders interviewed represented:

- Workplaces in other regions advancing EV technology
- Community-based organizations
- Dense multifamily housing and no public charging or light rail service
- Low-income and disadvantage communities
- Geography-based stakeholders
- Need-based/workplace needs
- Fleet agencies
- Clean mobility providers
- Affordable housing providers

Specifically, the participants were from the following organizations:

- Breathe California
- California Department of Food and Agriculture, Division of Measurement Standards
- City of Citrus Heights
- EVgo
- Mutual Housing California
- North Natomas Transportation Management Association (JIBE)
- Sacramento House Redevelopment Agency
- Sacramento Metropolitan Air Quality Management District (SMAQMD)
- Sacramento Employment and Training Agency (SETA) Head Start

6 January 2019 ChargePoint Webinar: Should You Charge for EV Charging?

The purpose of the interviews was to obtain stakeholder feedback about current issues and opportunities for expanded access to public and workplace EVSE. The interviewees were also prompted to obtain recommendations for leveraging current government incentive programs to accelerate EV adoption and infrastructure development. The interviewees were contacted by email and phone to participate. Then phone interviews were scheduled in advance and lasted between 30 and 60 minutes. All participants were asked the same questions with specific prompts according to their representation, with customized questions depending on their expertise or experience. Some participants were also asked specific questions as part of their focus group participation.

Responses regarding challenges and opportunities for public and/or workplace charging varied, but a few general observations emerged:

- All interviewees were aware and working on advancing EVSE in the public and in workplaces through diverse means, whether through grant-funded programming or a fleet agency actively working to upgrade their vehicles. Efforts were being made and the awareness levels were high amongst all interviewees, including awareness of the City's EV efforts.
- Cost and affordability continue to be a challenge amongst the people whom interviewees serve and within their organizations' management, although in contradiction interviewees who help conduct outreach about incentive programs feel that people and organizations are not taking advantage of those programs.
- Participants identified locations like park-and-ride lots and large employers as opportunities, yet also expressed concerns about safety, cost and risk, and liability.
- Some interviewees offer free charging and have seen the benefits with increased use by offering this model. With new legislation coming in 2021, charging models will change and ideas for incentivizing charging hosts will become more difficult with more regulations determining what can and cannot be charged. Income-generated models for public charging were mentioned as an incentive, although some people disagreed that the potential to generate income would outweigh barriers such as startup costs for installing EVSE.

Task 4.3: Evaluate and Recommend EVSE Upgrades and Strategies to Optimize Public Charging Access

The goal of this report was to provide near-term guidance to optimize existing public and workplace EV charging infrastructure and establish a pipeline of EV infrastructure projects that will expand public charging access and increase service in disadvantaged communities. Opportunities for City-owned public charging locations were prioritized and evaluated as prototypes for future public and workplace charging. This report also included conceptual design prototypes for City-owned public charging facilities that are intended for fundable near-term projects, along with associated cost estimates for installing charging infrastructure.

The report considered multiple factors to prioritize recommendations for City-owned facilities, such as future growth capacity, location near disadvantaged communities, and EVSE rankings from the prioritization tool. Most EVSE in City-owned garages will be upgraded in 2019 and 2020 using CALeVIP funds, so the recommendations focused on other public City-owned locations such as libraries and community centers.

Table 5: Recommended Locations for Public Chargers

Community Centers, Libraries and Parks	Address	Potential EVSE
Del Paso Library	920 Grand Ave.	One Level 2 EVSE with two connectors
Hagginwood Community Center	3271 Marysville Blvd.	Two Level 2 EVSEs with two connectors
Oak Park Community Center	3425 Martin Luther King Jr. Blvd.	Two Level 2 EVSEs with two connectors
Valley Hi North Laguna Library	7400 Imagination Parkway	Two Level 2 EVSEs with two connectors
Samuel C. Pannell Community Center	2450 Meadowview Rd.	Up to three Level 2 EVSEs with two connectors; possible dual-use at City Solid Waste Division
Martin Luther King Jr. Library	7340 24th St. Bypass	Two Level 2 EVSEs with two connectors; possible mobility hub with solar & storage at vacant lot
South Natomas Community Center	2921 Truxel Rd.	Two Level 2 EVSEs with two connectors; possible alternate location at park under construction

Source: City of Sacramento

The team drafted conceptual site designs for five of the seven sites recommended above, which were included in **Task 3.6** as well.

The City of Sacramento intends to implement a fee for use of EVSE, which has been shown to encourage more efficient use and turnover and increase EVSE availability for people who really need it, including those without access to home charging. The fees would also cover program costs including electricity, operation, and maintenance. Interviews with ChargePoint, EVgo, and cities and counties in the Bay Area revealed a variety of pricing models used at workplaces and municipal garages. However, it should be noted that the Electric Fueling Systems regulation (National Institute of Standards and Technology Handbook 44) will preclude some of the various pricing structures that currently exist, such as flat monthly fees, hourly fees, energy-based fees, graduated pricing based on duration of charge, time of use pricing, initial connection fee, and overstay fees.

CHAPTER 5:
EV Toolkits

Summary

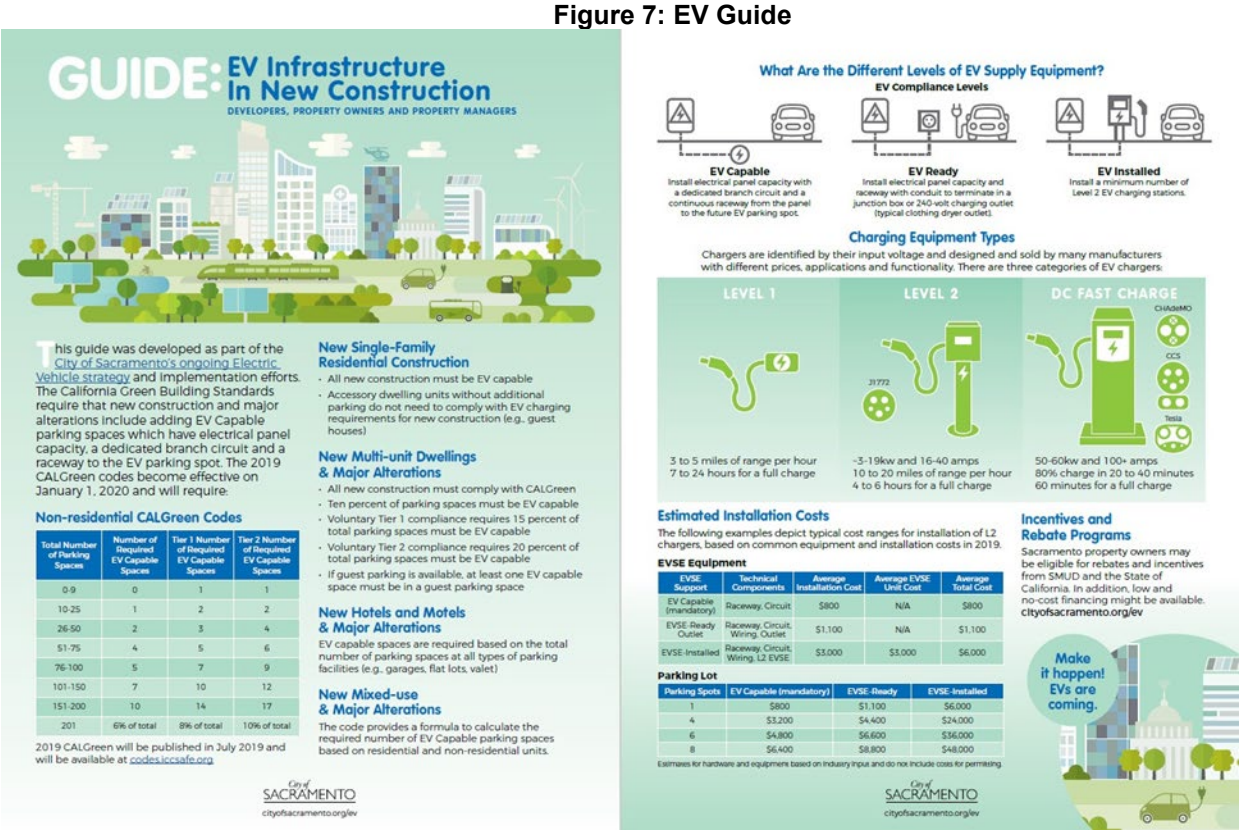
In this task, the team developed toolkits to foster both community and agency EV awareness. Priorities for this task were to lessen consumer barriers to EV adoption and identify a path for creating an economic EV ecosystem. The team prepared a package of EV informational resources designed to inform property owners and the general public on EVSE and EV options. The toolkit consists of graphic, user-friendly materials that summarize key resources and frequently asked questions from previous tasks and conversations. The materials included in the toolkit serve as a starting point for accessing more information for diverse EV audiences, with the primary intent of education and promotion. These resources also highlight partner efforts, summarizing regional programs and work to date. The final deliverables were adjusted based on stakeholder feedback and research. A revised approach was developed to increase the usefulness of the tools and be responsive to stakeholder engagement. The final deliverables included: (1) a poster for events; (2) a guide on EV infrastructure aimed at developers, property owners and property managers; (3) a FAQ for EVSE installation aimed at businesses, workplaces, shopping centers and apartments; (4) updated website content; and (5) other outreach materials that was developed as needed for events.

The second toolkit, EV Economic Pathways, outlined various strategies for the City to catalyze a ZEV workforce for advanced transportation employment opportunities, identify an operational structure for a potential ZEV service center, and develop a guide for agency efforts to strengthen the local ZEV workforce. Key issues included barriers entry for low-income and disadvantaged communities into the advanced transportation technology space.

Task 5.1 Prepare EV Toolkits

Example images of the EV Guide and EV FAQ sheet are on the following page in Figures 7 and 8. These tools will support the City in ongoing outreach. In addition, these documents will serve as educational resources the Community Development Department can use during engagement with developers and property owners.

Figure 7: EV Guide



GUIDE: EV Infrastructure In New Construction

DEVELOPERS, PROPERTY OWNERS AND PROPERTY MANAGERS

This guide was developed as part of the City of Sacramento's ongoing Electric Vehicle strategy and implementation efforts. The California Green Building Standards require that new construction and major alterations include adding EV Capable parking spaces which have electrical panel capacity, a dedicated branch circuit and a raceway to the EV parking spot. The 2019 CALGreen codes become effective on January 1, 2020 and will require:

Non-residential CALGreen Codes

Total Number of Parking Spaces	Number of Required EV Capable Spaces	Tier 1 Number of Required EV Capable Spaces	Tier 2 Number of Required EV Capable Spaces
0-9	0	1	1
10-25	1	2	2
26-50	2	3	4
51-75	4	5	6
76-100	5	7	9
101-150	7	10	12
151-200	10	14	17
201	6% of total	8% of total	10% of total

2019 CALGreen will be published in July 2019 and will be available at codes.iccsafe.org

New Single-Family Residential Construction

- All new construction must be EV capable
- Accessory dwelling units without additional parking do not need to comply with EV charging requirements for new construction (e.g., guest houses)

New Multi-unit Dwellings & Major Alterations

- All new construction must comply with CALGreen
- Ten percent of parking spaces must be EV capable
- Voluntary Tier 1 compliance requires 15 percent of total parking spaces must be EV capable
- Voluntary Tier 2 compliance requires 20 percent of total parking spaces must be EV capable
- If guest parking is available, at least one EV capable space must be in a guest parking space

New Hotels and Motels & Major Alterations

EV capable spaces are required based on the total number of parking spaces at all types of parking facilities (e.g., garages, flat lots, valet)

New Mixed-use & Major Alterations

The code provides a formula to calculate the required number of EV Capable parking spaces based on residential and non-residential units.

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What Are the Different Levels of EV Supply Equipment?

EV Compliance Levels

EV Capable
Install electrical panel capacity with a dedicated branch circuit and a continuous raceway from the panel to the future EV parking spot.

EV Ready
Install electrical panel capacity and raceway with conduit to terminate in a junction box or 240-volt charging outlet (typical clothing dryer outlet).

EV Installed
Install a minimum number of Level 2 EV charging stations.

Charging Equipment Types

Chargers are identified by their input voltage and designed and sold by many manufacturers with different prices, applications and functionality. There are three categories of EV chargers:

LEVEL 1	LEVEL 2	DC FAST CHARGE
3 to 5 miles of range per hour 7 to 24 hours for a full charge	~3-19kw and 16-40 amps 10 to 20 miles of range per hour 4 to 6 hours for a full charge	50-60kw and 100+ amps 80% charge in 20 to 40 minutes 60 minutes for a full charge

Estimated Installation Costs

The following examples depict typical cost ranges for installation of L2 chargers, based on common equipment and installation costs in 2019.

EVSE Equipment

EVSE Support	Technical Components	Average Installation Cost	Average EVSE Unit Cost	Average Total Cost
EV Capable (mandatory)	Raceway, Circuit	$800	N/A	$800
EVSE-Ready Outlet	Raceway, Circuit, Wiring, Outlet	$1,100	N/A	$1,100
EVSE-Installed	Raceway, Circuit, Wiring, L2 EVSE	$3,000	$3,000	$6,000

Parking Lot

Parking Spots	EV Capable (mandatory)	EVSE-Ready	EVSE-Installed
1	$800	$1,100	$6,000
4	$3,200	$4,400	$24,000
6	$4,800	$6,600	$36,000
8	$6,400	$8,800	$48,000

Estimates for hardware and equipment based on industry input and do not include costs for permitting.

Incentives and Rebate Programs

Sacramento property owners may be eligible for rebates and incentives from SMUD and the State of California. In addition, low and no-cost financing might be available.
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Make it happen! EVs are coming.

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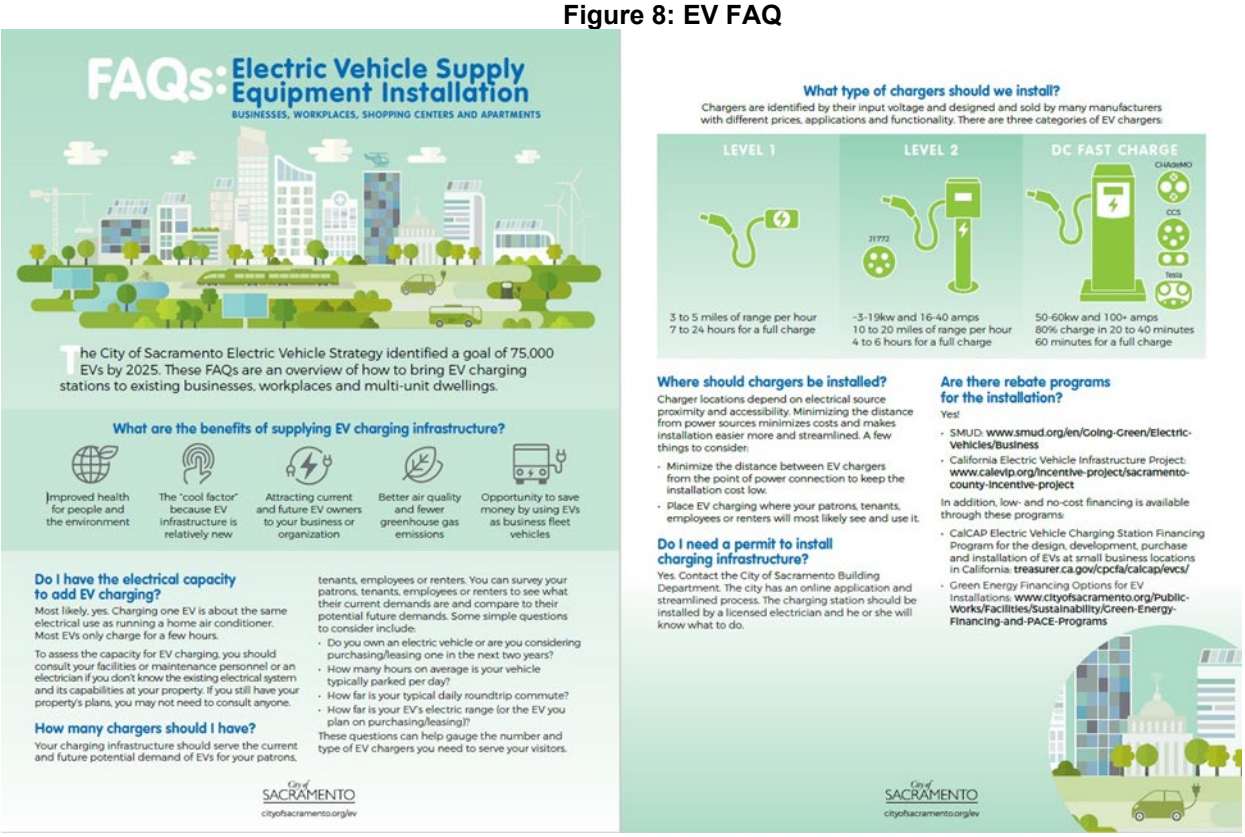
Source: City of Sacramento

Figure 8: EV FAQ



FAQs: Electric Vehicle Supply Equipment Installation

BUSINESSES, WORKPLACES, SHOPPING CENTERS AND APARTMENTS

The City of Sacramento Electric Vehicle Strategy identified a goal of 75,000 EVs by 2025. These FAQs are an overview of how to bring EV charging stations to existing businesses, workplaces and multi-unit dwellings.

What are the benefits of supplying EV charging infrastructure?

- Improved health for people and the environment
- The "cool factor" because EV infrastructure is relatively new
- Attracting current and future EV owners to your business or organization
- Better air quality and fewer greenhouse gas emissions
- Opportunity to save money by using EVs as business fleet vehicles

Do I have the electrical capacity to add EV charging?

Most likely, yes. Charging one EV is about the same electrical use as running a home air conditioner. Most EVs only charge for a few hours.

To assess the capacity for EV charging, you should consult your facilities or maintenance personnel or an electrician if you don't know the existing electrical system and its capabilities at your property. If you still have your property's plans, you may not need to consult anyone.

How many chargers should I have?

Your charging infrastructure should serve the current and future potential demand of EVs for your patrons, tenants, employees or renters. You can survey your patrons, tenants, employees or renters to see what their current demands are and compare to their potential future demands. Some simple questions to consider include:

- Do you own an electric vehicle or are you considering purchasing/leasing one in the next two years?
- How many hours on average is your vehicle typically parked per day?
- How far is your typical daily roundtrip commute?
- How far is your EV's electric range (or the EV you plan on purchasing/leasing)?

These questions can help gauge the number and type of EV chargers you need to serve your visitors.

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What type of chargers should we install?

Chargers are identified by their input voltage and designed and sold by many manufacturers with different prices, applications and functionality. There are three categories of EV chargers:

LEVEL 1	LEVEL 2	DC FAST CHARGE
3 to 5 miles of range per hour 7 to 24 hours for a full charge	~3-19kw and 16-40 amps 10 to 20 miles of range per hour 4 to 6 hours for a full charge	50-60kw and 100+ amps 80% charge in 20 to 40 minutes 60 minutes for a full charge

Where should chargers be installed?

Charger locations depend on electrical source proximity and accessibility. Minimizing the distance from power sources minimizes costs and makes installation easier more and streamlined. A few things to consider:

- Minimize the distance between EV chargers from the point of power connection to keep the installation cost low.
- Place EV charging where your patrons, tenants, employees or renters will most likely see and use it.

Do I need a permit to install charging infrastructure?

Yes. Contact the City of Sacramento Building Department. The city has an online application and streamlined process. The charging station should be installed by a licensed electrician and he or she will know what to do.

Are there rebate programs for the installation?

Yes!

- SMUD: www.smud.org/en/Going-Green/Electric-Vehicles/Business
- California Electric Vehicle Infrastructure Project: www.calevip.org/incentive-project/sacramento-county-incentive-project

In addition, low- and no-cost financing is available through these programs:

- CalCAP Electric Vehicle Charging Station Financing Program for the design, development, purchase and installation of EVs at small business locations in California: treasurer.ca.gov/cpcfa/calcap/evcs/
- Green Energy Financing Options for EV Installations: www.cityofsacramento.org/Public-Works/Facilities/Sustainability/Green-Energy-Financing-and-PACE-Programs

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cityofsacramento.org/ev

Source: City of Sacramento

Task 5.2: Develop EV Economic Pathways

The goal of this task was to develop a guide for agency efforts to strengthen the local ZEV workforce. The team evaluated the local economic context and opportunities for advanced transportation employment opportunities and developed recommended strategies.

Most ZEVs are leased from major automakers. Under the typical model, dealerships perform all maintenance, leased cars are typically returned before they need major servicing, and dealerships hire technicians that have completed automaker-specific training. Dealerships stated that ZEV servicing is different than traditional servicing for internal combustion engine vehicles – ZEV servicing is more like data analysis than automotive repair, and that auto mechanic classes offered at community colleges and trade schools neither equip students to work on ZEVs nor attract people who have an aptitude for data.

Fleet managers expect that their staff will eventually take on maintenance tasks related to electric vehicles (EVs), but do not anticipate offering training. Instead, they expect to hire people who have necessary certifications. At least one individual instructor teaches an EV certification course for experienced mechanics.

Journeyman electricians were identified as the largest employment gap in the next five years related to EV workforce needs. The International Brotherhood of Electrical Workers Local 340 estimates a current shortage of 1,500 people in the apprentice program. Apprenticeship, however, has significant barriers to entry.

All industries identified a need for people with customer service soft skills: from service writers at automotive repair to insurance estimators to agents answering phone calls about EV chargers or car-sharing, companies reported difficultly hiring qualified employees.

Specific steps that could help develop a ZEV-ready workforce include:

- Integrating ZEV servicing into computer classes at high school, community college, and adult education. Computer and technology classes are often presented as a pathway to a four-year degree and a desk job. Demonstrating the link between data analysis and cars could entice a new segment of people into EV service classes.
- Extending the City of Sacramento's Community Workforce Training Agreement (CWTA) to include apprentices for mobility-related projects to provide a pathway for residents of low-income and disadvantaged communities. CALeVIP recipients will be required to pay installers a prevailing wage and could create a pathway to using electrical contractors that participate in CWTA.
- Offering targeted tutoring, potentially through "bridging" classes or pre-apprenticeship programs—to help people pass reading comprehension and math tests required for apprenticeship programs
- Partnering with each council member to stage a customer service bootcamp followed by career fair with local business and e-mobility providers.
- Arranging for one or more train-the-trainer sessions to certify local instructors to teach the Automotive Career Development Center's (ACDC) EV certification course to experienced mechanics. Grow Sacramento Funds or Rapid Acceleration, Innovation, and Leadership (RAILS) grants could provide funding for a private company to lead this effort and purchase equipment for training.

Other opportunities include creation of service hubs, such as a ZEV service center. A ZEV service center could provide the equipment, training, and support needed for ZEV fleet expansion, workforce training, and ongoing ZEV fleet service and maintenance needs. Costs for establishing such a center could be high. Acquisition costs for property with appropriate zoning and square footage can range – examples surveyed for the report including a leasing option from $6,000 per month, or a property for sale at $675,000. Obtaining equipment, tools, a lift, business license, EVSE, and insurance is between

$50,000 and $60,000. Overhead (excluding lease) and supplies average $10,000 a month, plus salaries, employment taxes, and worker's compensation. Interviews completed for this task indicate that even a one-person shop needs to gross about $200,000 a year to break even.

The service center operators interviewed for this report stated that a ZEV-only service center (or a center that services both hybrids and ZEVs) is not financially viable at this time. Many interviewees stated that most people lease ZEVs and the dealerships service the cars, but they also pointed out that ZEVs don't need oil changes, tune-ups, and smog checks that are the financial backbone for most service centers.

CHAPTER 6:
Advanced EV Mobility Opportunities

Summary

This task allowed for a comprehensive review of EV mobility findings and development of recommendations based on Sacramento's early electrification initiatives. Findings will help the City and partners to identify sustainable business models and partnership approaches to increase service and access, learning from pilots to date in Sacramento and other regions. Additionally, this task examined various models for a holistic e-mobility demonstration hub, with recommendations that the City can use to develop a proposal for future funding requests in collaboration with partners such as the County of Sacramento, SMUD, SACOG, and the Sacramento Metropolitan SMAQMD.

Task 6.1: Evaluate EV Mobility Pilots

The goal of this task was to facilitate a critical evaluation of early EV pilots in Sacramento and new initiatives currently under development, with input from key stakeholders. The team conducted an inventory of EV mobility projects and prepared an interview framework that identified the list of pilots to evaluate, interviewees, and interview questions. The task helped identify opportunities to increase the scale and success of work to date, with a focus on increasing service to disadvantaged communities. The EV mobility pilots evaluated and/or partners engaged included:

- Our Community CarShare
- Zipcar
- Gig Car Share
- Envoy
- EVgo – Southside Park curbside high-power charger
- On-Demand/micro-transit, including the South Sacramento SmaRT Ride: SacRT
- JUMP Bike Share

Task 6.2: Create E-Mobility Hub Recommendations

The purpose of this task was to support development of the Sacramento Plug-In Electric Vehicle Collaborative's "e-mobility hub" concept and provide background information and assumptions to develop a concept for an e-mobility hub pilot for **Task 6.3**.

Mobility hubs are centers of connectivity at which multiple modes of travel converge. The concept is to provide an integrated suite of mobility services, with options such as transit, car share, bike share, wayfinding and urban design enhancements and technologies that include dynamic parking management strategies, real-time traveler information, and real-time ridesharing. Mobility hubs may include pick-up/drop-off zones for ride-hailing and "kiss-and-ride," freight delivery hubs and connections to bike and pedestrian routes.

An e-mobility hub is the concept of advancing the mobility hub one step further by adding the infrastructure and support services to enable every vehicle to be electric instead of running on petroleum. This concept includes provision of charging stations for a variety of vehicles, potentially

energy storage, and amenities that can serve all populations. Many agencies and organizations in the Sacramento region continue to explore options for e-mobility hubs.

The team evaluated relevant examples of mobility hubs and concepts from Seattle, Los Angeles, San Diego, and Minneapolis/St. Paul that combined multiple services, with attention to issues such as: upfront capital investments, operational structure and costs, site design, business model and/or level of public agency involvement, types of awareness and education activities provided on site, and integration of on-site solar photovoltaics or energy storage technologies. Options for e-mobility hub program structure were outlined, with an emphasis on close coordination with regional partners and Sacramento as a lead.

Deployment of e-mobility hubs should seek to optimize public benefit, and site projects along important transportation corridors that serve a variety of travel modes, preferably improving access to a concentration of services such as employment, housing, shopping, education and/or recreation. The team used the information in this task to create siting criteria for an e-mobility hub in Sacramento and evaluated potential locations against the criteria to develop a more comprehensive view of options that various sites could offer. Locations considered in the process were identified based on the outcomes from this project, including using the EVSE Priority Siting Tool; the model for sustainable car-share communities; interviews with stakeholders, developers, and community-based organizations; and public input from mapping exercises at the Sacramento PEV Collaborative and community events and workshops. It's likely that other candidate sites exist and will be identified as this concept progresses. **Table 6** summarizes the sites against the criteria (further detail can be found in the report). It is important to note that sites included in this assessment do not account for ownership or operational control; these properties are generally owned by other agencies or owners. The list is provided for discussion and brainstorming purposes, and does not indicate a project commitment. The City will continue to evaluate sites and identify priorities based on ongoing stakeholder engagement, partnerships, and funding.

Table 6: Examples of Potential Locations for E-Mobility Hubs and Evaluation Criteria*

		Criteria							
		Mode Transfer	Transit Service	Active Transportation Infrastructure	Proximity to Public Services	Socioeconomic Diversity	Adequate land	Electrical Infrastructure	Redevelopment
Potential sites	Franklin Blvd. Business District		X	X	X	X		?	X
	Township 9 LRT Station	X	X				X	?	X
	1349 Florin Road	X			X	X		?	
	University Transit Village	X	X	X	X	X		?	X
	Arena Reuse	X			X	X	X	?	X
	Northgate Blvd.	X		X	X	X		?	X
	Delta Shores	X			X		X	?	
	May and Grand Avenues	X	X	X	X	X		?	
	Cal Expo	X			X		X	?	X

Source: City of Sacramento. *Note: sites are identified for illustrative and discussion purposes only. Table includes sites not operated or controlled by the City.

Task 6.3: Identify Advanced EV Mobility Opportunities

Task 6.3 synthesized lessons from **Tasks 6.1** and **6.2**. This task provided summaries of interviews with e-mobility operators and research of successful e-mobility programs including carshare, EV charging, and on-demand transit. The evaluation included consideration of available program outcomes and key service indicators, along with analysis of business and service models.

While **Task 6.2** analyzed concepts and plans of other example mobility hub frameworks and expanded on those concepts to recommend an e-mobility hub prototype, this task included an additional focus on ensuring that all vehicle transportation be electric. However, the emphasis should remain on active transportation and shared rides, including transit. Four key principles to consider when designing and siting an e-mobility hub include:

1. **Active transportation first:** Enable people to walk or bike for five minutes on protected, well-lit lanes. People arriving at the hub by bike need secure storage. Include a charging dock for scooters and e-bikes so fully charged "micromobility" is ready to go when travelers arrive.
2. **Connect people to affordable and clean shared rides:** Prioritize transit connections in site design and layout with adequate loading spaces and quick connections to light rail and/or buses. Use distinctive, illuminated shelters with signage for pick-up and drop-off facilities for ODT and carpools. Include dedicated DC fast charging for drivers so that ride-hailing and on-demand transit vehicles can quickly charge on site or very close by between passengers or when waiting for transit to arrive.
3. **Electric cars where transit doesn't go:** Ensure adequate parking and use parking apps so that long-distance commuters can reserve spots in advance. Electric car-share vehicles are on site and fully charge. Equip parking lots with Level 2 charging—some dedicated to car-share vehicles and some for commuter cars—and Level 1 outlets so long-distance drivers can plug in continuing the commute on transit.
4. **Sustainable design:** Activate the hub with attractive design, art, and services that can encourage people to visit nearby business and community gathering spots. Provide free and fast Wi-Fi and plugs for charging cell phones. Enable travelers to order a shared ride or check out shared vehicles from a kiosk or from attendant or kiosk at the hub. Install electronic reader boards with real-time transit travel information that can be read from a distance. Incorporate solar energy and energy storage where appropriate to reduce grid demand. Add e-commerce lockers and a dedicated cargo delivery space so that people can pick up packages, groceries, or other items at the e-mobility hub.

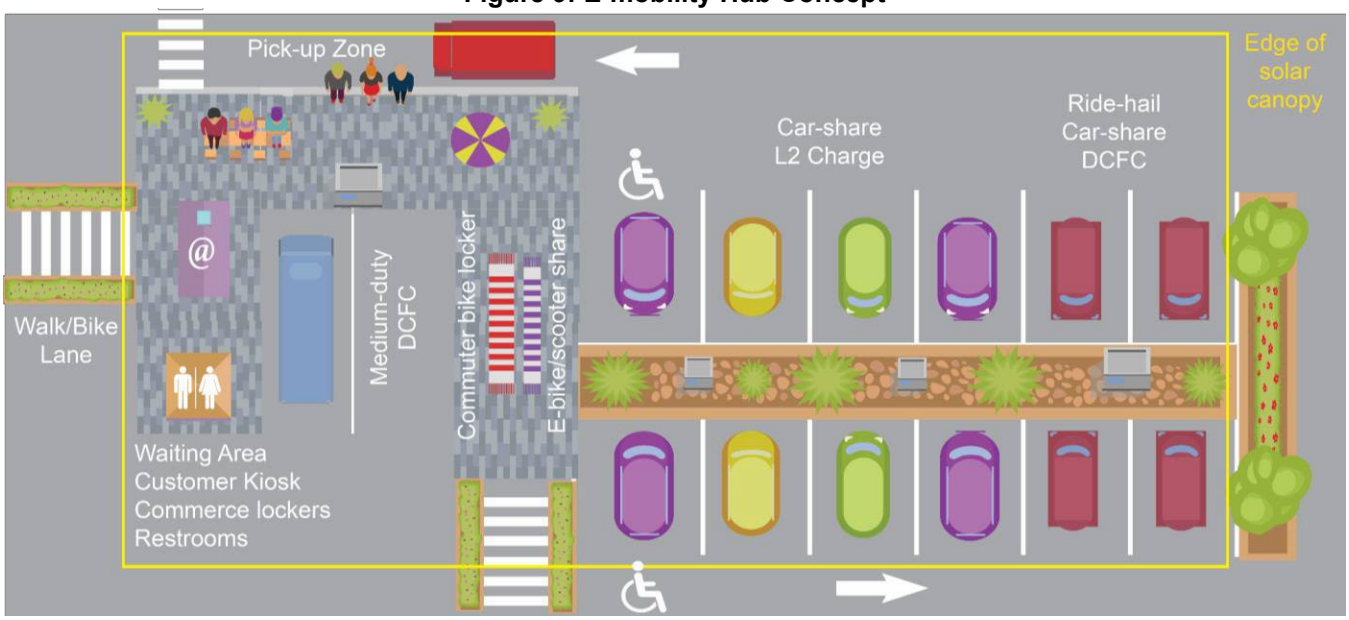
Ideally, e-mobility hubs will be located where multiple mobility modes already converge. Mobility hubs might also include charging stations for transit buses, but hubs could be sited at light rail stations and travelers will use other modes of transit to quickly reach their destinations. The team proposed a modular concept that can be at or near any high-capacity transit station and is intended to fit within a standard park-and-ride lot. **Figure 9** demonstrates the scalable e-mobility concept that can be deployed together or as individual elements.

The team's e-mobility concept envisions re-configuring surface parking into a flexible, modular design prototype that can be scaled up or down depending on available space, mobility demand, and electrical capacity. Optionally, some elements could be adjacent to the transit stop—across the street or at a nearby community center.

As the anticipated demand for shared e-mobility services continues to grow, facilities can be expanded and replicated at other transit locations to provide a regional multi-modal e-mobility network. The modular approach also future proofs the regional transit system as shared mobility becomes more convenient and economical than private vehicle ownership. For example, commuter parking spaces can gradually be replaced with docks for shared vehicles, a larger drop-off zone, or additional light rail tracks. The recommended Sacramento e-mobility hub concept includes features such as:

- Transit
- Microtransit (On-demand transit)
- Ride hailing and car sharing
- Micromobility
- Commerce
- Amenities
- E-features
- E-resources and information

Figure 9: E-mobility Hub Concept



Source: City of Sacramento

Because local government support is essential to ensure the hub serves social and environmental goals, the City could provide program management or management support for hub development, but not lead actual day-to-day operations. A third-party non-profit or community-based organization could manage daily operations. However, the right agency to operate the facility may depend on the funding sources, property ownership, or other nuances of any project. For example, the City could provide overall program oversight, including the following. These roles could also be filled by another agency, or implemented in partnership:

- Facilitate necessary conversations between project partners, stakeholders, and community stakeholders to guide project implementation.
- Work with the private industry partners to communicate and enforce City objectives, such as an emphasis on reducing vehicle likes traveled.

- Coordinate project partner meetings which to occur quarterly (at a minimum) and serve as the line of communication between the City and other regional partners.
- Hold the funding agreement with potential third-party funders and execute other contracting mechanisms with project partners and additional partners as appropriate but not own or have any legal interest in the equipment installed through this agreement.
- Coordinate with other departments that may contribute to the program like Transportation, Parking, Engineering and Facilities as well as the Department of Community Development including Planning and Building, and Information Technology Department.

Based on public records of similar projects' initial costs, the estimated startup costs for this concept range from $2.7MM - $3.5MM. These costs do not include operational costs for the first two years, due to the absence of available data.

CHAPTER 7:
Community Engagement

Summary

This task summarizes project tasks completed for the direct engagement of community leaders and residents on issues of EV awareness, adoption, workforce development and other topics related to the overall EV Blueprint project.

Task 7.1: Develop and Implement an EV Engagement Program

The goal of this task was to create and launch a community-wide EV engagement program to support implementation of Sacramento's EV Blueprint, relying on various approaches and types of events. The team developed an outreach strategy, outreach materials, and a summary of public outreach and community feedback to inform project recommendations.

The team participated in over 15 events from April to June 2019 in the City of Sacramento to increase EV engagement and identify barriers and opportunities to EV adoption. The events ranged from presentations to pop up booths or working sessions. To maximize participation, the project team attempted to show up at existing events, where community members were already present. Each event included complimentary materials such as posters, a survey in both online and a poster/dot voting format, curriculum, PowerPoints, interactive activities, and fact sheets. Events aimed to reach out to diverse community groups, residents, and neighborhoods. City staff sought to engage representatives and leaders of disadvantaged communities, such as key representatives from local community-based organizations serving those communities. While meetings were held in a variety of locations, the project team focused on attending existing events where communities were present , in order to remove barriers to listening and engagement. A key objective for these events was to identify perception, opportunities, and issues for EV adoption in low-income communities (LIC) and disadvantaged communities (DAC) in particular.

Table 7: List of Events

Date	Event/Group	District	Audience or Primary Target
4/4/2019	Sneak Preview: 2019 Title 24 Highlights	District 3, Citywide audience (event hosted at SMUD)	Building industry
4/17/2019	Clean Cities meeting, Lion Experience Center	City-wide	Fleet managers
4/19/2019	Drive Electric Earth Day at Kaiser South	District 8	Community, employees
4/22/2019	General Plan Workshop at Hagginwood Community Center	District 3	Community
4/25/2019	General Plan Workshop at Pannell Community Center	District 5	Community
4/28/2019	ECOS Earth Day at Southside Park	District 4 City-wide audience	Community, visitors
4/29/2019	General Plan Workshop at Oak Park Community Center	District 5	Community
4/30/2019	Joint Property Business Improvement District (PBID) meeting	City-wide	Businesses and property owners
5/7/2019	Pocket/Greenhaven Community Association Working Session	District 7	Community
5/8/2019	General Plan Update Special Visioning Workshop for Planning Academy Alumni	City-wide audience	Community
5/15/2019	Northern California Alt Car Expo	City-wide audience, many people who work downtown	All
5/30/2018	Let's Move! Community Event (Envision Broadway + Vision Zero Broadway/Stockton + EV Blueprint)	District 5	Community
6/8/2019	Sac to Zero Launch Event	District 4 City-wide audience	Community
6/20/2019	Sacramento Food Bank and Family Services Network Event	City-wide	Community and Service Providers

Source: City of Sacramento

Summaries of each event can be found in the Task 7.1 memo, but highlights of lessons learned are listed below:

- When speaking with industry and developers, most people thought the EV Ready option as a mandatory local code was reasonable.
- Most attendees at General Plan workshops were:
  - Aware of EVs, but do not own one
  - Unsure of whether an EV will save them money or if it's a safe transportation mode
    - Even EV advocates don't have a simple answer about how much is costs to charge an EV compared to filling a tank with gasoline.
  - Charging time was also an area of unknown for most of the attendees at this workshop
- Mapping activities were often limited because most attendees were not from the neighborhood and could not draw their routes on map.
- There is a need for community trainings on EV use and technology.
- Some of the biggest concerns for EV adoption were centered around price of initial purchase and investment, including buying an EV and installing a home charger.

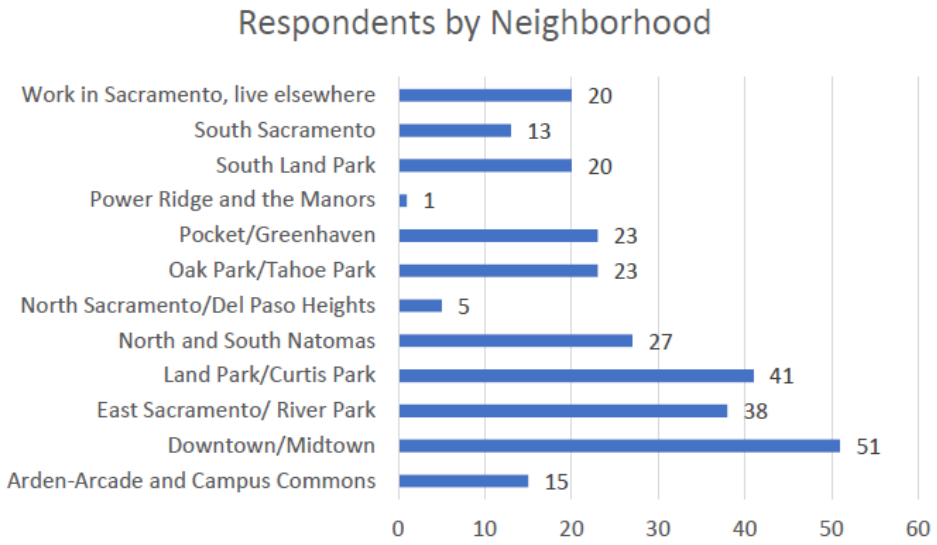
- For many, a personal car is the only option for getting to and from work in a timely fashion, and a lack of charging at the destination is a significant barrier to EV adoption.
- Messaging can be multifaceted, from many stakeholders and can be confusing: Property Business Improvement Districts (PBIDs) wanted a simple fact sheet to communicate more clearly with the businesses in their districts.
- Some communities expressed a lack of trust for car share or bike share apps since they have tracking capabilities; this was raised as a potential concern by communities of color in particular.
- There is a lack of awareness of the broad range of makes and models that offer EVs; almost all participants that played "Spot the EV" were surprised to learn that all 20 cars were EVs.
- Overall attendees seemed excited about the idea of a mobility hub and its potential long-term impacts on the community, both environmental and financial. Some expressed a need for an attendant or kiosk for customer support and education.

The team also developed an online survey to identify transportation patterns and barriers and opportunities for EVs throughout the City of Sacramento. The survey was posted on the www.CityofSacramento.org/EV website and was publicized through City outlets and EV Blueprint Strategy events throughout the duration of the project.

307 survey responses were returned, which is not statistically valid for the City's population size (a population of more than 500,000 people). Respondents that opted to participate in the survey may have a predisposition about the topic. Of the 307 responses, 277 are valid as people who live and/or work in Sacramento. Several responses were excluded from the analysis, including two responses because they were test answers, two responses because respondents took the survey to express an opinion about off-topic matters, and additional responses that were deleted because they were from people who live out of state.

Respondents were rather equally split between men and women and covered a wide geographic distribution throughout the City, as shown in **Figure 10** below.

Figure 10: Online Survey Respondents by Neighborhood



Source: City of Sacramento

Select findings are highlighted below:

- Consistent with input from outreach events, people drive more miles on a daily rate than statistics tell us. Data from the 2015 American Community Survey indicates that 8% of Sacramento residents drive 25 to 50 miles from work census block to home census block.
- When correlated with feedback from events and workshops, the lack of understanding about the cost to operate an EV is a barrier. The EV industry can't make an apples-to-apples comparison about the cost to charge a car and the cost-per-gallon of gasoline because electricity prices vary on the time of day, the place you plug in, the pay-per-charge scheme of the EVSE provider, and the level of charging.
- Another barrier is the price of the car, which is well-known and understood. For many people, cost is not specific to buying an electric car, but to buying a car at all (electric or gasoline-powered).
- Car-sharing is a relatively new concept so it's not surprising that respondents still need more information about how the EV car share programs work in general. Results of this part of the survey may have been influenced by the presence of GIG and Envoy at one outreach event. One consideration is that the people with access to bike sharing were more aware about car sharing, and a good first step may be to introduce electric bike sharing to areas such as the Pocket and South Land Park neighborhoods.

Task 7.2: EV Mobility and Opportunities Curriculum

The goal of this task was to create new educational materials on EVs and EV mobility programs targeted to the issues and needs of disadvantaged communities. The materials were used at various outreach events and will serve as a helpful communication tool for the City and its partners in the future. The curriculum compiled multiple existing resources into a comprehensive overview. These products include information on the benefits of EVs to combat pollution and climate change, provides information about EVs, incentives available, ZEV transit, charging infrastructure and options, and carsharing. It is all packaged as a four-page "Clean Air Gazette" booklet in a friendly, approachable format. The products even include a "test your knowledge" section at the end. Figure 11 shows the cover from a children's activity created for this task, the Clean Air Gazette.

Figure 11: Cover Page of the EV Curriculum

City of SACRAMENTO

Clean Air Gazette

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ELECTRIC VEHICLES COMBAT POLLUTION

AIR POLLUTION EFFECTS our economy and quality of life. Although Sacramento has significantly reduced air pollution levels, many residents breathe unhealthy levels of air pollutants—PM, NOx, and VOCs—during some part of the year. The Sacramento valley is like a bowl; during the summer, strong winds clamp a lid on the bowl trapping pollution and building ground-up ozone. In the winter, low pressure systems move in and create a similar effect.

"Ozone pollution is a corrosive gas," said Bonnie Holmes-Gen, director for air quality and climate change with the American Lung Association in California. "It actually causes burns on lung tissue, like a bad sunburn ... It can cause long-term health problems. It can worsen asthma symptoms and contributes to heart attacks and early death."

Greenhouse gases are also air pollutants. CO_2 released from transportation and energy production are causing global warming. Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather, which will impact Sacramento.

Although these air pollution villains come from many sources, transportation is a leading cause of pollution and greenhouse gas emissions.

Sac To Zero is one City of Sacramento combating the air pollution villains with electric cars.

Electric Cars 101

"EV" IS A GENERAL TERM for any car, truck or bus that runs on battery power and is recharged with electricity. EVs use electric energy to turn a motor that propels the car. EVs do not create pollution from the tailpipe and are called "zero emission vehicles."

Most EVs travel 100 miles or more on a full charge and have a smooth, silent operation. A variety of cars are already on the market and more are coming. SMUD makes it easy to shop for EVs at smud.zappyride.com.

Charging an EV is as simple as plugging in. Each car has its own cord and will slowly charge from a standard outlet-about three miles of range for every hour plugged in. Car charging equipment have cords that connect to the car and charge much faster; up to a full charge in an hour!

Sac To Zero has four initiatives to increase EVs in Sacramento: Own, Share, Ride and Charge.

Source: City of Sacramento

APPENDIX A:
List of Abbreviations

ACS	American Community Survey
CALeVIP	California Electric Vehicle Infrastructure Project
CALGreen	California Green Building Standards Code
CBSC	California Building Standards Commission
CEC	California Energy Commission
CVRP	Clean Vehicle Rebate Program
DAC	Disadvantaged community/communities
DCFC	Direct current fast charger
DMV	Department of Motor Vehicles
EV	Electric vehicle
EVSE	Electric vehicle supply equipment ("chargers")
FCEV	Fuel-cell electric vehicle
ICCT	International Council on Clean Transportation
L1	Level 1 EVSE: charger at 110-120 volts, 4-6 miles of range per hour of charge
L2	Level 2 EVSE: charger at 208-240 volts, 10-20 miles of range per hour of charge
PBID	Property Business Improvement District
PEV	Plug-in Electric Vehicle
PHEV	Plug-in hybrid electric vehicle
RFP	Request for proposals
SACOG	Sacramento Area Council of Governments
SacRT	Sacramento Regional Transit
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utility District
ZEV	Zero-emission vehicle